Handbook of Research on Modern Educational Technologies, Applications, and Management

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This book is dedicated to the memory of my late father for the love and care that he always displayed for his family, and for teaching me the importance of humanitarianism. Also, to my beautiful wife, Olga, and our handsome sons, Darius and Cyrus, for filling my life with so much love, joy, and happiness.

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Universities worldwide are starting to turn to cloud computing. The quality characteristics, which include access to a wider network of computing resources, pay-as-you-go services, self-services, agile services, and resource centralisation provide a convincing argument for HEIs to adopt cloud services. However, the risks leading to non-adoption range from security issues to a lack of cloud vendor support. The findings suggest that security, privacy, and trust are the key determinants to non-adoption as stakeholders felt that the cloud cannot fully guarantee the safeguarding of sensitive information. Key determinants to cloud adoption include improving relationships between students and teachers via collaborative tools and proposing cloud apps for mobile devices for accessing virtual learning materials and email securely off-campus. In conclusion, university stakeholders are still unconvinced about adopting cloud services, but future advances of the cloud may help to steer their decision to adopt this innovative technology given its overwhelming potential.

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Arunava Ghosh, Department of Information Systems, Indian Institute of Management, Indore, India
Tuhin Sengupta, Department of Information Technology and Operations Management, Goa Institute of Management, Goa, India
Amit K. Srivastava, Department of Information Systems, Indian Institute of Management, Indore, India

Extensive research has been conducted in identifying the critical issues and the implementation challenges involved in an ERP project in higher education. But limited studies investigated the implementation issues in the context of higher education institutions. The authors attempt to observe and compare two different

higher education institutions in South Africa and India with the objective of bringing out the practical determinants of roadblocks to a successful ERP project implementation and subsequently provide the readers with possible solutions. The findings suggest implementation issues broadly evolve from three major areas, namely, project management issues, which involve the technical as well as the functional aspects; issues concerning the improper application of software development life cycle phases; and human capital issues which involve beliefs and attitudes. The authors strongly believe that the learning received from the case studies significantly contribute to the organizational knowledge concerning technology and business process reengineering.

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Automated Essay Scoring Using Deep Learning Algorithms 37
Jinnie Shin, University of Alberta, Canada
Qi Guo, Medical Council of Canada, Canada
Mark J. Gierl, University of Alberta, Canada

The recent transition from paper to digitally based assessment has brought many positive changes in educational testing. For example, many high-stakes exams have started implementing essay-type questions because they allow students to creatively express their understanding with their own words. To reduce the burden of scoring these items, the implementation of automated essay scoring (AES) systems have gained more attention. However, despite some of the successful demonstrations, AES still encountered many criticisms from practitioners. Such concerns often include prediction accuracy and interpretability of the scoring algorithms. Hence, overcoming these challenges is critical for AES to be widely adopted in the field. The purpose of this chapter is to introduce deep learning AES models and to describe how certain aspects of the models can be used to overcome the challenges of prediction accuracy and interpretability of the scoring algorithms.

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Madhavi Arun Vaidya, Vivekanand Education Society's College of Arts, Science, and Commerce, India
Meghana Sanjeeva, Vivekanand Education Society's College of Arts, Science, and Commerce, India

Research, which is an integral part of higher education, is undergoing a metamorphosis. Researchers across disciplines are increasingly utilizing electronic tools to collect, analyze, and organize data. This "data deluge" creates a need to develop policies, infrastructures, and services in organisations, with the objective of assisting researchers in creating, collecting, manipulating, analysing, transporting, storing, and preserving datasets. Research is now conducted in the digital realm, with researchers generating and exchanging data among themselves. Research data management in context with library data could also be treated as big data without doubt due its properties of large volume, high velocity, and obvious variety. To sum up, it can be said that big datasets need to be more useful, visible, and accessible. With new and powerful analytics of big data, such as information visualization tools, researchers can look at data in new ways and mine it for information they intend to have.

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Qi Guo, Medical Council of Canada, Canada
Ying Cui, University of Alberta, Canada
Jacqueline P. Leighton, University of Alberta, Canada
Man-Wai Chu, University of Alberta, Canada

Digital technology has profound impacts on modern education. Digital technology not only greatly improves access to quality education, but it also can automatically save all the interactions between students and computers in log files. Clustering of log files can help researchers better understand students and improve the learning program. One challenge associated with log file clustering is that log files are sequential in nature, but traditional cluster analysis techniques are designed for cross-sectional data. To overcome this problem, several sequence clustering techniques are proposed recently. There are three major categories of sequence clustering techniques: Markov chain clustering, sequence distance clustering, and sequence feature clustering. The purpose of this chapter is to introduce these sequence clustering techniques and discuss their potential advantages and disadvantages.

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Aleksandra Mreła, Kazimierz Wielki University in Bydgoszcz, Poland
Oleksandr Sokolov, Nicolaus Copernicus University in Torun, Poland

New curriculum designers should prepare the set of learning outcomes that will be studied by students, and their acquirement will be verified by teachers. It is not easy to estimate whether students achieved the required learning outcomes even in the range of knowledge and skills, but when the competencies are considered, it becomes harder. Because of the convenience of using the linguistic terms (excellent, poor, good, and so on), it is better to apply fuzzy relations (type 1 if the numbers are chosen or type 2 if the sets are used), which can handle with the linguistic terms better than classical relations. The estimation of the learning outcome's acquirement can be conducted on the bases of a test or tests. For calculating the levels of learning outcome's acquirement, two fuzzy input relations are designed. Experts build one based on their knowledge, and the second one is based on the test results. The output relation, showing levels of learning outcome/outcomes' acquirement, is built with the application of the S-T composition of the first and second relations.

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Development of the Internet Literacy Indicator for Students (ILAS) and Longitudinal Analysis of Scores 109
Nagayuki Saito, International Professional University of Technology in Tokyo, Japan
Madoka Aragaki, Business Breakthrough University, Japan

Owing to the fact that ownership of telecommunication devices such as smartphones and tablets has spread among young people, the internet has become very familiar to them. On the other hand, they face the risks of encountering various internet problems. In this study, the authors analyzed and evaluated longitudinal survey data focusing on awareness education policies in order to periodically evaluate the internet environment for young people in line with the Youth Internet Environment Improvement Act Supplementary Provisions Article 3. From the results of the analysis and evaluation, the following were

found: 1) although awareness education has spread through school education and family education, its presence in family education is not sufficient and 2) to learn internet literacy, school education plays a major role.

Chapter 8
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Pete Swanson, United States Air Force Academy, USA
Jean W. LeLoup, United States Air Force Academy, USA

For more than 60 years, educational reform in the United States of America has been driven by four major questions revolving around teacher attributes, effectiveness, knowledge, and outcomes. Today, outcomes for not only students but also for those who teach them have become a focal point. The purpose of this chapter is to discuss the World Language edTPA—a performance-based, subject-specific assessment for pre-service teachers in 27 content areas that is now in place in 41 states and the District of Columbia. The authors begin by highlighting educational policy and best practices in teaching languages before providing research-based suggestions regarding the development of a high-quality portfolio by focusing on video recording considerations and the use of the integrated performance assessment.

Chapter 9
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Teay Shawyun, King Saud University, Saudi Arabia

Teay expounded the eIQA as key backbone infrastructure for the HEI's quality and accreditation management for stakeholders at all levels in the institution. The eIQA links the PMS-IMS-QMS trilogy as integrated units of the HEIs' performance management. The eIQA implementation illustrates the case study university's QA management from 2016-2019. The poor 2009-2019 national accreditation performance shows the resistance/rejections mindsets/attitudes of the "complicated, costly ever-changing accreditation business case requirements" and not the eIQA platform per say. It demonstrates mainstream literature on eIQA implementation challenges to include the stakeholders' negative "resistance/rejection" mindsets as key obstacles. Better understanding of the "human" psychological-behavioral-beliefs-attitudinal, personified of self-power clique actions, skills/capacities/capabilities, and structural/managerial elements as key deterrents to eIQA implementation as essential research agenda.

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Farideh Nekoobahr, The University of Houston, USA
Jacqueline Hawkins, The University of Houston, USA
Kristi L. Santi, The University of Houston, USA
Janeen R. S. Antonelli, The University of Houston, USA
Johanna Leigh Thorpe, The University of Houston, USA

Digitization and the globalization of English have made it possible to incorporate different forms of digital technology into the infrastructure of English language programs. However, there are no clear criteria in the existing literature to identify and evaluate appropriate language-learning technology tools. To fill the gap, this project proposed empirically supported guidelines in a rubric called the ULTIA Rubric to facilitate and accelerate the process of identifying and evaluating technology-supported language-learning

tools. The ULTIA Rubric has its basis in the major components of the five concepts of universal design for learning (UDL), learning science (LS), technology acceptance model (TAM), intelligent tutoring system (ITS), and automatic speech recognition (ASR). The rubric can function as a practical solution for program administrators, instructors, and English language learners (ELLs) who are seeking a reliable roadmap to evaluate language-learning software.

Section 2
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Educational Games as Software Through the Lens of Designing Process 179
Mifrah Ahmad, Deakin University, Australia

Educational games (EG) as learning software have become more dominant in the educational industry and have gained immense popularity. However, a constant battle between designing an EG that combines fun and educational content in delivering learning objective is a prominent challenge through the designing phase for various stakeholders involved, especially game designers. This chapter discusses three major contributions to game design fundamentals and principles and unpacks their concepts on designing EG. Moreover, an in-depth discussion of game design models/frameworks is understood. This analysis highlights issues and problems raised through the gaps existing between models/frameworks against them. This chapter proposes a combined prototyping process adopted from the discussion and emphasizes aspects required in documenting game design. With the process documented and aligned, game designers will be able to reflect a better understanding of a game design process in the industry.

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Yasin Cakan, Istanbul Technical University, Turkey
Aycan Kaya, Istanbul Technical University, Turkey
Cigdem Altin Gumussoy, Istanbul Technical University, Turkey

With the advances in mobile technology, mobile learning has gained importance and has spread widely especially among young people. In this study, a research model is developed to determine the factors affecting the usability of a mobile learning application belonging to one of the most popular MOOCs (massive open online courses) providers. The constructs—aesthetic graphics, color, control obviousness, entry point, fingertip-size controls, font, gestalt, hierarchy, subtle animation, and transition—adapted from the study of Hoehle et al. are included to reveal their effects on usability perception. Furthermore, the operating systems—iOS or Android—used in the mobile devices affect the usability of the mobile application is explored. A questionnaire is developed, and 223 surveys are collected from the users of the application. The results of the study show that gestalt, control obviousness, subtle animation, and aesthetic graphics are significant factors on the usability perception of the users.

Chapter 13
Main Features and Types of Educational Use of Wiki Technology 213
Nikolaos Karipidis, Democritus University of Thrace, Greece
Jim Prentzas, Democritus University of Thrace, Greece

Wiki technology has become very popular during the last years and is used in many fields. It enables the collaborative creation and management of content retaining the history of changes. There is abundant wiki-based content on the web covering a large number of subjects. A significant contribution of wikis involves education. Under certain conditions, technology may enhance the learning process due to the unique features it encompasses. In this context, wikis may prove very helpful as they provide the infrastructure for collaborative learning approaches and the development of online learning communities. This chapter discusses main features of wikis, wiki features specifically required in education, and typical uses of wikis in education. Representative examples of successful wikis are presented. Future research directions are also outlined.

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Stavros Tsetsos, Democritus University of Thrace, Greece
Jim Prentzas, Democritus University of Thrace, Greece

Web 2.0 tools are frequently integrated in education. The main goal of this integration is to provide enhanced learning experiences to students. Among other Web 2.0 tools, blogs are often used. Many approaches have been presented that successfully exploited blogs in all levels of education. An aspect of interest is to outline main directions of the corresponding research work that will provide insight to researchers, teachers, students, developers, and policymakers. This chapter provides a brief survey of approaches integrating blogs in primary and secondary education. Initially, main concepts regarding blogs as Web 2.0 tools and educational blogs are briefly discussed. Then, 16 approaches concerning the use of blogs in primary and secondary education are surveyed. The results derived from these approaches are analyzed. The analysis shows that the results are positive, and blogs turn out to be useful tools for school education. It is likely that more such approaches will be presented in the future. The chapter also outlines future research directions.

Chapter 15
Essential Features and Critical Issues With Educational Chatbots: Toward Personalized Learning via Digital Agents 246
Jeremy Riel, University of Illinois at Chicago, USA

Conversational agents, also known as chatbots, are automated systems for engaging in two-way dialogue with human users. These systems have existed in one form or another for at least 60 years but have recently demonstrated significant potential with advances in machine learning and artificial intelligence technologies. The use of conversational agents or chatbots for education can potentially reduce costs and supplement teacher instruction in transformative ways for formal learning. This chapter examines the design and status of chatbots and conversational agents for educational purposes. Common design functions and goals of educational chatbots are described, along with current practical applications of chatbots for educational purposes. Finally, this chapter considers issues about pedagogical commitments, ethics, and equity to suggest future work in the field.

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Reflecting on the Results of the Initiative ETiE for Using Tablets in Primary Schools 263
Emmanuel Fokides, University of the Aegean, Greece

Mobile devices, such as smartphones and tablets, have taken the world by storm. In education, they have exponentially increased the opportunities for mobile and ubiquitous learning, as their unique features give them a competitive edge over conventional teaching. In light of the above, the chapter summarizes and discusses the findings of a series of short research projects, conducted under the umbrella of the initiative Emerging Technologies in Education, involving the use of tablets for teaching science-related subjects, programming, and Greek mythology to kindergarten and primary school students. All in all, it was found that the learning outcomes, which can be considered as good compared to non-technologically enhanced teaching, are closely related to the teaching method, to certain tablets' features, and to the type of application being used. Then again, the impact on students' misconceptions was minimal. Finally, a number of suggestions to software developers as well as to education administrators and policymakers are being discussed.

Chapter 17
FeedForward With Screencasts 285
Rui Alberto Jesus, Cooperativa de Ensino Superior Politécnico e Universitário, Portugal

Feedforward is an educational strategy in which a professor gives orientations to students, prior to a certain task or assessment, in order to show them how to perform well in that upcoming task. This chapter explores the contribution of screencasts as one possible solution to providing feedforward. A screencast is a digital recording of computer screen output, including audio voiceover. If well planned and recorded, screencasts can expose students to the common errors in a certain field, as well as to the best practices that avoid or correct those mistakes. This chapter tests the following hypothesis: students who were exposed to feedforward with screencasts (experimental group) had better grades than those who did not see these common mistakes screencasts (control group). The students were Portuguese undergraduates of physiotherapy, taking a course of Inferential Statistics. The results show that the 48 students in the experimental group achieved an average of 11.64 (in a scale of 0 to 20), significantly higher than the average of 9.96 of the 41 students in the control group.

Chapter 18
Developing Computational Thinking Using Lego Education WeDo at 4th Grade of Primary Education: A Case Study 298
Ana María Pinto-Llorente, University of Salamanca, Spain

The research was carried out at the School Santísima Trinidad in the framework of robotics education and social science. The aims of the study were to determine participants' perceptions about the effectiveness of the experience to meet the learning objective, to construct and programme robotics models, and to help pupils to become familiar with computational concepts and practices. Based on these goals, it employed a case study method in which were involved a teacher and 52 students of the fourth grade of primary education. The instruments used to collect data were a questionnaire, a semantic differential, a semi-structured interview, and a monitoring guide. The findings suggested participants' positive perspective towards the project to achieve the objectives and contents of the unit; acquire the skills of critical thinking, creative thinking, problem solving; apply their knowledge to real-world problems; and become familiar with some mechanical movements and with a set of computational concepts.

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Assessment of the Use of Social Media by Students of the National Open University of Nigeria, Abeokuta Study Centre 317
Ganiu Oladega Okunnu, Crescent University, Abeokuta, Nigeria
Kola Ibrahim Adesina, Crescent University, Abeokuta, Nigeria
Mariam Oshuwa, Crescent University, Abeokuta, Nigeria

Social media sites have been recognised as important resources for education. They facilitate effective interaction between teachers and students and promote prompt and frequent interactions among students. Hence, this study was aimed at assessing the use of social media by students of National Open University of Nigeria (NOUN). To achieve this, the study attempted to determine the extent to which students of NOUN use social media, what the students use social media for, and the challenges and benefits of the use of social media by the students for academic purpose. Selected theories for this study are uses and gratification and diffusion of innovation theories. The study employed survey method of research. The study discovered that all the respondents had access to social media sites. The study also observed that majority of the respondents share academic materials through their social media sites. Some of the identified challenges in accessing social media include weak internet connection, inconsistent power supply, limited financial resources.

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Multimedia-Enabled Dot Codes as Communication Aids 331
Shigeru Ikuta, Otsuma Women's University, Japan
Masamichi Watanuki, Hattatsu Kyoiku Kenkyukai Co., Ltd., Japan
Shinya Abe, Gridmark Inc., Japan

Grid Onput is a set of novel two-dimensional codes comprising extremely small dots. The present authors recently developed software to overlap the dot codes on the user's designed sheet, to create a content to replay audios, to create a standalone application to replay multimedia, and to create an application to replay multimedia on iPad. Simply touching the dot codes with a speaking-pen and/or a dot-code reader enables users to directly access the corresponding digital information; a maximum of four mediums can be easily linked to each dot code icon. In collaboration with schoolteachers all over the world, one of the authors, Shigeru Ikuta, has been creating a variety of original self-made content and conducting various activities at both general and special needs schools. This chapter outlines the recent development of the state-of-the-art Grid Onput dot code technology and presents basic information regarding the creation of original teaching materials using newly developed software and the use at both general and special needs schools.

Chapter 21
An Overview of the Technological Options for Promoting Communication Skills of Children With Cerebral Palsy 346
Fabrizio Stasolla, University "Giustino Fortunato", Benevento, Italy
Alessandro O. Caffò, Department of Educational Sciences, Psychology, Communication, University of Bari, Italy
Viviana Perilli, Villa Apelusion Medical Care Center, Bari, Italy
Fiora D'Amico, Villa Argento Medical Care Center, Italy

This chapter provides the reader with a selective overview of the empirical contributions available in literature on the use of assistive technology-based interventions for promoting communication skills of children with cerebral palsy. Four categories were selected regarding (1) microswitches and computers, (2) aided-alternative and augmentative communication devices, (3) eye tracking, and (4) robots. Overall, 18 studies were retained, and 47 participants were included. Results were largely positive although a few failures occurred. Clinical, psychological, and rehabilitative implications for research and practice were critically discussed.

Section 3
Knowledge Sharing, Collaboration, and Professional Development

Chapter 22
Designing Schools as Learning Centers 359
Martha Ann Davis McGaw, Davis McGaw Family Foundation, USA

There are several variables that need to be considered when rethinking education delivery for the 21st century. Designing schools as learning centers is more than just about restructuring the physical space of schools. Effective education leadership and administration must successfully align several often-competing goals. These goals include guiding a human-centered organization, consisting primarily of young, evolving learners while continually managing knowledge and information delivery and balancing the needs of students and teachers with the education policy requirements set by federal and state legislation and subsequently interpreted by school districts. This chapter explores the 'rethinking education delivery' theme through several topics such as learner's comfort levels, teacher- training and professional development, and school district leadership. A case study looks at a six-year research project focused on the effect of district and school leadership styles on teaching and learning.

Chapter 23
Generalizable Models for Online Professional Learning Communities for America's K-12 Teachers 377
Jennie Larry Johnson, University of North Texas, USA
Adil Akhtar Khan, University of North Texas, USA

America's teachers are burning out. The emergence of teacher-centered online professional learning communities (PLCs) is a relatively new phenomenon with unestablished boundaries. The questions to be answered are: (1) What are the opportunities, issues, and challenges associated with online PLCs for K-12 teachers? (2) What are generalizable models for designing, implementing, and managing online PLCs for K-12 teachers? An exhaustive review gathered, organized, evaluated, coded, analyzed, and synthesized 45 relevant studies, dissertations, articles, and reports that examined online teacher PLCs. The goal was to identify and highlight conflicts, contradictory ideas among findings. The intent was to bridge gaps between theories and principles to create a common framework and generalizable models. This study was relevant because it sought to identify opportunities, issues, and challenges associated with online teacher PLCs and successful evidence-based micro-level, meso-level, and macro-level replicable practices for broader generalization.

Chapter 24
Professional Development and Training Needs for Administrators in an Islamic University Malaysia 396
Riyadotul Jannah Binti Mahyutan, International Islamic University Malaysia, Malaysia
Siti Syakirah Binte Muhammad Yusop, International Islamic University Malaysia, Malaysia
Saidah Na'ilah Binti Masrum, International Islamic University Malaysia, Malaysia
Ismail Hussein Amzat, International Islamic University Malaysia, Malaysia

There have been several studies that have been conducted on employee training and development, both in educational institutions and companies, such as the study conducted by Oktavianus, namely training and development of employees at schools in Indonesia. This study found that in order to help the process of education services, each existing unit must be equipped with competent administrative staff to help teachers and students, even parents for the purpose of the educational service process. Therefore, training and development must be given to these administrative staff so that they can do their jobs properly and correctly. Hence, the purpose of this chapter is to highlight the professional development needs for administrative staff at the Islamic University in Malaysia. Researchers explore the trainings that were provided by the university not only for self-development but also for the benefit of the university to reach its goals.

Chapter 25
Supporting Community Engagement Through Real-World Instructional Learning 415
Caroline M. Crawford, University of Houston-Clear Lake, USA
Janice Moore Newsum, University of Houston-Clear Lake, USA
Sharon Andrews White, University of Houston-Clear Lake, USA
Jennifer Young Wallace, Jackson State University, USA

The ability to attain knowledge for implementation within real-world environments is a shift in understanding within many instructional environments. Shifting from competency-based understandings wherein a knowledge base is attained as well as implemented towards a capability-based understanding that emphasizes the conceptual framework of information shift towards higher order knowledge creation within novel situations and environments is essential. Lifelong learning within nuanced understandings of new situations and new experiences is essential. Normally, these novel situations and experiences occur within a real-world community environment wherein the learner is critically analyzing new information and opinions from innumerable engaged people within the community. This style of learning is vital to understand within a competency-based learning environment, as well. Therefore, real-world instructional learning embeds the supporting community engagement at distinctly appropriate and impactful points throughout the instructional process, resulting in outstanding conceptual frameworks with the continuous understanding around cognitive engagement.

Chapter 26
Design, New Media, and Human-Computer Interactions 432
William J. Gibbs, Duquesne University, USA

In higher education design-oriented programs, collaborations with industry can be challenging to establish because of the time demands and work priories of professionals working in the field. Education should foster these relationships to enhance the overall educational experience for students. A common form of collaboration is projects in which students are given "real-world" design problems for which they

propose a solution. These types of endeavors are very much practice-based and can be especially valuable in digital media and interactive design academic programs. When education partners with industry on such practice-based projects, education can add value and potentially help sustain these collaborations by ensuring that student methods and solutions are rooted in theory and call upon the rich research and theoretical bases of these disciplines. This chapter reviews approaches that educators can use to enhance educational projects with industry partners and ultimately enrich student learning outcomes.

Chapter 27
The University Challenge in the Collaboration Relationship With the Industry 449
Marcello Chedid, University of Aveiro, Portugal
Leonor Teixeira, IEETA / DEGEIT, University of Aveiro, Portugal

Universities suffer from the impact of (1) life cycles associated with technological innovations, (2) the globalization of the economy and culture, (3) the educational needs of an increasingly knowledge-driven society, and (4) the training needs for high-performing professional activities. Solutions to these factors may be found in a positive attitude toward knowledge sharing and collaboration relationships. Collaboration has been considered a way to address the challenges of the 21st century, fostering the necessary innovation, growth, and productivity for all parties involved. Several studies reveal that collaboration can be strongly influenced by knowledge sharing. Collaboration relationships, besides the creation of new knowledge, may result in several outcomes and benefits for the university and society. This chapter aims to address and discuss the university challenges in the collaboration relationships with the industry based on the main results of some empirical studies developed during a research project.

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Knowledge Management in University-Software Industry Collaboration 466
Marcello Chedid, University of Aveiro, Portugal
Leonor Teixeira, IEETA / DEGEIT, University of Aveiro, Portugal

The university-software industry collaboration relationship has been represented a key resource, to the extent that together they can more easily promote technological development that underpins innovation solutions. Through a literature review, this chapter aims to explore the concepts and the facilitator or inhibitor factors associated with the collaboration relationships between university and software industry, taking knowledge management into account. This chapter is organized as follows. In the first section, the authors briefly introduce university, software industry, and knowledge management. The following section, based on the literature reviewed, provides a critical discussion of the university-software industry collaboration relationship, knowledge management in knowledge intensive organizations or community, and knowledge management in collaboration relationship between these two types of industries. Finally, in the rest of the sections, the authors point to future research directions and conclude.

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Knowledge Sharing Practices Among Non-Academic Staff in a Nigerian University 483
Funmilola Olubunmi Omotayo, University of Ibadan, Nigeria
Hafsat Titilade Abdul-Rahman, University of Ibadan, Nigeria

Knowledge sharing, an important part of knowledge management, has particularly been regarded as an important way of increasing competitiveness and performance of organisations. This study investigated knowledge sharing practices among non-academic staff at the University of Ibadan, Nigeria. Descriptive research designed was adopted. Findings reveal that the staff shared knowledge among themselves, and majority had understanding of, and good disposition to, knowledge sharing. The study found that the staff shared both tacit and explicit knowledge, but majorly tacit, and mainly through face-to-face interactions. The major knowledge sharing enabler is improved productivity, while lack of time is the major knowledge sharing barrier. The study concludes that there is a good knowledge sharing practices among the staff. However, there is need for the university to promote more collaboration and knowledge sharing practices among the staff by providing enabling environment for knowledge sharing, in addition to provision of adequate information and communication technologies.

Section 4
Leadership, Management, and Organizational Service

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Ushering Change in 21st Century Schools and Who Should Lead: What Are the Prerequisites and Processes? 499
Ismail Hussein Amzat, International Islamic University Malaysia, Malaysia

In the fast-paced field of education, change in school settings has reached its momentum and the debate on who is supposed to lead the change in school settings has been intensified. Leading change in a 21st century school engages the school principal, teachers, students, the community, and the government. In driving the change, a learner's achievement should be the ultimate goal for every school leader, since learning is the core business of every educational institution. Beyond the school community, parents and people in the community have a major role to play in their child's education, success of implementing change in school, as well as government providing sponsorship/strategic support to facilitate teaching and learning. In light of this collaboration in making schools better, this research has chosen qualitative methods to explore teacher's understanding in Northern State Malaysia of the role of school principals, teachers, students, the community, and the government in leading change in 21st century school settings.

Chapter 31
Transformational Teacher Leadership: A Global Perspective 521
David Richard Litz, Emirates College for Advanced Education, UAE

Transformational leadership along with change theory have become increasingly popular concepts within the field of educational leadership and administration during the last 20 years. This chapter examines the growth and popularity of transformational leadership, its relationship to organizational change, and the practical and theoretical justifications for its use as a relevant form of teacher leadership from a global and cross-cultural perspective. Emphasis is placed on discussing transformational teacher leadership practices as core strategies for modern educators in the process of overseeing teaching and learning objectives, contributing to school improvement and students' educational attainment, and managing essential change processes within globalized educational environments.

Chapter 32
Administration of Mega and Open Universities With Technological Singularity Beyond Master-Human 537
Serap Sisman-Ugur, Anadolu University, Turkey
Gulsun Kurubacak, Anadolu University, Turkey

The aim of this study is to foresee a futuristic view of how open universities can achieve their sustainability in the context of technological singularity. Technological singularity predicts that artificial intelligence will prevent human intelligence in the future. Not only can artificial intelligence radically change human habits, but it can also alter learning practices. The foundation of a revolutionary transformation on humanity learning will be established for both the open universities and for the technological singularity beyond master-human. Thus, open universities are not only sustainable, but, at the same time, they can be transformed into ecological learning environments. The framework of the internalizations and predictions of the study participants on open and distance learning environments will help us save open universities in the future.

Chapter 33
Making Sense of Data-Informed Decision Making in Educational Contexts 545
Venesser Fernandes, Monash University, Australia

Educational change is a constant reality that is faced by school leaders today. These leaders are held more accountable than ever before for decisions being made. This chapter discusses the strengths in the continuous school improvement approach that develops both leadership and organisational capabilities such as collaboration, communication, and organisational trust within schools and school systems as they continue to deal with the ongoing onslaught of change and complexity present today. In these complex, ever-changing school contexts, leaders have to make multiple decisions on a daily basis. This chapter focuses on making sense of 'how' and 'why' data-informed decision-making continues its rising ascent and significance in educational leadership contexts within schools today. Through the accurate use of educational data within schools, a number of these decisions, can through collaborative decision-making processes assist school leaders and teachers in delivering better educational opportunities and outcomes for students.

Chapter 34
Faculty Organizational Service: Problems and Solutions 564
William Bart, University of Minnesota, USA

The purpose of this chapter is to list and review some of the problems facing university faculty as they engage in their organizational service activities. University faculty members typically engage in three types of activities: (1) teaching and instruction, (2) research and scholarly compositions, and (3) service and organizational functioning. This chapter focuses on the third type of activities for university faculty members, namely, service and organizational functioning. For the purpose of simplicity, the expression "organizational service" will be used to replace the longer expression "service and organizational functioning." This chapter will provide a list and a review of problems in organizational service for university faculty members. In addition to a listing of problems, the chapter will present possible solutions for the problems.

Chapter 35
Increasing Education's Return Rate for Public Interest Professionals 573
Robert Leslie Fisher, Independent Researcher, USA

The author argues that the student loan debt crisis is, in fact, a shortage of public interest professionals. Solving this problem requires replacing the Becker Human Capital Model with a new post-secondary finance model, based on a suggestion of Carolyn Hoxby. The new model says that if the social benefits exceed the upfront costs, get the education. This is in contrast to the previous model that says if the lifetime income exceeds the upfront costs, get the education. The new model suggests counseling to help students be efficient in their college careers and back end debt forgiveness for people recruiting to public interest professions. Pell Grants tied to particular career paths would be used to attract non-traditional students to prepare for public interest careers.

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Comprehensive Marketing Intensity Indicator for Higher Educational Institutions 588
Badar Alam Iqbal, Faculty of Economics and Finance, Monarch University, Zug, Switzerland
Mohd Nayyer Rahman, Aligarh Muslim University, India

Higher educational institutions (HEI) have lately involved the marketing approach both locally and globally. While almost all HEI now involve marketing of education service, there is no comprehensive assessment indicator available for the marketing intensity. Marketing intensity as a new term is the holistic involvement of an organization into marketing not reflected solely by monetary variables. The chapter attempts to bring the term marketing intensity into the discussion of HEI and to build a comprehensive marketing intensity indicator, which may be easily used to compare HEI with respect to marketing intensity. The chapter presents the conceptual and theoretical model of the indicator.

Chapter 37
Accreditation of Medical Laboratories: Challenges and Opportunities 600
Donovan McGrowder, Department of Pathology, Faculty of Medical Sciences, The University of the West Indies, Kingston, Jamaica
Dwayne Tucker, Department of Pathology, Faculty of Medical Sciences, The University of the West Indies, Kingston, Jamaica
Fabian G. Miller, Faculty of Education, The Mico University College, Kingston, Jamaica
Melisa Anderson, College of Health Sciences, University of Technology, Jamaica
Kurt Antonio Vaz, Department of Pathology, Faculty of Medical Sciences, The University of the West Indies, Kingston, Jamaica
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Quality test results generated by medical laboratories across the globe are critical for patient diagnosis and treatment. In addition, this is an area of healthcare that requires standardization. Accreditation is the formal recognition by an authoritative body noting that the clinical laboratory has an established quality management system and is competent to carry out specific tasks related to testing. The Strengthening Laboratory Management Toward Accreditation (SLMTA) program was established to strengthen national laboratory systems and to drive improvements that are immediate and measurable in developing countries, particularly those in Sub-Saharan Africa. This review seeks to look at opportunities that can be garnered

by accredited medical laboratories and challenges in seeking accreditation during the implementation and operational states of the criteria of ISO 15189:2012. It also examines the progress toward clinical laboratories becoming accredited due to the enactment of the SLMTA in resource-limited settings.

Chapter 38
Education Leaders' Utilization of Information and Communication Technology for Development in Nigeria 617
AbdulGafar Olawale Fahm, University of Ilorin, Nigeria
Kazeem Kayode Bakare, Al-Madinah International University, Malaysia
Kamaldeen Korede Oladosu, University of Ilorin, Nigeria

The sample is comprised of principals, vice-principals, headmasters, and teachers as educational leaders in primary and secondary schools in Nigeria. The study adopted quantitative research design of the survey type to determine education leaders' perceptions on the adoption of information and communication technology. The quantitative approach in this study involves the use of research instruments consisting of closed-ended, on-line, and paper-based questionnaires (single version sent to multiple respondents). The study found out that education leaders have low perception on the adoption of information and communication technology for dissemination of information, utilization of virtual learning environments among teachers. The study also found out that lack of awareness on e-learning software and inadequate use of internet-enabled technologies or applications were highlighted as challenges in adoption of ICTs for development in Nigeria. The study recommended that educational leaders should make ICT adoption needs known to appropriate authorities.

Chapter 39
Redefining Chemical Engineering Education in Romania Between Massification, Atomization, and Performance 634
Eugenia Grecu, Politehnica University of Timisoara, Romania
Ionica Oncioiu, University of Bucharest, Romania
Getuța Camelia Stoica, Virgil Madgearu Economic College, Romania
Delia Mioara Popescu, Valahia University, Romania

Chemical engineering and higher education profile in Romania have a prestigious tradition. Declared a national priority, Romanian higher education has developed and has become a mass education. There was an extension and uncontrolled chemical engineering education, especially environmental engineering. In addition to traditional chemical engineering, education has appeared in places without a university tradition; new universities and faculties of study in this area and other universities and colleges have expanded the frontiers of research in education for green engineering. The study majorly focused to explore extent of chemical engineering career intention and to explore the relationship exist between engineering environment intentions with selected independent variables. The results show that demographic decline, decreased social inertia, and brain drain made the interest in chemical engineering and environmental study decline. In these circumstances, the present competition between providers of education in chemical engineering and environment is tough.

Section 5
Learning Theories

Chapter 40
Knowledge Sharing Mediating Information Technology Student Innovation 645
James Kiarie Ngugi, University of South Africa, South Africa
Leila Goosen, University of South Africa, South Africa

Research has identified factors promoting innovative behavior (IB) among employees in organizations. However, the effect of knowledge sharing behavior (KSB), self-regulated learning (SRL), and course design characteristics (CDCs) in developing IB among information technology (IT) students in universities is not well understood. The purpose of the study was developing a structural equation model (SEM) of the drivers of IB among IT students. As very little research simultaneously explores the determinants of undergraduate students' IB, one of the study objectives is to plug the literature gap by examining how SRL and CDCs act as antecedents of IB, via the mediating action of KSB. The findings are summated in a KSB-IB SEM. The results largely support all the hypotheses and suggest a significant indirect relationship between SRL and IB, fully mediated by KSB. The indirect relationship between CDCs and IB was significantly and fully mediated by KSB. The results of the study reveal that both CDCs and SRL act as drivers of KSB and IB among IT students.

Chapter 41
Effective Integration of Technology in Inquiry Learning: Themes and Examples..... 664
Lisa J. Lynn, University of Illinois at Chicago, USA

For education leaders (teachers, professors, curriculum designers, and administrators), there are well-documented benefits to using inquiry learning in a wide variety of grade levels, content levels, and contexts. Besides promoting deep learning and critical thinking, inquiry learning is readily adaptable to 21st century skills such as information and communication technologies literacy. However, the combination of sophisticated pedagogy and cutting-edge technologies can be overwhelming to education leaders when planning an inquiry learning curriculum. Faced with a wide variety of technology options, education leaders have little research-based guidance for choosing the ones that are best suited to an inquiry learning curriculum. This chapter reviews recent findings on the use of technology in inquiry learning and provides suggestions and guidelines for incorporating technology in inquiry learning in order to maximize the pedagogical affordances of technology.

Chapter 42
Disruption and Innovation in Global Higher Education as Viewed Through the Lens of Complexity Theory 677
Robert E. Waller, Columbus State University, USA
Pamela A. Lemoine, Troy Univerdsity, USA
Christopher J. Garretson, Collumbus State University, USA
Michael D. Richardson, Global Tertiary Institute, USA

The focus in 21st century society is knowledge-based: learning is critical, and information will continually become obsolete. The success of global higher education institutions will demonstrate their ability to manage networks of knowledge and to collect, document, and analyze data involving complex systems, thereby exhibiting adaptability and agility with complexity. In addition, technical innovations will alter

the skills and knowledge needed to succeed in the workplace and society. Yet disruption and innovation are often the menu of the day, creating chaos and disorder. Complexity theory impacts all the critical aspects of global higher education.

Chapter 43
Emotional Design in Multimedia and Measuring Learning Emotions 701
Ahmet Murat Uzun, Afyon Kocatepe University, Turkey
Zahide Yıldırım, Middle East Technical University, Turkey

Cognitive learning theories have extensively been used for designing effective and efficient multimedia materials. Yet, these theories have been limited to cognitive aspects of learning. With the introduction of the recent cognitive-affective theories, emotional and motivational factors are generating considerable interest. Recently, emotional design approach has been introduced by the researchers. Emotional design refers to manipulating visual appeal of a product or a learning material in an effort to induce positive emotions and thereby learning. Although emotional design approach is interesting, the research on the issue is at the beginning. What is more, studies mostly adopted paper-based measures that are based on self-report to detect learning emotions. Given this rationale, the aim of this chapter is to introduce emotional design approach used in multimedia, to mention different techniques for inducing positive emotions, and to address research on the topic. It also discusses objective tools identifying learning emotions with a focus on emWave emotion recognition technology.

Chapter 44
Education and Altruism and the Competence That Students Do Not Know They Possess..... 718
Rosa Iaquinta, Università della Basilicata, Italy
Francesco Milito, Università di Salerno, Italy

The term altruism in Italian contains semantic root "other" that means the one who is distinct from itself. Its meaning indicates love towards one's neighbor, more particularly, the attitude of one who directs his work towards the goal of achieving the good of others (or if you prefer, to find the own good in the good of others). Educating the students requires a particular educational-training plan. The school is responsible of this type of education, which is not only necessary within the class, but it is the necessary attitude to face the increasingly complex social problems of our time. The self-centered culture is infusing in everyone the convinction that people do not need a community anymore, promoting the abandonment of feelings, and of the sharing of relationships with the neighbor. The path to take is based on the education to the developmet of pro-socal competences, bringing into play the community as a relationship founded on the research of the common welfare.

Chapter 45
Constructivism in 21st Century Online Learning 730
Kathaleen Reid-Martinez, Oral Roberts University, USA
Linda D. Grooms, Regent University, USA

Augmenting communication in and among those in the academic, business, and military communities, the exponential advancement of science and technology has availed vast amounts of information to virtually millions of people around the globe. In conjunction with this knowledge explosion has been a growing concern for the democratization of the learning process, with constructivism driving much of the educational agenda, most particularly in areas such as online distance education. This chapter examines

the resurgence of the constructivist approach to teaching and learning, its convergence with rapidly changing technological advances, and its relationship to future trends in online pedagogy and andragogy.

Chapter 46
Creativity and Impactful Learning Through Implicit Cognitive Vulnerability 744
Caroline M. Crawford, University of Houston-Clear Lake, USA
Janice Newsum, University of Houston-Clear Lake, USA
Sharon Andrews White, University of Houston-Clear Lake, USA
Jennifer Young Wallace, Jackson State University, USA

Creating an instructional environment in which the learners can be cognitively vulnerable with the information learned, with learner colleagues, as well as with the instructional facilitator is vitally important towards information attainment and actively evaluating and revising one's own conceptual frameworking of information. The instructional engagement of the learner within the instructional environment is vitally important, towards knowledge acquisition as well as the learner's creativity towards understanding and working with the information, while emphasizing the strengths associated with impactful learning. Creativity is understood within implicit cognitive vulnerability, articulated as value, effectiveness. Further, impactful learning is understood as relationships and community, as well as respect and consciousness.

Chapter 47
Concept Maps as a Technique for Organizing, Analyzing, and Transforming Knowledge..... 762
Michael Tang, Virtual Education Research Institute, University of Colorado, Denver, USA
Janelle M. Johnson, Metropolitan State University of Denver, USA

The chapter begins with the origins of concept maps as a tool to promote constructivist learning, an educational philosophy and practice, and is followed by a concept map taxonomy. A definition of concept maps is provided and the main differences between Mind Maps©, Thinking Maps®, and Concept Maps are discussed with Thinking Maps classified as a type of concept map that is separate and different from both other maps. The chapter then offers a second definition of the term "concept maps," with a detailed discussion of Thinking Maps resulting in a new taxonomy of knowledge or concept maps. The authors then investigate integrating concept maps with cognitive styles theory to determine if concept mapping might have a neuro-psychological basis and if mapping theory can be related to different academic fields and professions. The chapter concludes that the use of concept mapping can promote more holistic and effective teaching, learning, and practice in STEM education.

Section 6
Online and Virtual Learning

Chapter 48
Incorporating Technology in a Cooperative Learning Environment 779
James Oren, University of Illinois at Chicago, USA

Cooperative learning is largely considered a powerful instructional method. Decades of research based on the interdependency theory has created a strong framework on how to design an effective cooperative learning environment. In recent years, new technological innovations have emerged, creating a new field of research known as Computer-Supported Collaborative Learning. This chapter examines how technology

can be incorporated using the foundation set by cooperative learning, the challenges such incorporation solves, and the challenges it creates. Additionally, this chapter poses some recommendations for both practitioners and researchers of cooperative learning.

Chapter 49
A Survey on the Use of Adaptive Learning Techniques Towards Learning Personalization 790
Sonali Banerjee, Supreme Knowledge Foundation Group of Institutions, India
Kaustuv Deb, Supreme Knowledge Foundation Group of Institutions, India
Atanu Das, Netaji Subhash Engineering College, India
Rajib Bag, Supreme Knowledge Foundation Group of Institutions, India

E-learning has a great impact on learners today. E-learning supports enhancing learner knowledge anytime, anywhere with lesser efforts than traditional models. In these situations, nonlinear approaches often modify teaching and learning strategies according to students' needs, and hence, automated machine-guided approaches seem useful in the name of adaptive learning. It identifies individual learner styles and provides the most suitable strategy that fits each learner as a case of personalization. Adaptive learning uses personalization for continuously improving student outcomes. Personalized learning takes place when e-learning systems use educational experience supporting desires, objectives, endowments, and curiosities of each individual learner. This work has reviewed the recent developments in the problem area of learning personalization through adaptive learning. Then the solution domain methods are compared to identify the knowledge and technology gap from their limitations. These analyses help to identify research potentials in learning technology for future works.

Chapter 50
Different Shades of Virtual Learning Environments: From Retrospective to Prospective 809
Arshia Ayoub, Kashmir University, India
Zahid Ashraf Wani, Kashmir University, India

The emergence of the internet has opened a wealth of new, network-based applications, from digital music stores to new venues for scholarly publishing. It has replaced the physical learning environments with virtual ones. The virtual learning environments are utilized for not only imparting informal but formal education as well. A collaborative virtual learning environment is a computer-based, distributed, virtual space or set of places. In such places, people can meet and interact with others, with agents, or with virtual objects. Collaborative virtual learning environment might vary in their representational richness from 3D graphical spaces, 2.5D, and 2D environments to text-based environments. In this milieu, the proposed study shall make an endeavor to time travel and identify various virtual learning systems, services, and tool that are being used and adopted by virtual learners. In addition, the study shall also anticipate the future virtual learning environments based on current trends and future requirements.

Chapter 51
An Effective Pedagogy Toolkit for Learning in an Intelligent Virtual Environment..... 825
R. S. Kamath, Chhatrapati Shahu Institute of Business Education and Research, India
R. K. Kamat, Shivaji University, India

Throughout the progression of the pedagogy, educators are striving hard to bring up the systems centering on effective learning. This omnipresent trend has led to the ontogeny of innovative and culmination of many congregation technologies such as virtual reality (VR), artificial intelligence (AI), and natural language

processing (NLP) ensuing as intelligent virtual learning environment (IVLE). Technology-enhanced encyclopedism can facilitate pupils with influential and high-quality learning experiences as compared to the traditional learning approach. This chapter portrays learning in intelligent virtual environment as an effective pedagogy approach. The pedagogic tool developed by the authors captures text written in English as an input and creates the envisioned virtual setting. The ability of natural language interface (NLI) for VR-based learning systems is the most significant attainment of the present work, which brings a novel perspective in the field pedagogy.

Chapter 52
Online Learning and Quality Practice With Administrative Support and Collaboration 837
Deborah G. Wooldridge, Bowling Green State University, USA
Sandra Poirier, Middle Tennessee State University, USA
Julia M. Matuga, Bowling Green State University, USA

Higher education institutions must innovate and develop new modes of learning, both formal and informal, that meet the demands of the knowledge-driven economy. There is a growing demand for education and a push for non-traditional ways of delivering knowledge and learning. This chapter begins by identifying the technological changes that are affecting all societies and how these changes will specifically impact postsecondary education. The topic of course delivery is viewed as a cultural issue that permeates processes from the design of an online course to the evaluation of an online course. This chapter will examine and review key components of and tools for designing high impact online courses that support student learning and provide suggestions for faculty teaching online courses to assist in creating high-quality online courses that support teaching and, consequently, facilitate opportunities for student learning.

Chapter 53
Distance Learning From Itinerant Teachers to Cloud-Based Technologies 855
Linda D. Grooms, Regent University, USA

The knowledge explosion, the increased complexity of human life, and the ubiquitous, 24/7 nature of technology coupled with the globalization of the marketplace herald the need to embrace the most effective methods and platforms of teaching and learning. Currently providing powerful educational opportunities, the science and technology of distance teaching and learning continues to multiply at unprecedented rates. While historically traveling from village to village verbally disseminating knowledge was the only process of training those at a distance, today's learners eagerly embrace the rapidly expanding cloud-based technologies of the 21st century, offering a plethora of informational and educational opportunities. With this exponentially expanding global educational landscape, one must question what exactly distance teaching and learning is, how it has evolved, what the current state of affairs is, and what we anticipate in the future?

Chapter 54
Pre-Service Teachers' Perceptions of the Effectiveness of a Virtual Learning Environment to Support a Learner-Centred Approach: A Qualitative Study 870
Ana María Pinto-Llorente, University of Salamanca, Spain

The aim of the research was to apply a qualitative study approach to explore pre-service teachers' perspectives towards a virtual learning environment to establish the reasons to determine its effectiveness to support learner-centered approach. The population of the research included a total of 94 pre-service

teachers, studying the last year of the Degree in Primary Education. The qualitative sample of the study was theoretical sampling, systematic, non-probabilistic, sequential, and cumulative. Qualitative data were collected through individual semi-structured interviews. The findings suggested participants' positive perspectives towards the VLE to support learner-centred approach in which they were placed at the centre of the learning process, created knowledge, and had the opportunity to develop an important set of skills needed in the current society and for lifelong learning. It was favoured a constructivist learning in a constructivist environment that involved the students in the development of knowledge having an active role.

Chapter 55
Techno Task: A Step Ahead in Learning and Teaching English as a Second Language at Elementary Level 888
Beena Anil, SDNB Vaishnav College for Women, India

Language is all about words and meanings. Language is powerful when it is being used perfectly and relevantly. The more it is used, the better it is learnt. Today, learners want language to be learnt in a holistic and exciting way with a slice of life in it. Language is essential to communicate in our day to day in varied lively situations. Learning happens everywhere and anywhere as the language is embedded in all situations verbally and nonverbally. In this techno world, learners have an abundance of learning materials to improvise their language learning ability extensively. Teacher as a facilitator in the teaching milieu should sieve required tasks for her/his wards to make them comfortable to learn the language interestingly. She/he should select tasks those are embodied with the qualities of observation, analysis, and performance in every learner. The chapter focuses on the various essentialities of teaching and learning English as a second language through techno-tasks.

Chapter 56
A Case Study on Extensive Online Reading in Higher Education 908
Diana Presadă, Petroleum-Gas University of Ploiesti, Romania
Mihaela Badea, Petroleum-Gas University of Ploiesti, Romania

The authors have noticed that students tend to focus exclusively on syllabus reading materials, ignoring reading for pleasure outside the classroom. Rarely taught in ordinary university classes, extensive reading skills may play an important part in the foreign language teaching and learning process. Given these facts, the authors decided to pilot an extensive reading program at the academic level, the ultimate aim being to implement it in the future. In addition, the pilot was continued with postgraduate students two years later. Therefore, the purposes of the chapter are to discover students' attitudes towards extensive reading and to assess the results of the pilot as reflected in their opinions with a view to conceiving a large-scale future reading program. The study attempts to shed light on the issues triggered by the introduction of such a program into the curriculum of Humanities students, being mainly concerned with the practical side of the phenomenon and highlighting the interdependence between the findings and the latest theories in the field.

Chapter 57
Towards Disability-Aware Social Media-Enriched Virtual Learning Environments 922
Julius T. Nganji, University of Toronto, Canada

The increasing use of social media brings about the need to consider learners with disability when designing learning environments incorporating social learning. Additionally, there is need for educational institutions to consider social media-enriched learning environments. By default, designers and developers of virtual learning environments tend to design for learners without disabilities. The consequences for learners with disabilities are enormous. This chapter aims to propose a disability-aware approach to designing social learning environments that advocates that stakeholders consider the needs of learners with disabilities throughout development. The challenges that learners with disabilities face when interacting with learning systems are reviewed, and a disability-aware approach to designing social learning environments is presented, examining how this could be practically implemented. The opinions and recommendations of 48 students with disabilities from two universities in the United Kingdom and Canada are presented.

Chapter 58
Online Courses Accessible to College Students With Disabilities 937
Dorea D. Bonneau, University of North Carolina at Pembroke, USA
Margaret M. Cramer, Northcentral University, USA

More students can attend colleges and universities from a distance due to broader access and technological advances. Therefore, facilitators are facing the challenge of providing more accommodations and modifications to nontraditional students. The provision of these special services, which have traditionally been provided by special educators, are receiving limited attention. Special educators are educated to make these adjustments on an individual basis in the elementary and secondary levels. However, this has not been the traditional role of the university professor. With today's mass enrollments in online courses, procedures for providing accommodations to all students have become a significant challenge. This chapter will review research on online course design and implementation to address the needs of students with disabilities.

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Preface

As technology continues to transform industries all over the world, there has been much debate regarding its integration in education. While many educators advocate for its use to promote engagement and knowledge retention, others see it as a hindrance and distraction. Challenges to its implementation and effective integration into courses, as well as instructor reluctance or resistance to its use, has incited problems and slowed its progression. In 2020, it became more and more evident that online learning is paramount to not only inclusive education, but for the continuance of learning during global crises. When the COVID-19 pandemic spread across the world, education was disrupted at every level. Kitchens became classrooms, parents became teacher aides, and instructional methods had to get creative. Higher education instructors were challenged to spur meaningful discussions through virtual classrooms, while K-12 teachers were forced to produce and execute lesson plans meant for in-classroom delivery in an online format. This unprecedented event showcased the problems still apparent in online learning, revealing struggles from testing and assessment to accessibility issues for students with disabilities. More importantly, it revealed the necessity and permanence of educational technologies and the challenges educational leaders and administrators face now, and in the years to come.

The benefits of educational technologies in all aspects of education have been widely researched and reported. Past research has focused on introducing technology into K-12 classrooms as a supplementary learning tool, utilizing such technologies as gamification and mobile apps to foster and encourage participation. In the higher education domain, further steps were taken to develop fully online courses and virtual classrooms which allowed education to reach beyond the limitations of physical institutions, creating opportunity for nontraditional students who would find education, especially higher education, otherwise inaccessible. Technology has also allowed students around the world greater and more direct access to a wider range of experts and instructors better prepared to educate them on more specific specializations and areas of expertise. Assistive technologies allow improved physical access and cognitive engagement to institutions in ways that were previously impossible. This allows a greater range of students to participate in the utilization of academic institutions and to benefit from educational opportunities that might otherwise be unavailable to them while also fostering a level of independence that would be unfeasible without technology.

Moreover, broader educational access is not limited to education itself, but also to student information, making the management and administration of academic institutions more convenient. Administrators and educational managers are able to consolidate records into formats that are easier to reference and manage. Such uses can support educational leaders as they tackle the shifting responsibilities of managing a successful institution.

The everchanging face of education, prompted in part by technology, has forced an evolution of leadership and management strategies. Universities and colleges must now form lasting partnerships and industry collaborations to remain relevant and adequately compete for students. Fostering a relationship with the community is also of importance as teachers are expected to create more meaningful experiences for their students that instill in them empathy, resourcefulness, cultural sensitivity, and a passion for life-long learning.

As the definition of productive learning and successful educational institutions continues to change, it is imperative that educational leaders and instructors alike remain up to date on the best practices and newest theories that will support effective learning. Teachers need to ensure that they are continually learning and properly sharing knowledge with one another to facilitate valuable techniques and methods for better teaching. As such, IGI Global is pleased to offer this two-volume comprehensive reference, the **Handbook of Research on Modern Educational Technologies, Applications, and Management**, that will empower teachers, academicians, education professionals, curriculum designers, administrators, researchers, and students with a stronger understanding of modern educational technologies, applications, and management.

This compilation is designed to act as a single reference source on conceptual, methodological, and technical aspects, and will provide insight into emerging topics including, but not limited to: deep learning, social media, blogs, chatbots, tablets, online learning, mobile learning, new learning theories including inquiry learning and complexity theory, university-software industry collaborations, performance assessments, data mining techniques, and teacher leadership. These chapters, contributed by more than 100 global experts from prominent institutions, are sure to provide readers the tools necessary for further research and discovery in their respective industries and/or fields.

The two-volume **Handbook of Research on Modern Educational Technologies, Applications, and Management** is comprised of 58 chapters and organized into six sections that provide comprehensive coverage of important topics. The sections are:

1. Administrative Technologies, Data Management, and Performance Assessments
2. Educational and Assistive Technologies
3. Knowledge Sharing, Collaboration, and Professional Development
4. Leadership, Management, and Organizational Service
5. Learning Theories
6. Online and Virtual Learning

Each of the focused sections include diverse chapters centered around a common theme, with each of the chapters then arranged by relevance to the theme and to each other. Below is an overview of each of the chapter contributions.

SECTION 1: ADMINISTRATIVE TECHNOLOGIES, DATA MANAGEMENT, AND PERFORMANCE ASSESSMENTS

This section opens this extensive reference source by highlighting the latest emerging technologies that school administrators are implementing for the management of data as well as for more effective measurement and testing. **Chapter One** titled "***Multi-Perspectives of Cloud Computing Service Adoption***

Quality and Risks in Higher Education," authored by Prof. Mohammed Ali from the Alliance Manchester Business School, UK, examines the applications of cloud computing and cloud-based services for universities. **Chapter Two** titled "***A Comparative Evaluation of ERP Implementation Factors in Higher Education***," authored by Profs. Arunava Ghosh, Tuhin Sengupta, and Amit Srivastava from the Indian Institute of Management Indore, India, observes and compares two different higher education institutions in South Africa and India with the objective of investigating the practical determinants of roadblocks to a successful ERP project implementation and provides solutions. **Chapter Three** titled "***Automated Essay Scoring Using Deep Learning Algorithms***," authored by Profs. Jinnie Shin, Qi Guo, and Mark Gierl from the University of Alberta, Canada, explores the influence of the transition from paper to digitally based assessment. **Chapter Four** titled "***A Study of Big Data Analytical Frameworks in Research Data Management using Data Mining Techniques***," authored by Profs. Madhavi Vaidya and Meghana Sanjeeva of the Vivekanand Education Society's College of Arts Science and Commerce, India, investigates the need to develop policies, infrastructures, and services in organizations, with the objective of assisting researchers in creating, collecting, manipulating, analyzing, transporting, storing, and preserving datasets. **Chapter Five** titled "***Sequence Clustering Techniques in Educational Data Mining***," authored by Profs. Qi Guo, Ying Cui, Jacqueline Leighton, and Man-Wai Chu from the University of Alberta, Canada, provides comprehensive research on the impact of digital technologies on modern education. **Chapter Six** titled "***Estimating Levels of Learning Outcomes Acquirement Based on Fuzzy Sets, Relations, and Their Compositions***," authored by Prof. Aleksandra Mrela from Kazimierz Wielki University, Poland and Prof. Oleksandr Sokolov of Nicolaus Copernicus University, Poland, examines student assessment and outcomes through the lens of fuzzy relations. **Chapter Seven** titled "***Development of the Internet Literacy Indicator for Students (ILAS) and Longitudinal Analysis of Scores***," authored by Prof. Nagayuki Saito from the International Professional University of Technology in Tokyo, Japan and Prof. Madoka Aragaki of Business Breakthrough University, Japan, analyze and evaluate longitudinal survey data focusing on awareness education policies, in order to periodically evaluate the Internet environment for young people in line with the Youth Internet Environment Improvement Act Supplementary Provisions Article 3. **Chapter Eight** titled "***Quality Videos and Integrated Performance Assessments Are Essential in the World Language edTPA***," authored by Profs. Peter Swanson and Jean LeLoup of the United States Air Force Academy, USA, highlights educational policy and best practices in teaching languages before providing research-based suggestions regarding the development of a high-quality portfolio by focusing on video recording considerations and the use of the integrated performance assessment. **Chapter Nine** which is the final chapter in this section and titled "***Implementation Imperils and Imperatives of Integrated eIQA of HEI***," authored by Prof. Teay Shawyun from King Saud University, Saudi Arabia, explores the challenges of implementing eIQA including resistant mindsets.

SECTION 2: EDUCATIONAL AND ASSISTIVE TECHNOLOGIES

This section includes chapters on emerging technologies that foster effective and inclusive learning. **Chapter Ten** which is the first in this section and titled "***Identifying and Evaluating Language-Learning Technology Tools***," authored by Profs. Farideh Nekoobahr, Jacqueline Hawkins, Kristi Santi, Janeen Antonelli, and Johanna Thorpe from The University of Houston, USA, examines the incorporation of various digital technologies in English language learning programs. **Chapter Eleven**

titled "***Educational Games as Software Through the Lens of Designing Process***," authored by Prof. Mifrah Ahmad of Deakin University, Australia, discusses three major contributions to game design fundamentals and principles and unpacks their concepts on designing educational games. **Chapter Twelve** titled "***Usability Analysis of a Mobile Learning Application***," authored by Profs. Yasin Cakan, Aycan Kaya, and Cigdem Gumussoy from Istanbul Technical University, Turkey, examines a research model developed to determine the factors affecting the usability of a mobile learning application belonging to one of the most popular MOOCs (Massive Open Online Courses) providers. **Chapter Thirteen** titled **"*Main Features and Types of Educational Use of Wiki Technology*,"** authored by Profs. Nikolaos Karipidis and Jim Premtzas from the Democritus University of Thrace, Greece, looks at the popularity of Wiki technology and its potential contributions to education. **Chapter Fourteen** titled **"*A Survey of Recent Approaches Integrating Blogs in School Education*,"** authored by Profs. Stavros Tsetsos and Jim Prentzas of the Democritus University of Thrace, Greece, provides a brief survey of approaches integrating blogs in primary and secondary education along with future research directions. **Chapter Fifteen** titled **"*Essential Features and Critical Issues With Educational Chatbots: Toward Personalized Learning via Digital Agents*,"** authored by Prof. Jeremy Riel from the University of Illinois at Chicago, USA, examines the design and status of chatbots and conversational agents for educational purposes. **Chapter Sixteen** titled **"*Reflecting on the Results of the Initiative ETiE for Using Tablets in Primary Schools*,"** authored by Prof. Emmanuel Fokides from the University of the Aegean, Greece, provides comprehensive research on the educational opportunities afforded through the use of mobile devices. **Chapter Seventeen** titled **"*FeedForward With Screencasts*,"** authored by Prof. Rui Jesus from CESPU, Portugal, explores the contribution of screencasts as one possible solution to providing feedforward. **Chapter Eighteen** titled **"*Developing Computational Thinking Using Lego Education WeDo at 4th Grade of Primary Education: A Case Study*,"** authored by Prof. Ana María Pinto-Llorente, of the University of Salamanca, Spain, describes a study conducted to determine participants' perceptions about the effectiveness of the experience to meet the learning objective, to construct and program robotics models, and to help pupils to become familiar with computational concepts and practices. **Chapter Nineteen** titled **"*Assessment of the Use of Social Media by Students of the National Open University of Nigeria, Abeokuta Study Centre*,"** authored by Profs. Ganiu Okunnu, Kola Adesina, and Mariam Oshuwa from Crescent University, Nigeria, examines social media use in educational programs and the benefits to education that social media use provides. **Chapter Twenty** titled **"*Multimedia-Enabled Dot Codes as Communication Aids*,"** authored by Prof. Shigeru Ikuta of Otsuma Women's University, Japan, Prof. Masamichi Watanuki from Hattatsu kyoiku kenkyukai Co., Ltd., Japan, and Prof. Shinya Abe of Gridmark Inc., Japan, outlines the recent development of the state-of-the-art Grid Onput dot code technology and presents basic information regarding the creation of original teaching materials using newly developed software and the use at both general and special needs schools. **Chapter Twenty-One** which is the final chapter in this section and titled "***An Overview of the Technological Options for Promoting Communication Skills of Children With Cerebral Palsy***," authored by Prof. Viviana Perilli of Villa Apelusion Medical Care Center, Italy, Prof. Fabrizio Stasolla from the University "Giustino Fortunato", Italy, Prof. Alessandro Caffò, from the University of Bari, Italy, and Prof. Fiora D'Amico of Villa Argento Medical Care Center, Italy, explores the use of assistive technology-based interventions for promoting communication skills of children with cerebral palsy.

SECTION 3: KNOWLEDGE SHARING, COLLABORATION, AND PROFESSIONAL DEVELOPMENT

This section presents coverage on knowledge management and professional development strategies for educators, administrators, and educational leaders, as well as tactics for establishing technological and industry partnerships that can further educational programs. **Chapter Twenty-Two** which is the first in this section and titled **"*Designing Schools as Learning Centers*,"** authored by Prof. Martha Ann Davis McGaw from the Davis McGaw Family Foundation, USA, provides comprehensive research on how architecture, personnel, and environment work together to impact educational delivery. **Chapter Twenty-Three** titled **"*Generalizable Models for Online Professional Learning Communities for America's K-12 Teachers*,"** authored by Profs. Jennie Johnson and Adil Khan from the University of North Texas, USA, focuses on online professional learning communities and the opportunities and support that they provide for teachers. **Chapter Twenty-Four** titled **"*Professional Development and Training Needs for Administrators in an Islamic University*,"** authored by Profs. Riyadotul binti Mahyutan, Siti Syakirah Muhammad Yusop, Saidah Na'ilah Masrum, and Ismail Amzat from the International Islamic University Malaysia (IIUM), Malaysia, highlights the professional development needs for administrative staff at the Islamic University in Malaysia. **Chapter Twenty-Five** titled **"*Supporting Community Engagement Through Real-World Instructional Learning*,"** authored by Profs. Caroline Crawford, Janice Newsum, and Sharon White of the University of Houston-Clear Lake, USA and Prof. Jennifer Wallace from Jackson State University, USA, examines the engagement of students and community through the lens of real world instructional learning. **Chapter Twenty-Six** titled **"*Design, New Media, and Human Computer Interactions*,"** by Prof. William Gibbs from Duquesne University, USA, provides comprehensive research on education partnerships with industry on practice-based projects and how education can add value and potentially help sustain these collaborations. **Chapter Twenty-Seven** titled **"*The University Challenge in the Collaboration Relationship with the Industry*,"** authored by Profs. Marcello Chedid and Leonor Teixeira from the University of Aveiro, Portugal, addresses and discusses the university challenges in the collaboration relationships with the industry based on the main results of some empirical studies developed during a research project. **Chapter Twenty-Eight** titled **"*Knowledge Management in University-Software Industry Collaboration*,"** authored by Profs. Marcello Chedid and Leonor Teixeira from the University of Aveiro, Portugal, explores the university-software industry collaboration relationship as a key resource that together can more easily promote technological development that underpins innovation solutions. **Chapter Twenty-Nine** which is the final chapter in this section and titled **"*Knowledge Sharing Practices Among Non-Academic Staff in a Nigerian University*,"** authored by Profs. Funmilola Omotayo and Hafsat Abdul-Rahman from the University of Ibadan, Nigeria, investigates knowledge sharing practices and the shared tacit and explicit knowledge between staff through face-to-face interactions.

SECTION 4: LEADERSHIP, MANAGEMENT, AND ORGANIZATIONAL SERVICE

This section discusses coverage and research perspectives on leaders and decision makers in educational settings and the effective management of educational institutions and services. **Chapter Thirty** which is the first in this section and titled **"*Ushering Change in 21st Century Schools and Who Should Lead: What Are the Prerequisites and Processes?*,"** authored by Prof. Ismail Amzat

from International Islamic University Malaysia (IIUM), Malaysia, examines change in schools and who should be leading changes in these settings. **Chapter Thirty-One** titled **"*Transformational Teacher Leadership: A Global Perspective*,"** authored by Prof. David Litz of the Emirates College for Advanced Education, United Arab Emirates, examines the growth and popularity of transformational leadership, its relationship to organizational change, and the practical and theoretical justifications for its use as a relevant form of teacher leadership from a global and cross-cultural perspective. **Chapter Thirty-Two** titled **"*Administration of Mega and Open Universities With Technological Singularity Beyond Master-Human*,"** authored by Profs. Serap Sisman-Ugur and Gulsun Kurubacak-Meric from Anadolu University, Turkey, provides cutting-edge research on the sustainability of open universities with the constant advancement of technology. **Chapter Thirty-Three** titled **"*Making Sense of Data Informed Decision Making in Educational Contexts*,"** authored by Prof. Venesser Fernandes of Monash University, Australia, discusses the strengths in the continuous school improvement approach that develops both leadership and organizational capabilities such as collaboration, communication, and organizational trust within schools and school systems as they continue to deal with the ongoing onslaught of change and complexity present today. **Chapter Thirty-Four** titled **"*Faculty Organizational Service: Problems and Solutions*,"** authored by Prof. William Bart from the University of Minnesota, USA, examines some of the problems facing university faculty as they engage in their organizational service activities. **Chapter Thirty-Five** titled **"*Increasing Education's Return Rate for Public Interest Professionals*,"** authored by Prof. Robert Fisher, an Independent Contractor, USA, argues that the student loan debt crisis is, in fact, a shortage of public interest professionals and suggests that solving this problem requires replacing the Becker Human Capital Model with a new post-secondary finance model. **Chapter Thirty-Six** titled **"*Comprehensive Marketing Intensity Indicator for Higher Educational Institutions*,"** authored by Prof. Badar Iqbal from Monarch University Zug, Switzerland and Prof. Mohd Rahman from Aligarh Muslim University, India, brings the term marketing intensity into the discussion of higher education institutions (HEI) to build a comprehensive marketing intensity indicator which may be easily used to compare HEI with respect to marketing intensity. **Chapter Thirty-Seven** titled "***Accreditation of Medical Laboratories: Challenges and Opportunities***," authored by Profs. Donovan McGrowder, Dwayne Tucker, Melisa Anderson, Kurt Vaz, and Lennox Anderson-Jackson from The University of the West Indies, Jamaica and Prof. Fabian Miller of the Mico University College, Jamaica, features comprehensive research on the process noting that clinical laboratories have established quality management systems and are competent to carry out specific tasks related to testing. **Chapter Thirty-Eight** titled **"*Utilization of Information and Communication Technology for Development in Nigeria*,"** authored by Profs. AbdulGafar Fahm and Kamaldeen Oladosu from the University of Ilorin, Nigeria and Prof. Kazeem Bakare of Al-Madinah International University, Malaysia, presents a study to determine education leaders' perception on the adoption of information and communication technology. **Chapter Thirty-Nine** which is the final chapter in this section and titled **"*Redefining Chemical Engineering Education in Romania Between Massification, Atomization, and Performance*,"** authored by Prof. Eugenia Grecu from the Politehnica University of Timisoara, Romania, Prof. Ionica Oncioiu of the University of Bucharest, Romania, Prof. Getuța Camelia Stoica from Virgil Madgearu Economic College, Romania, and Prof. Delia Mioara Popescu of Valahia University, Romania, explores chemical engineering education programs and career intention.

SECTION 5: LEARNING THEORIES

This section discusses coverage and research perspectives on frameworks and strategies which promote knowledge retention among students. **Chapter Forty** which is the first in this section and titled **"*Knowledge Sharing Mediating Information Technology Student Innovation*,"** authored by Profs. James Ngugi and Leila Goosen from the University of South Africa, South Africa, examines various innovative behaviors and how they are developed among educators and students. **Chapter Forty-One** titled **"*Effective Integration of Technology in Inquiry Learning: Themes and Examples*,"** authored by Prof. Lisa Lynn of the University of Illinois at Chicago, USA, reviews recent findings on the use of technology in inquiry learning and provides suggestions and guidelines for incorporating technology in inquiry learning in order to maximize the pedagogical affordances of technology. **Chapter Forty-Two** titled **"*Disruption and Innovation in Global Higher Education as Viewed Through the Lens of Complexity Theory*,"** authored by Prof. Robert Waller from Columbus State University, USA, Prof. Pamela Lemoine of Troy University, USA, and Profs. Christopher Garretson and Michael Richardson from Columbus State University, USA, examines the success of higher education institutions as demonstrative of their ability to manage networks of knowledge and to collect, document, and analyze data involving complex systems. **Chapter Forty-Three** titled **"*Emotional Design in Multimedia and Measuring Learning Emotions*,"** authored by Prof. Ahmet Uzun from Afyon Kocatepe University, Turkey and Prof. Zahide Yildirim of the Middle East Technical University, Turkey, explores the use of emotional design in education to induce positive emotions and create a positive association with learning. **Chapter Forty-Four** titled **"*Education and Altruism and the Competence That Students Do Not Know They Possess*,"** authored by Prof. Rosa Iaquinta from the Università della Basilicata, Italy and Prof. Francesco Milito of the Università di Salerno, Italy, examines developing pro-social competencies and bringing into play the community as a relationship founded on the research of the common welfare to encourage altruism. **Chapter Forty-Five** titled **"*Constructivism in 21st Century Online Learning*,"** authored by Prof. Kathaleen Reid-Martinez of Oral Roberts University, USA and Prof. Linda Grooms from Regent University, USA, examines knowledge accessibility and the democratization of the learning process. **Chapter Forty-Six** titled **"*Creativity and Impactful Learning Through Implicit Cognitive Vulnerability*,"** authored by Profs. Caroline Crawford, Janice Newsum, and Sharon White of the University of Houston-Clear Lake, USA and Prof. Jennifer Wallace, from Jackson State University, USA, explores implicit cognitive vulnerability and its impact on inciting creativity in learning. **Chapter Forty-Seven** which is the final chapter in this section and titled **"*Concept Maps as a Technique for Organizing, Analyzing, and Transforming Knowledge*,"** authored by Prof. Michael Tang from the University of Colorado, Denver, USA and Prof. Janelle Johnson from Metropolitan State University of Denver, USA, provides cutting-edge research on integrating concept maps with cognitive styles theory to determine if concept mapping can be related to different academic fields and professions.

SECTION 6: ONLINE AND VIRTUAL LEARNING

This section discusses coverage and research perspectives on digital learning environments and the use of the internet in education. **Chapter Forty-Eight** which is the first in this section and titled **"*Incorporating Technology in a Cooperative Learning Environment*,"** authored by Prof. James Oren from the University of Illinois at Chicago, USA, features comprehensive research on effective cooperative learning environ-

ment design. **Chapter Forty-Nine** titled **"*A Survey on Use of Adaptive Learning Techniques Towards Learning Personalization*,"** authored by Profs. Sonali Banerjee, Kaustuv Deb, and Rajib Bag from the Supreme Knowledge Foundation Group of Institutions, India and Prof. Atanu Das of the Netaji Subhash Engineering College, India, examines e-learning and the enhancement of learner knowledge. **Chapter Fifty** titled **"*Different Shades of Virtual Learning Environments: From Retrospective to Prospective*,"** authored by Profs. Arshia Ayoub and Zahid Wani from Kashmir University, India, makes an endeavor to time travel and identify various virtual learning systems, services, and tools that are being used and adopted by virtual learners. **Chapter Fifty-One** titled **"*An Effective Pedagogy Toolkit for Learning in an Intelligent Virtual Environment*,"** authored by Prof. R. Kamath from Chhatrapati Shahu Institute of Business Education and Research, India and Prof. R. Kamat, of Shivaji University, India, portrays learning in intelligent virtual environments as an effective pedagogical approach. **Chapter Fifty-Two** titled **"*Online Learning and Quality Practice With Administrative Support and Collaboration*,"** authored by Prof. Deborah Wooldridge and Prof. Julia Matuga of Bowling Green State University, USA and Prof. Sandra Poirier from Middle Tennessee State University, USA, examines and reviews key components of, and tools for, designing high impact online courses that support student learning and provide suggestions for faculty teaching online courses to assist in creating high quality online courses that support teaching and, consequently, facilitate opportunities for student learning. **Chapter Fifty-Three** titled **"*Distance Learning From Itinerant Teachers to Cloud-Based Technologies*,"** authored by Prof. Linda Grooms from Regent University, USA, answers the questions of what exactly is distance teaching and learning?, how has it evolved?, what is the current state of affairs?, and what can readers anticipate in the future? **Chapter Fifty-Four** titled **"*Pre-Service Teachers' Perceptions of the Effectiveness of a Virtual Learning Environment to Support a Learner-Centered Approach*,"** authored by Prof. Ana María Pinto-Llorente from the University of Salamanca, Spain, applies a qualitative study approach to explore pre-service teachers' perspectives towards a virtual learning environment to establish the reasons to determine its effectiveness to support a learner-centered approach. **Chapter Fifty-Five** titled **"*Techno Task: A Step Ahead in Learning and Teaching English as a Second Language at Elementary Level*,"** authored by Prof. Beena Anil of SDNB Vaishnav College for Women, India, focuses on the various essentialities of teaching and learning English as a second language through techno-tasks. **Chapter Fifty-Six** titled **"*A Case Study on Extensive Online Reading in Higher Education*,"** authored by Profs. Diana Presada and Mihaela Badea from Petroleum-Gas University of Ploiesti, Romania, investigates students' attitudes towards extensive reading and assesses the results of the pilot as reflected in their opinions with a view to conceiving a large-scale future reading program. **Chapter Fifty-Seven** titled **"*Towards Disability-Aware Social Media Enriched Virtual Learning Environments*,"** authored by Prof. Julius Nganji from the University of Toronto, Canada, explores considerations for learners with disabilities when designing social learning environments. **Chapter Fifty-Eight** which is the final chapter in this book and titled **"*Online Courses Accessible to College Students with Disabilities*,"** authored by Prof. Dorea Bonneau from the University of North Carolina-Pembroke, USA and Prof. Margaret Cramer from Northcentral University, USA, examines strategies for providing accommodation and modifications for nontraditional students in online course design as well as the implementation of such programs to address the needs of students with disabilities.

In summary, although the primary focus of the contents in this comprehensive reference publication is based on its six sections, offering a progression of coverage of the important concepts, methodologies, technologies, applications, social issues, and emerging trends, the reader can also identify specific contents by utilizing the extensive indexing system listed at the end of this publication.

We hope that the diverse and comprehensive coverage offered within these chapters will contribute to a better understanding of all topics, research, discoveries, and solutions in this evolving field. This publication should inspire its readers to further contribute to the current body of knowledge in this immense field. It will create possibilities for further research and discovery of how technology and new methodologies can inspire educators and evolve educational settings all over the world in support of knowledge discoveries and dissemination in current situations as well as in future years.

Mehdi Khosrow-Pour, D.B.A.
Editor-in-Chief
Handbook of Research on Modern Educational Technologies, Applications, and Management

Acknowledgment

Editing and completing an authoritative and comprehensive scholarly research publication such as the *Handbook of Research on Modern Educational Technologies, Applications, and Management* requires tremendous contributions, and a great deal of assistance from large groups of scholars and staff. The primary objective of this handbook of research is to provide the most up-to-date scholarly coverage of all topics related to the evolving nature of methodologies, technologies, applications, and tools in educational settings.

The contributed chapters from experts all over the world provide an in-depth look into topics such as deep learning, social media, blogs, chatbots, tablets, online learning, mobile learning, new learning theories including inquiry learning and complexity theory, university-software industry collaborations, performance assessments, data mining techniques, teacher leadership, and much more. I am indebted to all the authors for their excellent contributions to this publication.

All submitted manuscripts to this publication underwent a double-blind peer review process in order to achieve the highest level of quality and accuracy. I am thankful to all the reviewers of this handbook of research for providing their expertise and their rigorous, unbiased assessment of the manuscripts assigned to them on a double-blind basis, as well as the members of the Editorial Advisory Board for their wisdom, guidance, and assistance with various decisions throughout the editorial process.

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Mehdi Khosrow-Pour, D.B.A.
Editor-in-Chief
Handbook of Research on Modern Educational Technologies, Applications, and Management

Section 1

Administrative Technologies, Data Management, and Performance Assessments

Chapter 1
Multi-Perspectives of Cloud Computing Service Adoption Quality and Risks in Higher Education

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ABSTRACT

Universities worldwide are starting to turn to cloud computing. The quality characteristics, which include access to a wider network of computing resources, pay-as-you-go services, self-services, agile services, and resource centralisation provide a convincing argument for HEIs to adopt cloud services. However, the risks leading to non-adoption range from security issues to a lack of cloud vendor support. The findings suggest that security, privacy, and trust are the key determinants to non-adoption as stakeholders felt that the cloud cannot fully guarantee the safeguarding of sensitive information. Key determinants to cloud adoption include improving relationships between students and teachers via collaborative tools and proposing cloud apps for mobile devices for accessing virtual learning materials and email securely off-campus. In conclusion, university stakeholders are still unconvinced about adopting cloud services, but future advances of the cloud may help to steer their decision to adopt this innovative technology given its overwhelming potential.

INTRODUCTION

Recently, cloud computing (CC) has become a major player in education (Sultan, 2010). CC is a ubiquitous computing paradigm that enables users to access a host of cloud services. These computing paradigms are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a service (IaaS) (see Sultan, 2010). Software applications, for instance, virtualized by CC, can be distributed over the Internet rather than deploying them on computers or workstations (Rindos et al., 2010). As such, CC has been

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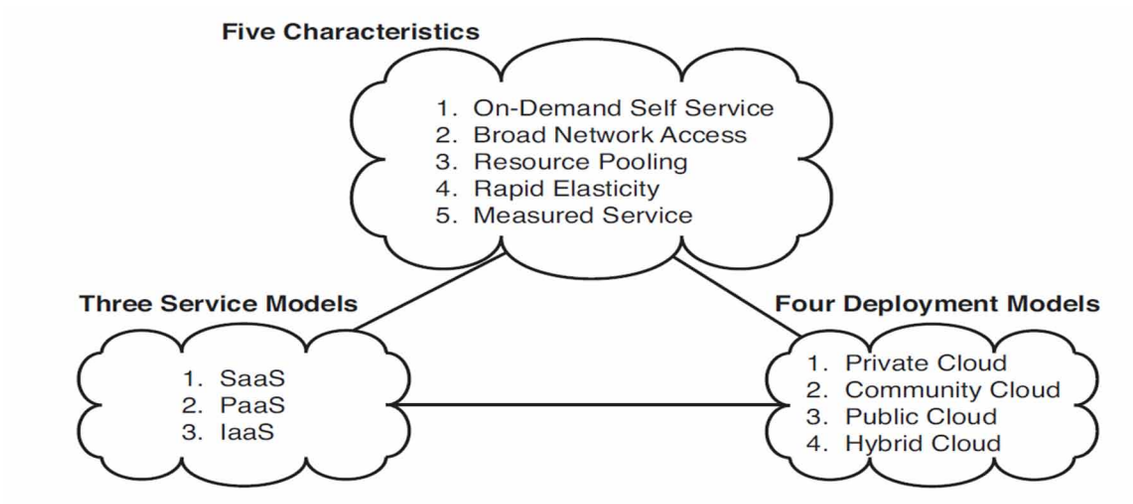
integrated into e-learning systems, mobile learning and online distance learning (Cvetkovic et al., 2017; Rao and Selvamani 2015; Doelitzscher et al., 2011; Round, 2011; Al-Zoube et al., 2010). In particular, Higher education institutions (HEIs), including Universities and colleges are now starting to implement three types of CC models; public, private and hybrid clouds, with private clouds being the most prevalent among colleges to establish their own CC environment (Schaffer et al., 2009). In addition, Universities also purchase CC services from a third party service providers (Shakeabubakor et al., 2015). Willcocks et al., summarises the aforementioned CC components as follows (see Fig.1):

Figure 1. CC components (Willcocks et al., 2014)



In this research, HEIs refer to university level institutions that provide a wide range of courses at undergraduate and postgraduate level, and teaching and research services. Quality in the context of this study is defined as the quality elements or characteristics, which make CC a powerful and viable technology for Universities to adopt. Whereas, the risks refer to the potential barriers or dangers that may dissuade Universities from adopting CC. Adoption refers to stakeholders' acceptance of CC, whereas non-adoption refers to the rejection of CC (outcome). Adoption of the cloud among Universities has fluctuated over the years due to the quality (or perhaps, the benefits) (Sultan et al., 2010) and risks (challenges) (Okai et al., 2014) of the cloud.

Although there is a clear understanding about the specific components related to the cloud (Fig.1), the problem under investigation is a limited understanding of the quality and risks associated with CC that influence HEIs', namely Universities' adoptive decision. Currently, CC is widely accepted among various firms, industries, businesses and even government agencies (Alassafi et al., 2017; Chang, 2015; Ammurathavalli & Ramesh, 2014; Hoberg et al., 2012; Low et al., 2011). There is limited research to support the quality and risks associated with CC, particularly with emphasis on UK Universities. Therefore, this paper sought to explore the quality and risks associated with CC from a multiple perspective in the context of UK Universities.

BACKGROUND

This paper explores the quality and risks of CC adoption in HEIs from multiple perspectives. The study focuses on CC service quality in terms of the characteristics, which will add value to the stakeholders needs in HEIs. Looking at the quality and risks of the cloud through a multi-perspective lens, this research contributes a new dimension of cloud adoption that previous research has ignored.

LITERATURE REVIEW

Recent studies have stressed the importance of CC in various HEIs situated around the world (AlAjmi et al., 2017; Mokhtar et al., 2016; Hegazy et al., 2015; Hussein & Omar, 2015; Ammurathavalli & Ramesh, 2014; Doelitzscher et al., 2011; Al-Zoube et al., 2010; Sultan, 2010). Governments, in particular, are now backing CC initiatives in HEIs, namely Universities and Colleges who also purchase CC service third-party vendors (Shakeabubakor et al., 2015), and establish their own CC environments (Schaffer et al., 2009).

There is a myriad of research that supports the linkage between CC and HEIs, and the adoption and use of the technology at a user level, namely by students (Rababah et al., 2017; Alharthi et al., 2015; Aaron & Roche, 2012; Sultan, 2011). By employing TAM3 (Technology Acceptance Model), researchers have been able to demonstrate the acceptance or adoption of CC by students. On an organisational level, cost effectiveness is considered as the key influencing feature toward the acceptance of CC (Behrend et al., 2011). Despite Behrend not studying the levels of CC adoption and acceptance by teachers, they did exhibit "clear differences" when questioned.

HEIs are now moving to the cloud for various reasons (Sultan, 2011), especially for economic purposes (Mircea et al., 2011b, Mircea and Andreescu, 2011a). In the context of education, CC balances both economies of scale and control, providing a lower total cost of ownership (Bonuccelli, 2014). This is heavily linked to the quality of CC, which influences HEIs' adoptive decision. This paper has defined quality as the key elements or characteristics, which make CC a powerful and viable technology to adopt, and reflecting the efficient and economic nature of the cloud.

Mell and Grance (2011) identified five essential quality characteristics of the cloud:

- **Broad Network Access:** Users can access network resources from a range of devices;
- **Measured Service:** The cloud can automatically control and enhance resource use via the introduction of a measured service, which can be altered to suit the needs of the HEI. This is a highly efficient and cost-effective aspect of the cloud as a metering service only allows users to pay for what they use, and thus no money is wasted on downtime;
- **On-Demand Self-Service:** This enables students, teachers and administrators, among other key HEI stakeholders (users) to have anytime, anywhere access to various cloud resources, such as email, storage and applications without human interaction with the service vendor;
- **Rapid Elasticity:** Similar to measured service, rapid elasticity is the process of adjusting cloud system resources to meet user demands;
- **Resource Pooling:** This refers to the use of cloud resources via a network, and cloud vendors use shared computing resources to provide cloud services to their users. (Jian and Pandy, 2013; Mateos and Rosenberg, 2011).

The above quality characteristics are all linked to the advantages of adopting CC, particularly in terms of cost-effectiveness and the deployment of hardware and software (Rao et al., 2012). CC enables HEIs to develop quality, low-cost education at global level. Not only that, depending on individual machines to meet computing needs is no longer financially justified (Shayan et al., 2014). Further, aggregating IT services also justifies the quality and efficient nature of the cloud, ranging from personnel and expertise to licencing (Siegle, 2010).

Quality aspects of the cloud and cost reductions and rapid developments in modern technologies are clear justifications for CC adoption by HEIs (Sultan, 2011, Sultan, 2010). The quality cloud improves efficiency, reduces costs, and is an ideal model for the education sector (Almajalid, 2017; Okai et al., 2014; Sultan, 2010). The customisability of CC and the pay-as-you-go metered service, have a significant effect on the financial decisions associated with IT spending (Opala et al., 2015). Therefore, CC encompasses a paradigm shift for various IT developments in HEIs.

Despite these compelling arguments for the adoption of CC via the quality aspects of the technology, there are various risks associated with the cloud, which can sway HEIs' adoptive decision, leading to non-adoption (Rao et al., 2014). The risks associated with the cloud leading to non-adoption, include confidence, surety and trust (Shayan et al., 2014).

Confidence refers to users' willingness and readiness to use and accept a cloud solution; this is a branch of cultural resistance in which users may reject the technology purely based on their unfamiliarity and the unwillingness to adapt to change (Shakeabubakor et al., 2015). Surety refers to the cloud solution delivering its intended purpose, which with new innovations can be uncertain, since this is a novel technology, which many users will not be accustomed to. Trust refers to users' acceptance of the cloud solution based on having full confidence in the technology, but given the many potential risks of novel technologies, users will more than likely not trust the innovation (Sultan, 2010). For example, an institution may not trust a third party cloud vendor with its sensitive information owing to the risk of that information becoming disclosed by the vendor (Alhanahnah et al., 2017).

It is clear that the majority of cloud services have poor track record when it comes to building trust when migrating from existing services to a new solution that is supposed to add quality and benefit, given that it is a relatively new technology with potential uncertainty (Rao et al., 2014). The cloud can therefore only flourish with time, experience and reputation. Another issue is that many HEIs are unskilled and lack the required knowledge to manage risk and service performance at a third party service level, all of which requires a degree of confidence (Shayan et al., 2014). For example, a lack of confidence in CC in the commercial sector stems from:

- Poor risk management skills;
- Vendor lock-in;
- Management issues;
- Market immaturity;
- Inadequate or absent service level agreements (SLA).

In HEIs, similar issues occur via the concerns, which are influenced by a lack of trust in such institutions to deliver quality cloud services to its stakeholders. Akin et al. (2014) found that Institutional culture is cited as a barrier to adopting the cloud. In other words, would the cloud solution be compatible with the HEIs needs and expectations? Another issue cited by Akin et al. is IT security and privacy given the

regulatory compliance limiting potential adoption of CC. Potential adopters stressed that they would only be persuaded to move to the cloud if the security and privacy issues surrounding the cloud are addressed.

In short, CC is becoming heavily linked to e-learning systems in HEIs. Previously, conventional e-learning systems were only endogenous to HEIs (Sultan et al., 2010). CC can offer its stakeholders, such as students, teachers and administrators, a quality low-cost computing solution and the ability to develop virtual computing environments, especially in areas, such as distance or online learning and science education (Al-Zoube et al., 2010). CC is still a relatively new technology that is vulnerable to risk, but with long-term commitment, time and experience, potential adopters will begin to realise the true quality of this fascinating and innovative piece of computing technology. Therefore, this leaves potential stakeholders of CC at a crossroad. From the aforementioned literature review, the following CC qualities and risks were deduced. Table 1 provides a full summary of the quality and risks of CC.

With the main concepts in place, the research model could now be developed to assist the empirical research process.

Table 1. Summary of cloud service quality and risks

Component	Identified Sub-Component	Source	Description
Quality	Broad network Access Measured Service On-demand Self-Service Rapid Elasticity Resource Pooling	Almajalid (2017); Jian and Pandy (2013); Mateos and Rosenberg (2011); Mell and Grance (2011); Okai et al. (2014); Opala et al. (2015); Rao et al. (2012); Shayan et al. (2014); Sultan (2010); Sultan (2011).	The qualities reflect the key characteristics that add value to cloud services. **Broad Network Access**: users can access network resources from a range of devices **Measured Service**: enables the cloud to be automatically controlled and enhances resource use, which can be altered to suit HEI needs, thus is a highly efficient and cost-effective as HEIs only pay for what they use **On-demand self-service**: this reflects the ubiquitous nature of the cloud as users can access the cloud 24/7 at any given location with an internet connection via a range of mobile devices **Rapid Elasticity**: adjusting cloud system resources to meet user demands **Resource Pooling**: the use of cloud resources via a network, and cloud vendors use shared computing resources to provide cloud services to users
Risk	Confidence Privacy Security Surety Trust	Akin et al. (2014); Alhanahnah et al. (2017); Al-Zoube et al. (2010); Katz et al. (2010); Shakeabubakor et al. (2015); Shayan et al. (2014); Sultan (2010).	The risks reflect the barriers associated with the adoption of cloud services. **Confidence**: users' willingness and readiness to use and accept a cloud solution **Privacy**: since the cloud is a huge data centre comprising of sensitive information, it can become an easy target for hackers to locate and disclose user information **Security**: similar to privacy, security issues in the cloud stem from information disclosure from unknown attackers and system attacks **Surety**: uncertainty about a cloud solution delivering its intended purpose **Trust**: user acceptance of the cloud solution based on having full confidence in the technology, but technophobia could affect the trust in a newly introduced technology

RESEARCH MODEL

The multiview framework, developed by Avison and Wood-Harper and the more recent multi-view 3 (MV3) framework by Bell and Wood-Harper (2014) is an approach that support the analysis, design and the development of information systems (IS) and evaluating possible solutions to IS related issues from multiple perspectives. Using a soft systems approach, it draws on various elements, such as human activity systems, socio-technical systems, data analysis and structured analysis, besides tackling the different perspectives of people using IS. In other words, multiview helps to determine multiple perspectives through individual perceptions of the IS development process or in the context of this research the quality and risks of adopting a cloud solution in HEIs. Therefore, this research used the MV3 model to explore the quality and risks of CC in higher education. Further, the MV3 model is a novel framework, particularly to the CC and educational areas as to the researcher's knowledge, no previous studies have applied such a model in this context. The multiview model has been applied in other areas, such as electronic banking (Mohamad et al., 2015), and Enterprise Resource Planning (ERP) (Badewi et al., 2015).

Multiview can be used by researchers to explore the quality and risks associated with the adoption of a technological innovation from multiple perspectives (Bell and Wood-Harper, 2014, Wood-Harper and Avison, 1992). The model comprises of three perspectives: technical, organisational and personal (Bell and Wood-Harper, 2014). In the current study, the technical perspective refers to the quality (or characteristics) and risks of the cloud, which influence adoption. The organisational perspective refers to HEIs, namely Universities' and their decision to adopt the technology based on weighing the pros and cons of the cloud solution. The personal perspective refers to the individuals involved with the system, namely stakeholders, such as students, teachers, senior management and administrators and their needs and expectations from the cloud solution. The MV3 model by Bell and Wood-Harper (2014) has inspired the proposed model. It includes various elements, such as key stakeholders involved in the CC adoption process (personal), quality and risks of the cloud system (technical), and the targeted institution, UK Universities (organisational). Figure 2 demonstrates the research model.

The current literature has identified five key quality characteristics of adopting the cloud (Broad network Access; Measured Service; On-demand Self-Service; Rapid Elasticity; and Resource Pooling) and five key risks of adopting the cloud (Confidence; Privacy; Security; Surety; and Trust). The framework was developed, considering these qualities and risks of the cloud, and consists of three key components.

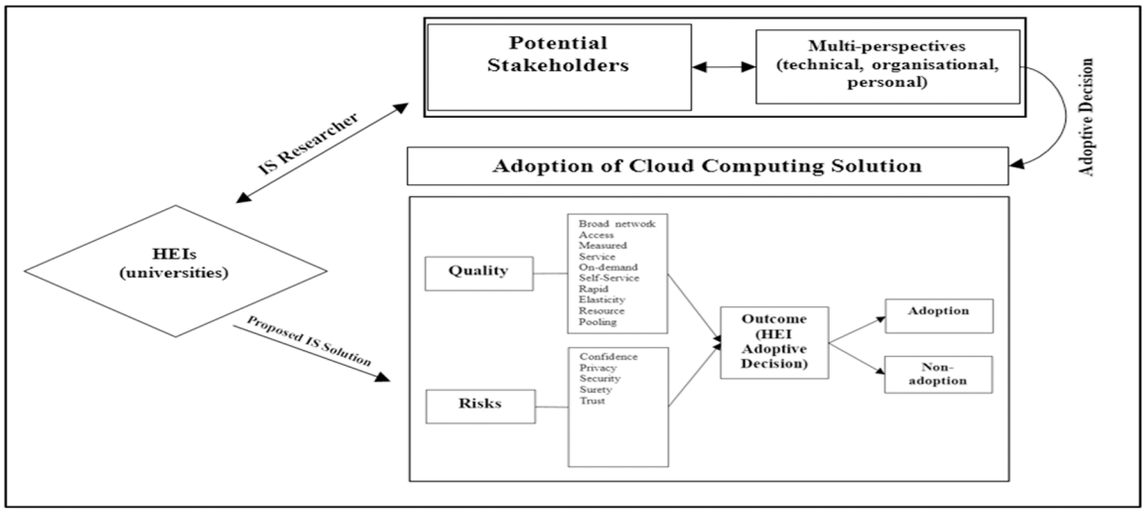
The first component of the framework involves the multiple perspectives (TOP – Technical: CC, Organisational: universities, and Personal: users i.e. students, teachers, senior management and administrators). The next component involves the target institution or context (HEIs) and proposes a potential emerging technology to adopt (CC). The third component assesses the quality and risks of the cloud to influence HEI and stakeholder decisions to adopt CC based on user needs and expectations (outcome).

The following research questions were derived from the review of the current literature on the quality and risks of CC adoption:

RQ1: What quality characteristics influence stakeholders' (students, teachers, senior management and administrators) acceptance of CC, leading to adoption?

RQ2: What risks influence stakeholders' (students, teachers, senior management and administrators) rejection of CC, leading to non-adoption?

Figure 2. Proposed research model



METHOD

This was an exploratory qualitative study. Empirical data was gathered using semi-structured interviews in order to answer the research questions. Participants were asked a series of open-ended questions during the interview process.

The participants were stakeholders situated at two UK Universities in North-West England with some prior knowledge and experience of adopting a cloud solution. One University had gone ahead with the adoption process, whereas the other did not. In addition, the stakeholders were made up of students, lecturers, senior management and administrators operating within the University's business school, all of whom were interviewed accordingly. These are the main university stakeholders because these are common users of information systems in HEIs. Students, for example, will use the cloud to perhaps share information and collaborate with their lecturers and colleagues. For lecturers, the cloud could help them to engage with their students beyond the classroom and share learning materials. For senior managers, the cloud could assist them in their managerial practices, such as relaying important student information to educational ministries, such as VISAs and scholarship funding. For administrators, the cloud could speed up speed up the student admission process by having instant access to student information in one centralised data centre.

Given the limited case studies of CC adoption among UK HEIs, this was a great opportunity to assess the effectiveness of CC adoption in UK HEIs from multiple stakeholder perspectives based on the quality and risks of this innovation. A sample of 36 university stakeholders were interviewed; 18 stakeholders from University A, namely 10 students, 4 lecturers, 2 senior managers and 2 administrators, and the same sample was applied to University B.

UK HEIs (University stakeholders) represent the research population and sample. Ross (2010) claims that HEIs are potential consumers of cloud technologies, thus justifying the chosen sample and population. Subjects were selected using purposive sampling since they were selected based on specific characteristics e.g. students, lecturers and administrators who work or study at a University. Semi-structured interviews

were the main data collection tool, and multiple University stakeholders were interviewed on-campus in a private room. Students, lecturers, senior managers and administrators were all volunteers willing to participate in the current study, and were obtained via word of mouth by other students and lecturers who knew them personally. The interviews were conducted over a Skype conference call, which lasted up to 30 minutes per session, and the entire process took place over a two-month period. In total, 36 interviews were conducted in the summer of 2017 (out of an initial sample of 40), which yielded a 66% response rate. Eight interviewees failed to attend the interview sessions. In addition, there were a total of 14 positive responses and 2 negative responses. Therefore, 18 valid responses were analysed.

The research data was analysed using thematic analysis. After the data was transcribed, it was analysed and presented in a descriptive format, where the most significant findings were deduced. The data was analysed using a qualitative software package called N-Vivo, i.e. the open-ended interview questions (Guest et al., 2011; Miles et al., 2013).

FINDINGS

Here, the interview findings of the research are presented. There was a total of 36 University stakeholders who were interviewed, namely University students, lecturers, senior managers and administrators, across two UK Universities situated in North-West England in order to determine the quality and risk determinants which influence adoption and non-adoption (outcome) of CC from multiple perspectives (technical, organisational and personal). Various themes were deduced from the findings according to each perspective of the MV3 methodology. The following table provides a summary of the research participants:

Some general findings were also deduced from the research data, mostly pertaining to the stakeholder roles in UK HEIs. Students' role was self-explanatory as they conduct research for assignments and exams and monitor their course progress through email and the existing Virtual Learning Environment (VLE) employed at the University. Lecturers are responsible for teaching students, conducting lecturers, grading exams and assignments and other teaching-related duties. Senior managers or heads of department roles are similar to those of lecturers as they also engage on some level of teaching, but also coordinate and manage their staff in their respected department. For example, the business school has one head of department and that department consists of various lecturers who teach a wide range of business-related subjects. Lastly, the administrator's role involves providing assistance to academic staff, besides handling student admissions.

The analysis found that the technical perspective highlights the proposed cloud solution, namely in terms of design issues, access to the technology and the actual use of CC. The organisational perspective highlights the collaboration between the key actors of CC within UK Universities. Finally, the personal perspective highlights the individual interests of CC within UK Universities, namely the stakeholders involved with the technology.

The findings show that the technical determinants require considerable attention before adopting CC in HEIs. The quality and risks of the cloud from a technical perspective were highlighted as a highly important issue. For example, lecturers and senior managers perceived quality as a high priority before considering the acceptance of a cloud solution. L1A indicated that: "For the cloud to work, the system would have to include some type of on-demand virtual learning environment so that I can grade my

Table 2. Research participants

No.	University	Participant	Code		No.	University	Participant	Code
UA1	University A	Student	S1A		UB1	University B	Student	S1B
UA2	University A	Student	S2A		UB2	University B	Student	S2B
UA3	University A	Student	S3A		UB3	University B	Student	S3B
UA4	University A	Student	S4A		UB4	University B	Student	S4B
UA5	University A	Student	S5A		UB5	University B	Student	S5B
UA6	University A	Student	S6A		UB6	University B	Student	S6B
UA7	University A	Student	S7A		UB7	University B	Student	S7B
UA8	University A	Student	S8A		UB8	University B	Student	S8B
UA9	University A	Student	S9A		UB9	University B	Student	S9B
UA10	University A	Student	S10A		UB10	University B	Student	S10B
UA11	University A	Lecturer	L1A		UB11	University B	Lecturer	L1B
UA12	University A	Lecturer	L2A		UB12	University B	Lecturer	L2B
UA13	University A	Lecturer	L3A		UB13	University B	Lecturer	L3B
UA14	University A	Lecturer	L4A		UB14	University B	Lecturer	L4B
UA15	University A	Senior manager	SM1A		UB15	University B	Senior manager	SM1B
UA16	University A	Senior manager	SM2A		UB16	University B	Senior manager	SM2B
UA17	University A	Admin	A1A		UB17	University B	Admin	A1B
UA18	University A	Admin	A2A		UB18	University B	Admin	A2B

students' work and even conduct more collaborative lectures with them. This would help towards the acceptance of CC among University staff."

S1B further emphasised that "I would like a system where I can access my course material and grades from a range of devices, anytime, anywhere as the existing VLE has compatibility issues with certain devices, such as smart phones. A cloud app, which combines a cloud VLE with existing Google cloud services, such as Gmail and Google docs would be great. I would be completely supportive of CC if this was to happen."

A2B further emphasised that: "CC would be great if it can facilitate the admission process at the University. Currently, we use an outdated database software, which has very limited features. A new system with better accessibility and more features would be necessary to facilitate the admission process."

SM1A, SM1B, SMA6 and SM5B all agreed with lecturers, students and administrators to some extent and further indicated that accepting CC can be achieved by familiarising stakeholders with the potential benefits of the cloud.

However, the stakeholders did raise some concern about the technical issues related to the security and privacy risk determinants in the cloud. The findings indicate that security risks are the most influencing determinant, which prevents HEIs from adopting CC. This stems from security issues being one of the most annoying barriers for HEIs, thus making HEIs become hesitant about migrating to the cloud. Security is essential for HEIs, and they will never risk its compromise. A1A indicated that: "Security is a must in the University. I handle highly sensitive student and staff data on a daily basis, and I cannot trust this technology unless both students and my work colleagues' information will not be compromised."

One student (S2A) emphasised that "I am uncertain that my personal data will remain secure as I would be accessing these services from a wide range of apps, which are potentially vulnerable to hackers. Uncertainty of the cloud is a huge issue for me." SM2B also reported that: "having the will to adopt the cloud requires the readiness to not only embrace the technology, but to be prepared for potential cloud hacks or attacks leading to the expose of my personal data and student data. This is an innovative, but highly risky IS solution." In addition, the administrators shared a similar view (A2B): "No new system is worth the risk of disclosing personal admission data. From experience, cloud vendors have got away with disclosing other company's sensitive data owing to the different data protection legislation among different countries. For instance, you could outsource your data to Germany, and because the DPA is a UK legislation, German vendors could disclose some information without being held liable."

Lastly, SM1B stated, "the government has done nothing to improve our trust relations with cloud vendors and draft fair legislation that protects from the disclosure of sensitive data, irrespective of the geographical location. So a universal law should be implemented for data protection among foreign cloud vendors. This will ultimately help to build trust with these vendors and to encourage the adoption of their services."

The next section discusses the findings in light of the existing literature.

DISCUSSION

This study aimed to determine the quality and risk determinants that could potentially influence the adoption or non-adoption of CC in UK HEIs. The findings were interpreted based on the research model. The model proposed HEIs' adoptive decision of a cloud solution from multiple perspectives, namely technical, organisational and personal perspectives.

The findings indicated that each University stakeholder had differing system needs, and thus it was expected that stakeholders would have very different and specific expectations from CC. For example, students' needs stem from having a cloud solution which enables them to access course materials and emailing systems from a range of devices with anytime anywhere features. This directly relates to the quality of the cloud in terms of access to a wider network of computing resources (broad network access) and self-service on request (on-demand self-service) (Almajalid, 2017; Shayan et al., 2014; Opala et al., 2015). Students also believed that the cloud be a great idea granted that it supports their learning outcomes. Therefore, students demand a cloud solution that delivers efficient and broad access to course materials and other important course data.

Administrators demand a cloud solution that is secure and private, as these were perceived key risks to non-adoption identified (Shayan et al., 2014). Since they are responsible for handling student admissions, this was expected from the administration staff as they work with sensitive data on a daily basis. Therefore, there is a policy issue here concerning how sensitive data is handled within the University and thus cloud vendors are expected to draft a policy regarding the safety of information in their possession. The administrators also pointed a legislative conflict in form of cloud vendors not being held liable for disclosing sensitive information owing to differing data protection legislations in the vendor's geographical location. This leaves Universities unsure about the reliability of third party cloud vendors to manage sensitive information. There is an underlying cultural issue here since stakeholders are worried about the disclosure of their intuition's private data, and thus do not trust the cloud and ultimately reject it.

Security and privacy is crucial when considering CC, and it has the highest priority. The findings suggest that security is perceived differently from each set of participants based on their technical awareness and its usefulness towards UK HEIs (Alhanahnah et al., 2017). Meanwhile, senior managers and lecturers shared similar views about accepting a cloud solution that is secure, backed by fair data protection laws by the government and has the ability to facilitate the teaching process and to help them plan, coordinate and conduct lectures in a collaborative manner. Therefore, lecturers were very much open to a cloud solution that would help to improve student-teacher relationships.

The technical perspective is more related to the quality aspects of the cloud as the essential characteristics were clearly emphasised by the participants. Security was also technical as the technology itself has a duty to safeguard sensitive information. Therefore, failing to meet these demands would result in non-adoption, as opposed to adoption. The organisational perspective was found to have a direct linkage to improving relationships between the HEI and its students and staff via collaborative tools. Finally, the personal perspective was related to the potential solutions the stakeholders gave to meet their individual needs and expectations from the cloud, leading to adoption. One of the most notable examples was one student's proposed cloud apps for mobile devices in which they can access their virtual learning materials and email securely off-campus.

In conclusion, the technical, organisational and personal perspectives are mostly related to the quality aspects of the cloud, particularly among various stakeholders who voiced their concerns about security and accessibility of the cloud and potential solutions. The risks, however, were more personal, since any stakeholders had concerns about how data would be protected by the cloud. Security, however, was found to be related to all aspects as this affects not only the technology and HEIs, but also the individuals who use the system. Lastly, several new risks were deduced from the existing risks that were assessed in the empirical study, including culture, lack of government support, legislative conflicts, policy issues and reliability. These aforementioned risks appear to relate to the security, privacy and trust risks associated with the disclosure of sensitive information by cloud vendors, which has found to be a great contributor to non-adoption of CC.

Table 3 provides a summary of the quality and risks of the cloud from multiple perspectives according to the research findings. Based on table 3, figure 3 is a revised model based on the empirical findings.

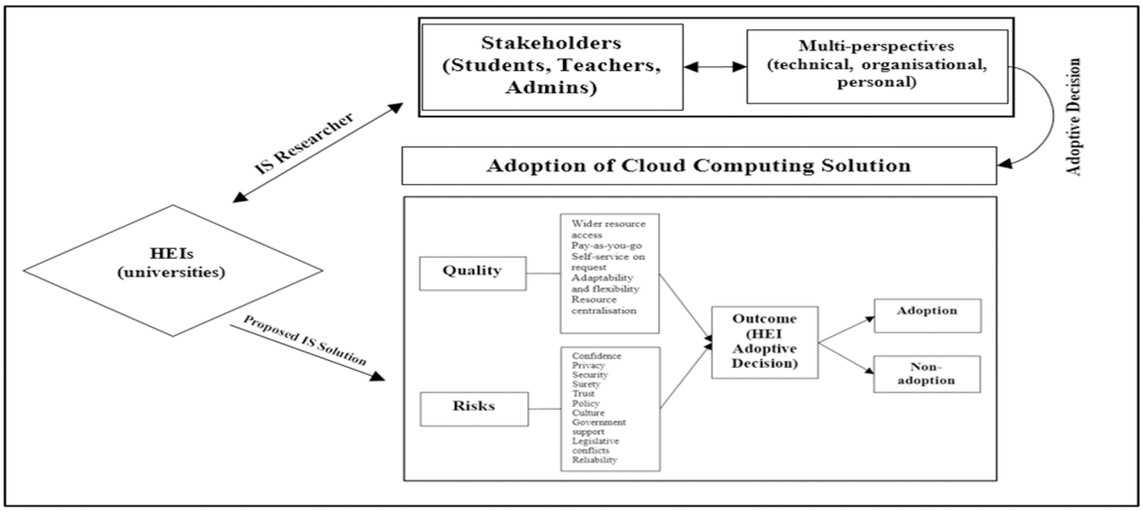
CONTRIBUTION

This research bridges between technological innovations, IS adoption and development, and applied a multi-perspective theory (Bell and Wood-Harper, 2014) to an emerging technology, cloud computing (CC). In doing so, this research explored the quality and risks of CC from multiple perspectives as a means to determine whether such an innovative solution would be viable for educational settings, namely UK HEIs or Universities. This research also aimed to conceptualise CC adoption and development to determine which quality and risks influence adoption and non-adoption in UK Universities. Further, this research provided a literature review of existing qualities and risks of the cloud to address the current literature gap. A CC development framework was also proposed and then adapted based on the MV3 methodology. This framework facilitated the research process and to determine the key qualities and risks that influence the adoption or non-adoption of CC from multiple perspectives. The key components include multi-perspective determinants, namely technical (CC solution); organisational: (Universities), and personal (users i.e. students, teachers, senior management and administrators) and an assessment

Table 3. Quality and risks of the cloud from multiple perspectives

Component	Identified Sub-Component	Role	Perspective
Quality	Access to a wider network of computing resources (broad network access)	Students	Technical Organisational
	Pay-as-you-go (measured service)	Students	Technical Organisational
	Self-service on request (on-demand self-service)	Students	Technical Organisational Personal
	Adaptability and flexibility service (rapid elasticity)	Administrators Senior management Lecturers	Technical Organisational
	Resource centralisation (resource pooling)	Administrators	Technical Organisational
Risk	Confidence	Students Administrators Lecturers Senior managers	Personal
	Privacy	Students Administrators Lecturers Senior managers	Personal
	Security	Students Administrators Lecturers Senior managers	Technical Organisational Personal
	Surety	Students Administrators Lecturers Senior managers	Technical Personal
	Trust	Students Administrators Lecturers Senior managers	Personal
	Policy	Students Administrators Lecturers Senior managers	Organisational Personal
	Culture	Students Administrators Lecturers	Organisational Personal
	Government support	Senior managers	Organisational
	Legislative conflicts	Administrators Senior managers	Organisational
	Reliability	Administrators Students Lecturers	Technical Organisational Personal

Figure 3. Revised Research Model



of the quality and risks of the cloud to influence HEI and stakeholder decisions to adopt CC based on user needs and expectations (outcome).

SOLUTIONS AND RECOMMENDATIONS

The findings suggest that quality and risk considerations of the cloud has a significant impact on adoption in UK HEIs. Since privacy, security and trust is a major concern for potential new users of the cloud, it is recommended for service providers to develop new approaches that tackles these concerns, including establishing partnerships with local governmental agencies who specialise in information and communication technologies. Here, service providers will offer cloud-computing services, but only via local governmental agencies, which will be responsible for governance. This solution could potentially reduce consumers' security risks and concerns, and establishing trust in such services. Workshops and seminars could be established by service providers to raise awareness of innovations associated with cloud security to potential cloud users. In this research, beneficiaries or users refer to potential users such as students, senior managers, lecturers and administrators. With respect to privacy, service providers should highlight their approaches and strategies transparently to combat data privacy to users. One solution is to enable customers to host their own data and applications in their own private data centre. Another solution could be to develop a data management or encryption system that would be integrated into the user's cloud. This system would encrypt data before it is transferred to the cloud and when the user wants to access this data it will be temporarily decrypted. Considering the above solutions could help to build users' trust in CC and thus potentially increase the uptake of cloud adoption in HEIs.

FUTURE RESEARCH DIRECTIONS

Future studies could take the findings of this study and apply them to other countries around the world. A comparative study of the quality and risks of CC in HEIs in developing and developed countries would help to distinguish between different stakeholder needs and expectations of the cloud as a means to facilitate the IS development process. In addition, investigations into the more personal perspective are needed as it was discovered that individual trust was also a determinant in CC adoption, as it was found that there is a potential trust issue among providers of cloud services. An exploration into the trust relationship between cloud providers and HEI stakeholders is needed and may yield some interesting findings. It may also help cloud vendors to market or advertise their services to ensure that the quality services they provide can be trusted, which in turn could entice potential customers such as HEIs to adopt their services. Therefore, these recommended studies will help future authors to conduct research on multiple case HEIs to obtain broader perceptions of CC in different countries around the world.

CONCLUSION

This study to the authors' knowledge is the first to explore the determinants of CC adoption by HEIs in terms of quality and risk determinants from multiple perspectives.

The key quality determinants reflected the essential characteristics of the cloud, such as access to a wider network of computing resources, pay-as-you-go service, self-service on request, adaptability and flexibility (rapid elasticity) and resource centralisation. Whereas, confidence, privacy, security, surety, and trust were identified as the risk determinants of the cloud. Understanding the impact of these determinants can support multiple stakeholders, such as students, lecturers, senior managers and administrators in their adoptive decision of CC in their respected institutions.

Security was highlighted as a key determinant to non-adoption as safeguarding sensitive information is vital in the cloud and the participants appeared unconvinced about the cloud achieving this. Therefore, trust was another key determinant to non-adoption. However, determinants to cloud adoption included the cloud having the potential to improve relationships between students and teachers via collaborative tools. Students even proposed cloud apps for mobile devices for accessing virtual learning materials and email securely off-campus. Meeting these expectations appear to be a convincing argument for cloud adoption.

One limitation was limited cases. This research was conducted using only two UK Universities. The research could have benefitted from more cases to obtain more generalised data and broader perceptions of the quality and risks of CC adoption from multiple perspectives. Based on this limitation, the research did not fully capture multi-perspective view of CC quality and risks in UK HEIs. It is important for future studies to address these limitations.

In conclusion, it can be deduced that HEIs are in position to adopt multiple cloud solutions. For example, e-mail and virtual learning services and online collaboration tools and learning management systems to facilitate the teaching process and to build student-teacher relationships. However, the existing security and privacy determinants of the cloud still represent a real concern for stakeholders and will more than likely reject the technology, which in turn leaves them at a crossroad. Future studies may help to steer stakeholders' decision to adopt the cloud as the technology develops in the coming years.

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KEY TERMS AND DEFINITIONS

Cloud Adoption: The potential acceptance or rejection of CC.

Cloud Computing: A ubiquitous tool that utilises remote servers over the Internet to store, manage, and process data.

Confidence: Users' willingness and readiness to use and accept CC.

HEIs: Institutions of teaching, learning and research that provide a host of college and University level undergraduate and postgraduate courses.

Multiple-Perspectives: Analysing CC through a multiple perspective lens, namely organisational, technical, and personal.

Privacy: Maintaining the anonymity of users' sensitive information hosted on the cloud.

Quality: The key characteristics that add value to cloud services.

Risks: The barriers associated with the adoption of cloud services.

Security: The protection of users' sensitive information hosted on the cloud.

Surety: Uncertainty about a cloud solution delivering its intended purpose.

Trust: User acceptance of the cloud solution based on having full confidence in the technology.

Chapter 2
A Comparative Evaluation of ERP Implementation Factors in Higher Education

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ABSTRACT

Extensive research has been conducted in identifying the critical issues and the implementation challenges involved in an ERP project in higher education. But limited studies investigated the implementation issues in the context of higher education institutions. The authors attempt to observe and compare two different higher education institutions in South Africa and India with the objective of bringing out the practical determinants of roadblocks to a successful ERP project implementation and subsequently provide the readers with possible solutions. The findings suggest implementation issues broadly evolve from three major areas, namely, project management issues, which involve the technical as well as the functional aspects; issues concerning the improper application of software development life cycle phases; and human capital issues which involve beliefs and attitudes. The authors strongly believe that the learning received from the case studies significantly contribute to the organizational knowledge concerning technology and business process reengineering.

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INTRODUCTION AND LITERATURE REVIEW

The study considers the implementation of Enterprise Resource Planning (ERP) in different business functions of an organization. The ERP system has become the pillar of IT industry in most medium and large scale organizations across the world (Morton & Hu, 2008). ERP can be considered as a company-wide data framework that incorporates all parts of the business. It guarantees that there will be a single database, single application, and a unified interface across the whole enterprise. It is advantageous for the organizations as it promotes quick response to market opportunities, adaptable product configurations, reduced stocks and improved supply-chain links, etc. (Bingi et al., 2006). Considering the evidence of the positive impact of ERP for a business enterprise, the challenges remain on successful implementation of ERP in different contextual business functions. Some concerns regarding the ERP implementation are as follows: Lack of commitment from top management, Business Process Re-engineering and integration with other applications, Absence of competent ERP consultants, Time-consuming implementation, and High fixed and operational costs (Bingi et al., 2006).

Let us first understand the literature in brief. Schlichter and Kraemmergaard (2010) conducted a thorough literature review that comprised 885 peer reviewed articles on ERP from 2000 to 2009. The classification of papers was based on a number of relevant factors such as research discipline, research topic, and research methodologies. The most important finding associated with the synthesis of literature was the division of subject areas in the context of ERP. Therefore, the literature was divided into seven specific areas: implementation, post implementation, organizational change and managerial implications, training and education, the target market of ERP in the industrial context, supply chain management, and the ERP system as a separate entity. The earlier literature review papers either lack conceptual frameworks or have considered frameworks from the IS literature only. It is crucial that research on ERP be observed also through the lens of other disciplines. Amani and Fadlalla (2016) bridged this gap by conducting a literature review of 543 articles published from 2000 to 2014 on the basis of a marketing conceptual framework (Macinnis, 2011), which ensured a knowledge-centric approach for gathering insights from a macro-level perspective. Very few papers combine the multi dimensionality nature of ERP systems, which is more relevant upon viewing through the lens of project management. To elaborate further, Wickramasinghe and Gunawardena (2010) discussed the determinants that differentiates a successful project from an unsuccessful one. The key findings have been user involvement, project management, testing and troubleshooting, software development, etc. However, discussing about ERP projects, they tend to talk about these micro level factors on a generic level. For example, Laukkanen et al. (2007) discussed in depth about the key issues of ERP implementation with increase in the firm size. Similarly, Alshawi et al. (2004) conducted a case study showing how the diverse ERP system implementation in the form of customization presents a challenge to the ERP consultants. Soja (2006) extended the same view and provided a detailed account of the ERP implementation success factors from the world of practitioners.

Although studies have been carried out in different business contexts (Almajali et al., 2016), probably none of the studies has conducted a comparative analysis of the success and failure of the ERP implementation in two different countries. This paper argues that a good comparison can only be made upon comparing two similar projects in different environments. The authors considered the higher education sector as their research sample, primarily for two reasons. First, to the best of knowledge, very limited research has been conducted in the context of ERP implementation in higher education (Abugabah & Sanzogni, 2010; Abugabah et al., 2015; Noaman & Ahmed, 2015), especially related to comparing projects implemented across different nations. Second, the reports suggest that the higher education

sector displays a void in professional management and effective leadership, owing to its size and the importance it generates for societies and individuals (Ernst & Young LLP, 2013).

The success or failure of any ERP implementation project is dependent on three factors—people, processes, and technology. The implementation of enterprise technology requires to instigate considerable change in the existing organizational culture (Al-mashari & Zairi, 2000). While both the technology and business processes are critical to the success of ERP, the employees will bring about change in the system. Several dimensions surrounding the role of management and employees lead to the success of an ERP project. Some of the deliverables from the organizational point of view are the top management support, scrutiny of the implementation project team with focus on the key inputs from the different departments of the organizations, etc.. Therefore, objections and agreements are bound to occur due to business process reengineering, which in turn forces the intervention of top management team, thus resulting in changes in the corporate culture. With regard to the business processes, organizations are constantly changing their business environment due to globalization and changing needs of different business functions. Hence, companies need to constantly automate or integrate the existing systems to fulfil their current needs. Therefore, it becomes crucial for organizations to be specific in communicating the exact needs of different departmental modules to the ERP implementation team, which often leads to customization of different ERP modules to satisfy different customers. Hence, this study observes that organizations (people) ensure that their new requirements (process) are in place with the help of the ERP module (technology). This flexibility (customization) and utility (manufacturing, services, etc.) of such technology play a crucial role in selecting the correct ERP system.

This study achieves three purposes: First, comparison of two ERP projects in BRICS (Brazil, Russia, India, China and South Africa) nations—one is a successful project and the other is a failure. Second, the comparison will result in adding relevant literature to the ERP implementation framework in higher education sector. Last, the study will highlight organizational factors, user related factors, process related factors contributing to the failure of ERP project in India because there are scant literature regarding ERP failure in the developing countries (Hawari & Heeks, 2010).

BACKGROUND: IMPLEMENTATION OF ERP IN HIGHER EDUCATION

The literature concerning ERP implementation in the higher education started in the early 2000s, but the growth of the same has been limited over the past decade. Beekhuyzen et al. (2001) introduced one of the first few studies on ERP adoption in the Australian Universities. The focus of the paper was mainly to highlight the rate of adoption of ERP systems in the Australian universities. Pollock and Cornford (2001) discussed the process of implementing ERP adoption in a particular institution in the United Kingdom. The study further gave due importance to the role of customization of ERP modules based on the institution's unique set of internal processes. The paper utilizes the actor-network theory to define the various closely connected systems (people and processes) in a network. The struggles of these "actor-networks" decide whether the implementation is successful or not.

King (2002) conducted a detailed survey on 481 respondents from EDUCAUSE[1] member institutions for capturing the reasons behind educational institutions' investment in ERP. The major issues emerging from the respondents are: resistance to change factor in adopting ERP systems, lack of customization ability of certain ERP packages, lack of understanding of software capabilities, lack of internal expertise in understanding and handling the ERP interface, and misalignment of business processes and software

deliverables. Pollock (2004) demonstrated that while implementing the ERP systems, it is vital to customize the systems owing to the uniqueness of the organization. There are studies in the ERP implementations in higher education. Fisher (2006) examined staff perceptions about the implementation of the ERP systems in three Australian Universities. Similarly, Mehlinger (2006) found that organizational culture has little or no impact on the successful implementation of ERP systems. Most of the studies in the ERP literature have focused on finding the critical success factors behind the implementation of ERP system. However, Bhat et al. (2013) is probably the only study on the Indian education institutions that pertain to the ERP implementation from a user perspective. The findings include lack of IT exposure of the administrative staff, lack of implementation support and vendor experience in the Indian IT market, and lack of IT management capabilities in the higher education institutions in India. Okunoye et al. (2014) focused on the need to address the ERP implementation projects from the perspective of stakeholder. Therefore, the stakeholder theory is taken as a means to determine various influences of different stakeholders in deciding the success or failure of such projects. Alqashami and Mohammad (2015) presented a set of guidelines and framework to help the higher education institutions in managing the issues and obstacles related to the ERP systems, and in this attempt, they further explained the critical success factors that will help practitioners to implement the ERP projects in Saudi Arabia. Soliman and Karia (2016) discussed the status of ERP implementation projects in Egypt by highlighting the risks associated with ERP projects.

THEORETICAL LINKAGES

Previous studies have depicted that a project can exceed the implementation time mainly because of four factors, which are organizational, social, psychological, and project based (Staw & Ross, 1987). The term used for referring to increase in the implementation time is escalation. Typically, escalation occurs mainly during the implementation of software projects. The escalation of a project may raise the budget limits, which may put more constraints on the resources dedicated to other projects (Keil & Flatto, 1999). Few researchers have also termed escalation as commitment to pursue the project, despite the challenges faced during the course of the project implementation (Keil et al., 2016). According to the goal setting theory, clarity, commitment, and continuous feedback mechanisms must be made available before initiating project implementation. To restrict and avoid escalation, the management can set specific targets for budget as well as provide a schedule to help the planning committee.

Psychologists have proposed two types of motivational theories, namely, intrinsic motivation and extrinsic motivation. A person is intrinsically motivated as he or she does something for himself or herself, whereas, a person is extrinsically motivated as he or she does something to achieve a goal. One of the crucial reasons for an organization to undertake a new project is to derive successful outcomes after implementation of the project. The prediction of outcome motivates an organization for undertaking the project. The lack of motivation among the top management arises tendency among employees to resist the adaption to the new system implemented in the organization (Erwin et al., 2010). A Deloitte and Touche survey performed on the 400 organizations concluded that resistance to change among employees is the primary reason for the failure of new organizational initiatives (Prochaska et al., 2001). The Technology Acceptance Model can help in overcoming the resistance to change by highlighting the usefulness and ease-of-use of the new initiatives taken by the organization. Employees can be made aware that the new

system would reduce their effort and further enhance the work process leading to improvement of his or her job performance (Venkatesh, & Davis, 2000).

On feeling motivated, the top management encourages implementation of the new system in an organization and would be in touch with the project development team and follow up the progress and provide feedback to the development team during the project implementation cycle (Boehm, 1988). Thus, the system will be gradually implemented in different stages, and each stage can be subjected to proper review and feedback. Further, the employees of the organization or the end-users of the system can provide reliable user feedback. By the time the system becomes operational, the end users are well aware of the functioning of the system. This is particularly useful in case the project to be implemented is big and the implementation cycle is divided into phases. After successful review and implementation of one phase, the developer can proceed toward implementing the next phase (Rajlich & Bennett, 2000). During implementation of a new system, iterative feedback will prevent occurrences of errors after full implementation of the system.

Another aspect on which this study focuses is the agency theory within the context of ERP implementation (Basu & Lederer, 2004). Let us consider a situation where the consultant is the agent and the client is the principal. Most researchers often describe the principal-agent issues in the context of information asymmetry, which essentially means that the agent possesses some private information about the product or service and the principal is unaware of the same. Therefore, it becomes important for the ERP clients (principal) to select those consultants (agents), who act on behalf of the client. For example, the agents may customize the ERP modules based on his competence level and may not inform about the minor flaws to the principal at the time of customization. In the absence of adequate project monitoring, the principal may neglect such behaviour from the agent but will suffer project delays and rework at the end. Therefore, the agency theory in ERP states that the pre-qualification effort (selection of proper vendor/agent to avoid adverse selection), effective project monitoring (to avoid moral hazard), and incorporation of incentive/penalty structure in the contract design will decrease the chances of ERP implementation failure.

Therefore, it would result in the motivation of connecting the Governance Theory perspective in the case of ERP projects (Niehaves et al., 2016). The framework provides lists of the various agents involved in the decision making process and the potential pitfalls or failures may arise in case certain designs are not followed by those actors. For example, the framework highlights the ways in which the ERP steering committee proves to play a vital role in ensuring that the different customization modules are in line with the business context of the organization. It also highlights that ERP steering committee should be reinstated early in the project for avoiding such misalignments in the module.

Another vital and relevant theory that needs attention is the Diffusion of Innovation theory (Rogers, 2010). Every project is unique, and the successful implementation of the same not only requires customization but also requires innovation from various stakeholders. ERP implementation is, therefore, no exception. The diffusion of innovation model explains 28 attitudes in five characteristics, which are required for successful diffusion of the innovation. Let us mention the important characteristics and the ways in which these characteristics may influence ERP implementation at workplace (Akca & Özer, 2014). Based on the five characteristics, our paper presents the following arguments:

- User Satisfaction is a significant contributor to ERP success.
- Technical Capability of the consultant as well as the client can lead to successful integration of different ERP modules in the system

- Re-engineering capability is a positive contributor to the success of ERP.
- Top management support is vital for the effective ERP implementation and successful ERP integration in the future
- Training of employees regarding ERP modules increases the productivity of the employee and decreases the user resistance to technology adaption

Research Methodology

Following a case study approach (Pan & Tan, 2011), in this paper, the authors aimed to highlight the conditions and the reasons behind the success or failure of an ERP implementation project by observing the same industry in two different environments. Specifically, the authors adopted a cross case analysis to understand and document the learnings associated from each case. A cross-case analysis is a research method, which synthesizes the knowledge acquired from various case studies (Rasuli et al., 2018; Stronge et al., 2011; Khan & VanWynsberghe, 2008). Past literature has shown that the ERP implementation research utilizes the cross case analysis as an effective tool for highlighting the post implementation and pre-implementation journey of ERP (Kouki et al., 2007; Muscatello & Parente, 2006). In addition, numerous studies on the education sector has been conducted through the medium of cross case analysis for capturing and disseminating various solutions to the pressing problems in the education sector (Cooper, 2014; McWhorter et al., 2013; Viberg & Grönlund, 2013; Rodríguez et al., 2010)..

The names of the companies were disguized for the sake of confidentiality. Pseudonyms were used intentionally for individuals involved in the project to keep their identity anonymous. In this study, the duration of observation for the first project in South Africa was a period of 23 months (October, 2010 to September, 2012); and the duration of observation for the second project in India was 31 months (October, 2012 to May, 2015). The data included information collected through customer site visits as an employee of the organization and certain critical lessons were learned by attending project review meetings.

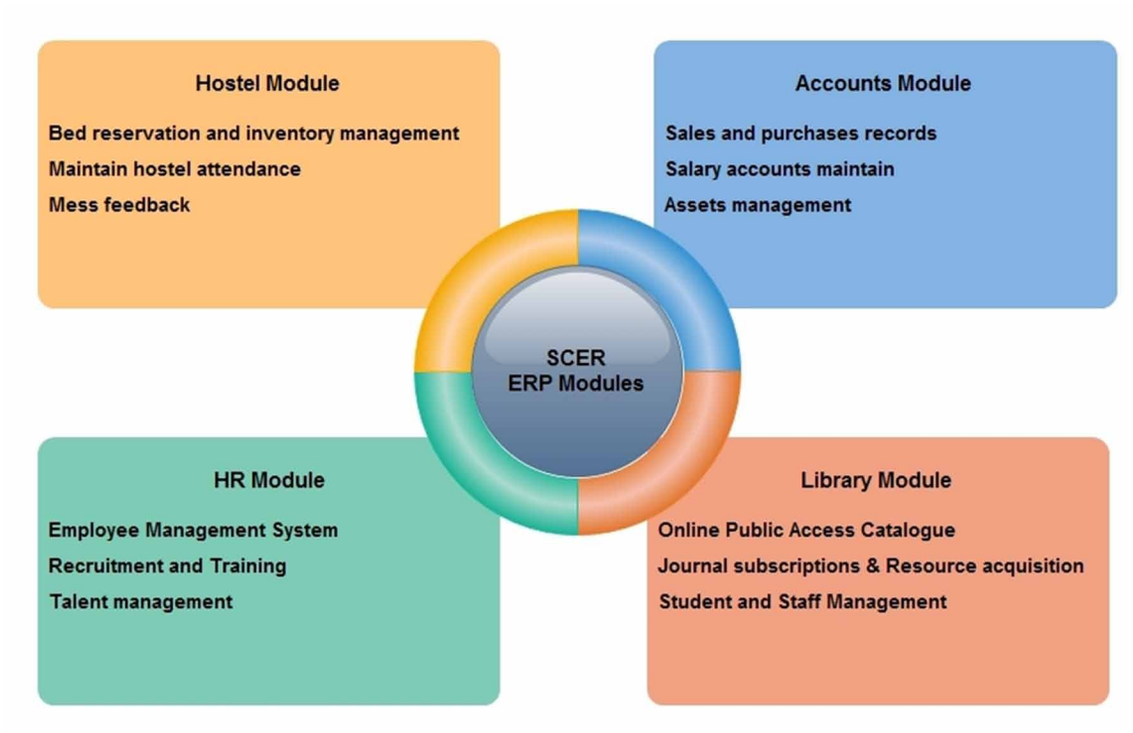
Company Background

Shawn Centre for Education and Research (SCER), Cape Town, South Africa, established in 1922, is a public research institute situated in the central Cape Town. The University is spread across five campuses with the main administrative campus in the East. To maintain coordination and transparency in the functioning of the large number of departments in SCER, the executive committee of SCER decided to go for Enterprise Resource Planning (ERP) for automating and integrating different departments in the University. Several ERP modules (**Figure 1**) were developed during the ERP implementation project of SCER, which was undertaken by Nylon Business Consulting (NBC).

Nylon Business Consulting (NBC), founded in 1968, is a multinational information technology service provider with headquarter in Mumbai, India. Its branches are spread across 46 countries with employee strength of around 353,843. It offers services in Business Processing, Digital Enterprise, IT Services, and Enterprise Solutions.

Pithampur University (PU) is a public business school located in Bhopal, Madhya Pradesh, India. The University was established in 1984, and it is one of the leading B-schools in India. PU offers graduate and post-graduate programs in the area of business administration. In view of the large number of candidates applying to the Institute each year, PU decided to introduce ERP as a mechanism for automating

Figure 1. ERP modules for Shawn Centre for Education and Research (SCER)



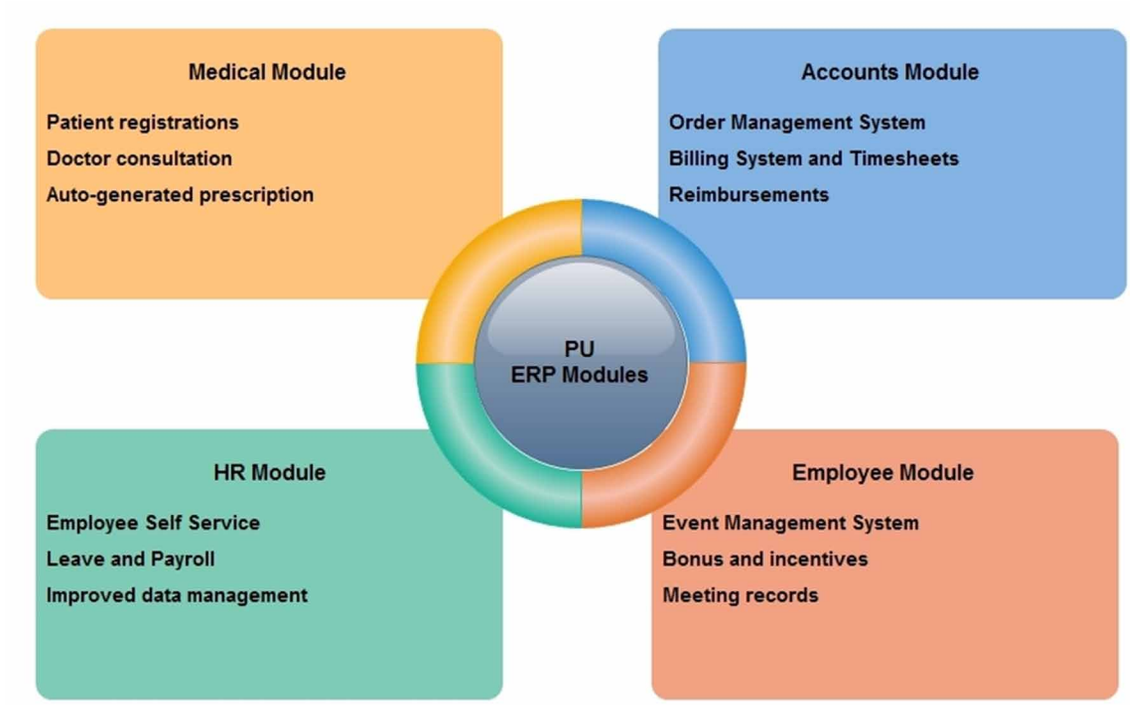
the admission process to shortlist the candidates eligible for admission in PU based on certain selection criteria. Further, the Institute decided to upgrade and optimize its existing departments. Consequently, the institute requested the help of potential consultants for effective management of different ERP modules (**Figure 2**). Finally, the ERP implementation project was awarded to Silverline Technology Solutions (STS).

Silverline Technology Solutions (STS), established in 1998, is a multinational professional service provider with headquarter in London, United Kingdom. It has a network of offices in 157 countries and 756 locations with employee strength of more than 208,109. The major offices of STS are located in London, Cairo, Frankfurt, Los Angeles, Peru, Melbourne, Norway, Tokyo, Poland, Madrid, and Auckland.

CASE BACKGROUND

In this section, the two separate case studies are discussed in brief. The first case discusses the progress of ERP implementation in Cape Town, South Africa, where the client is SCER and the ERP implementation consultant is NBC. The second case highlights a similar ERP implementation project in Bhopal, India, where the client is PU and the consultant is STS. There are several ERP system vendors in the market; some of the crucial vendors are SAP, Oracle, J.D. Edwards, and Baan. This case focuses on Oracle's ERP product as a leading example of the ERP system implementation.

Figure 2. ERP modules for Pithampur University (PU)



SCER and NBC

SCER follows an existing legacy system[2] that was developed by different vendors. The main objective of this system was to automate the day-to-day activities in departments such as student administration, employee administration, finance, etc. However, the major drawback was that the different departmental systems were not integrated; hence, the information flow was manual, which led to information loss and delay. Hence, there was an urgent need of integrating all the departments, which could be achieved only by installing a new software product. In such a scenario, the top management of SCER had to ensure that the new product have the provision of integrating all the departments. It is convenient that the consultant in an ERP implementation project initiates a systematic procedure to acquire user requirements. NBC knew that SCER, being a higher education institute, would have to focus on mainly three activities, namely, admissions, administration, and accounts. A brief discussion of various issues pertaining to each department is given as follows.

In the admissions department, the basic function was to ensure smooth monitoring of incoming students from academic standpoint. SCER had two specific performance metrics for the students in various disciplines; these two metrics were the 'Academic Index' and the 'Composite Index'. The merit list of each candidate was based on these indices. The rationale behind these indices included several intermediate formulas, which were not only time consuming but also had inherent risk of mistakes occurring due to manual operations. In their existing legacy system, no such functionality exists. Therefore, an additional Student Self Service Module requirement was present, which ensured that marks, results, and other personal details could be properly uploaded and reviewed by the department.

In the administration department, the major concern for relevant stakeholders was to manage meetings both inside as well as outside the campus. It became a different challenge, as the client needed a functionality that would record and document the agenda as well as minutes of the meetings, and full details of the individuals who attended the meetings. This was unique to SCER owing to its large size in terms of the number of departments and academic programs.

In the accounts department, two issues needed immediate attention. One issue was improper information flow between accounts department and admissions department ranging from the mapping of student details to individual fee submission.

The second issue was the need to capture the travel details of employees, which was again a cumbersome task owing to the size of the client organization. The accounts department requested the client for automation of the travel booking and integration of ledger handling in the accounts module.

NBC collected all the information and the following outcomes were achieved:

1. During the admission process, it was necessary that aspirants should be able to apply through their website, but they must not be allowed to access the ERP directly. Vanilla ERP[3] system was capable of capturing all the details of the aspirants. However, the ERP team integrated the SCER website with their integrated system to prevent direct exposure of the ERP system to the aspirants.
2. The admissions department demanded certain reports in the leave module, which were not present in the Vanilla HR module of the ERP. However, all the other leave functionalities required by SCER were present in the Vanilla ERP. Therefore, to fulfil the preparation of specific reports related to the leave module, the requirements were taken from the department.
3. There was a requirement of Library module in SCER, which was run by legacy software. However, this module was not available in Vanilla ERP. Hence, a fully customized module was developed by considering the requirements given by the library personnel (Library Head).
4. The accounts department also had certain requirements such as preparation/capture of ledgers, journals, etc., which were mapped directly to the Vanilla finance module of the ERP. Hence, no customization was required for the same.
5. Through the student self-service module of Vanilla ERP, the students could apply for leave and the full leave approval process could be completed online. However, no modification or extra customization was required for the same.

PU and STS

PU, like SCER, also faced similar concerns regarding the need to improve different departmental functions within the organization. The only way of enhancing was to integrate the various departments with the objective of amplifying information transfer across departments and to reduce manual work within the organization. After carefully analyzing the information system, the top management of PU decided to adopt an ERP package. In the accounts department, the problems faced by the team were similar to the problems observed in SCER, which was evident from the similarity of both the organizations in terms of business objective. PU also faced issues related to improper mapping of student details with their fee submission details. Mr. Sanjay Karmakar, the admissions officer, emphasized on the need of an online attendance system, and Mr. Swaroop Saxena, the administrative officer, stressed on the need to automate leave of absence workflow.

PU had formed a steering committee to look after the implementation of the project. The steering committee advised the STS team members to gather relevant information and requirements from the respective department heads or end users. The client team demonstrated the Vanilla ERP modules to the respective departments and subsequently conducted a fit-gap analysis. This is a typical process of requirement gathering and STS finally collected all the requirements. Some of the important outcomes are given below:

1. In the accounts department, they were preparing ledgers for different vendors. Though the requirements were matching with the Vanilla ERP finance module, some of the reports, such as vendor-ledger report showed details of the ledger against each vendor as required by the user, were not available.
2. In the Vanilla ERP Campus Solution (CS) module relating to attendance, the requirements were mapped without any customization.
3. Through the Vanilla HR module of the ERP, they recorded leave and flow of information from employee to supervisor and supervisor to respective heads. But there was requirement of an "outstation permission" sub-module that must be incorporated as per user requirement, and it was a minor customization.
4. Some standalone modules had to be developed, and one of these modules was employee-benefit allowance. On the basis of the performance of the employee, a monetary benefit was attached every year.
5. In the Vanilla ERP finance module, a direct map was implemented for capturing fee submission from students and the flow of subsequent information to the admissions department.

LESSONS LEARNED

Given the complexity of different business functions, firms faced many contextual challenges, which prod them to devise solutions by catering to individual needs. However, there are several challenges that are generic, irrespective of the industry in which they operate. Our case study demonstrated the ways in which institutional culture plays an important role in determining the success or failure of a project. This study further indicated the importance of different stakeholders in implementing the ERP system in an organization. Therefore, in this work, the authors classified the lessons learned into five broad areas, namely, project management issues, human resource issues, behavioural issues, technical limitations concerning ERP module, and improper application in the different phases of Software Development Life Cycle.

First, the ERP implementation may exceed the budget and time limit expectations of various stakeholders. Organizations opting for the ERP implementation must be prepared for such circumstances, which can be explained through a particular instance. Mr. Singh, the Head of Accounts Department in PU, had given the requirements for accounts receivable module. All the functionalities needed were already available in the Vanilla ERP product. However, later on, Mr. Singh realized that the department would need some extra ad-hoc modules, which the existing Vanilla ERP product failed to generate. To achieve the extra functionalities, the ERP team had to change some configurations in the Vanilla ERP product, which resulted in extension of the project completion time. However, Mr. Jonathan, the Head

of HR Department in SCER, had consulted with all the employees of the HR department and listed all the required functionalities in detail before submitting the requirement specification for the HR module.

Second, if ERP implementation is required to improve the existing work processes, the top management must be internally motivated to implement ERP in their organizations (Amoako-gyampah & Salam, 2004). The lack of internal motivation at the top can lead to conflict of interest between the client and the vendor. The vendor team approached Mr. Rakesh, the representative of accounts department and a member of ERP steering committee in PU, for finalizing meetings between the head of accounts department and the ERP team; however, he failed to do so in the agreed time. In the case of SCER, Mr. Bob, the member of ERP steering committee and representative of the accounts department, prepared a calendar of meetings between the accounts department and the ERP team in advance and used to monitor and record the takeaways from each meeting, which facilitated a smooth progress in the implementation.

Third, one of the biggest issues that organizations face while undergoing change is employee resistance to change (Aladwani, 2012; Amoako-gyampah & Salam, 2004). For instance, as the ERP team consulted Mr. Shekhawat, the payroll department executive in PU, for any meeting to discuss the payroll module, he would often reschedule the meeting to a later time. He thought that upon implementation of the module, he would have to learn and adapt to the new technology. However, Mr. Chirst, the Hostel department executive in SCER, was actively involved in all the discussions related to his module and organized several user trainings for the ERP product among the department members.

Fourth, there could be certain end-user requirements that are not in-built within the existing ERP module. If the end-user or management are insistent on such kind of modifications, it leads to customization of the particular module, which can affect the other modules. For example, there was a personal data section in the HR module of the ERP for recording the students' personal data. But the fees submitted by the students were not mentioned in the personal data section. The fees details were documented in the Finance module. However, the HR department members in PU used to maintain the students' personal data and fees details on the same page of the register. Therefore, they wanted all the above-mentioned details of students on the same section of the HR module. To implement the above requirements, the ERP team had to customize the HR module, which resulted in several trivial customizations in the interlinked modules. On the contrary, the HR department members in SCER had no such complaints for achieving their department's functionalities.

Last, it is recommended that during the course of development of a particular module, the functional and technical teams from the consultant side should be continuously in touch with the end-users for their iterative feedback on the on-going development of the module. Therefore, while developing the employee-benefit allowance module for PU, the ERP team gathered the requirements at the beginning and held limited discussions during the development process. They presented the module to the concerned department after completely developing the module. After going through the module, the end-users of PU realized that the module had certain operational issues related to the functioning of the existing medical reimbursement process in PU. Therefore, the ERP team had to re-visit and modify the whole module. In SCER, during the course of developing the library module, the ERP team was in continuous touch with the end-users for their feedback, which facilitated the incorporation of all the suggestions and feedbacks during the development cycle itself. The authors summarized the lessons learned in **Table 1.**

Table 1. Comparison of the success and failure implementation factors of the case studies implied

Serial No.	Issues	ERP implementation by NBC in SCER	ERP implementation by STS in PU
1	Project Management Issues	All the employees of the HR department were consulted and the required functionalities were listed in detail. Therefore, all the functionalities needed in the ERP module were achieved within the expected time frame.	Project completion time extended as extra ad-hoc modules were suggested to the vanilla ERP after project completion by the head of the accounts department. The ERP team had to reconfigure the vanilla ERP which exceeded the completion time.
2	Human Resource Issues	A calendar of meetings between the accounts department and the ERP team was prepared well in advance. Takeaways from each meeting was recorded which facilitated a smooth progress in the implementation.	The ERP team faced a lot of issues due to lack of internal motivation and improper planning by the accounts department of PU. They didn't finalize the meetings between the head of accounts department and the ERP team in the agreed time.
3	Behavioural Issues	The hostel department executives were actively involved in all the discussions related to their ERP module and organized several user trainings for the ERP product among the department members.	Employees' resistance was high to switch to ERP. They were afraid of learning the new ERP technology for usage. Therefore, the payroll department executives in PU would often postpone the meetings with the ERP team to delay the progress.
4	Technical Limitations concerning ERP module	HR department members in SCER had no complaints after their ERP modules were delivered to them.	Several trivial customizations had to be done in the interlinked ERP modules upon the insistence of the HR department members in PU which lead to the over-customization of the delivered ERP modules. Now, the ERP team would face issues while upgrading to the higher versions of the delivered ERP product.
5	Improper application in different phases of Software Development Life Cycle	In SCER, during the course of development of the library module, the ERP team was in continuous touch with the end-users for their feedback. This facilitated the incorporation of all the suggestions and feedbacks during the development cycle itself.	The end-users of PU realized that the delivered module had certain operational issues related to the functioning of the existing medical reimbursement process. This occurred due to the lack of iterative feedbacks from the end-users of PU during the phases of the ERP module development.

CONCLUSION

Despite the emergence of several consulting firms involved in the ERP implementation for different industries, the idea of an ideal and proven process for successful completion of an ERP project remains illusory for many firms, particularly the educational institutes. The case study will provide some practical relevance for the educational Institute so that these institutes can better equip themselves for future ERP projects. The providers of ERP solutions and system integrators do not always understand the distinctions of higher education culture. Hence, the key stake- holders get isolated, which leaves the leaders in a disadvantageous position with respect to organizational change management. It is observed that higher education institutions would significantly benefit from implementing ERP within their business functions and further found that though ERP solutions are readily available on cloud, there are major factors like process mapping, change management, etc., which decide the success or failure of an ERP project. Moreover, the top management in higher education often views IT as efficient tool and ERP as back-office technology support; however, they fail to see the roles that IT and ERP have in capturing

the changing educational needs of modern time. This paper makes a modest attempt to introduce ERP implementation challenges in a completely different industry. Future research should focus on similar organizations to validate and generalize the findings of this paper and to develop an implementable approach for handling projects involved in technology adaption in business functions for cloud environment.

FUTURE RESEARCH DIRECTIONS

Our paper has certain limitations that open the avenue for future research. First, this paper does not take into account a dyadic perspective of client-contractor relationship toward ERP implementation. Future research could look into dyadic interviews between the operations team of the client and the consultant for capturing better insights. Second, this study lacks generalizability in terms of relevance of these factors in other emerging markets. Future research can adopt this study in different emerging markets and thus present a compare and contrast views to the findings of this paper. Third, our study lacks robustness in terms of understanding the educational systems of both the case organizations. It is needless to argue that different institutions will have different educational requirement and cultures, which severely affect operational issues that include designing of the ERP modules and its importance. Future research could take a holistic approach by incorporating and analyzing ERP implementation studies in higher education from the lens of organizational culture.

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ENDNOTES

1 EDUCAUSE is a higher education technology association and the largest community of IT leaders and professionals committed to advancing higher education.

2 The term "Legacy System" was a common jargon used by the Project Team members to refer an existing automated module already present in the client workflow

3 The term "Vanilla ERP" system refers to the non-customized package purchased from the ERP vendors.

Chapter 3
Automated Essay Scoring Using Deep Learning Algorithms

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ABSTRACT

The recent transition from paper to digitally based assessment has brought many positive changes in educational testing. For example, many high-stakes exams have started implementing essay-type questions because they allow students to creatively express their understanding with their own words. To reduce the burden of scoring these items, the implementation of automated essay scoring (AES) systems have gained more attention. However, despite some of the successful demonstrations, AES still encountered many criticisms from practitioners. Such concerns often include prediction accuracy and interpretability of the scoring algorithms. Hence, overcoming these challenges is critical for AES to be widely adopted in the field. The purpose of this chapter is to introduce deep learning AES models and to describe how certain aspects of the models can be used to overcome the challenges of prediction accuracy and interpretability of the scoring algorithms.

INTRODUCTION

High-stakes testing is in the process of transitioning from paper to computer-based assessment. While the initial transitions have focused primarily on administrative benefits, such as increased test security and flexible testing schedules, the more recent transitions are focused on the use of new item formats. For example, the National Assessment of Educational Progress (NAEP) introduced innovative item types—such as interactive scenario-based questions—with their new digital-based assessment environment.

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The purpose of these new item types is to provide more authentic assessment opportunities for students (NAEP, 2018). Such items often require students to express their understanding in a creative way using their own words, thereby, invoking higher-order reasoning and complex thinking skills (Scully, 2017).

With traditional paper-based assessment, selected-response items (e.g., multiple-choice questions) are often used because they are efficient to administer, they are easy to score objectively, and they can be used to sample a wide range of content domains in a relatively short time using a single test administration (Haladyna & Rodriguez, 2013; Rodriguez, 2016). Compared to essays and other written-response tasks, which are prone to subjective scoring and which require more time for recording answers, selected-response questions can be scored more accurately and they require students to spend less time recording answers.

However, written-response items do have many benefits. They provide evidence of students' composition and organization skills, grammatical knowledge, background knowledge, and analytic thinking and reasoning skills. Therefore, to promote the use of written-response tasks that can be used to evaluate student understanding in a creative and less restrictive way, overcoming such disadvantages stemming from scoring and administration procedures is critical in the digitally-based assessment.

Automated essay scoring (AES) was first developed to help overcome this scoring and administration problems by encouraging cost- and time-efficient marking procedures of written-response questions (Page, 1967). Traditional scoring procedures often consist of a minimum of three scorers to ensure scoring reliability and the fundamental idea of AES was to introduce a system to replace the third marker thereby saving time and money. Thus, the machine-replaced third marker can be trained based on how the scoring and grading was made by the other two human markers. To do so, the AES system has to identify deterministic linguistic features that human raters used to identify essay quality. Such features often include the length of essays, number of words, word usage, and sentence complexity. Then, the AES system attempts to learn a scoring pattern or a rule close to the human raters' using those features. When successfully implemented, AES can speed up the scoring process significantly. Moreover, it can bring several surprising benefits, such as improving the consistency of scoring and the possibility of providing instant feedback to students on their performance (Gierl, Latifi, Lai, Boulais, & De Champlain, 2014).

However, despite these potential benefits, traditional AES encountered many challenges that must be overcome before it is widely adopted in the field. Such concerns commonly stem from difficulties in selecting appropriate features and establishing the interpretability of the scoring systems (Zaidi, 2016). Selecting deterministic features directly connected to essay quality is laborious and requires tremendous amounts of linguistic knowledge. Moreover, as many commercial vendors concealed the information about features as proprietary information, AES frameworks are not accessible for most practitioners. In addition, the 'black box' nature of the traditional AES systems could not provide clear information regarding how the system arrives at the final scoring decision. Therefore, proper validation could not be made by human markers about the machine's scoring algorithms.

One of the promising directions in AES that may help address these drawbacks is the application of deep learning algorithms. Intuitively, deep learning aims to achieve more abstract and comprehensive associations among the features to achieve improved performance (Simpson, 2015). To do so, the algorithms connect input—student essays—and output—essay scores—using several "deep" layers compared to traditional machine learning. With the capacity provided by a deeper structure, these learning models can decide which features to extract without human intervention and learn comprehensive rules to make good score predictions. Moreover, because these algorithms are capable of learning features automatically in an end-to-end manner, it does not require extensive knowledge in linguistics to determine which features to include in the model (Williams & Zipser, 1989). Many studies conducted in the last decade

have demonstrated how deep learning models can be used to achieve high score predictive accuracy (e.g., Miklov et al., 2010; Kim, 2014; Dong, Zhang, & Yang 2017). Hence, we introduce the reader to how deep learning AES models actually work and to describe how certain aspects of the models can help overcome some of the current challenges of employing AES in educational assessments.

BACKGROUND

Recent studies have demonstrated that deep learning AES frameworks can be used to produce more robust results with better score accuracy compared to the traditional models based on machine learning algorithms (e.g., Taghipour & Ng, 2016). Moreover, unlike machine learning AES which requires extensive feature extraction for a score prediction, deep learning AES can directly take students' essays for scoring. To do so, deep learning AES models commonly accompany several data processing methods to enhance their prediction capabilities in conjunction with an appropriate selection of specific learning algorithms. To begin, the written responses are converted into machine-understandable numeric values using word embedding techniques. Then, several deep learning algorithms that are appropriate for text analysis are implemented and the prediction results evaluated. In this chapter we discuss some key variations of the word embedding techniques in AES, followed by a summary of several studies that were used to successful demonstrate the application of deep learning AES. The benefits of these applications to the practical use of AES will also be highlighted.

AUTOMATED ESSAY SCORING FRAMEWORKS

Representing Text Using Word Embedding Methods

Students' written responses cannot be used as text, instead, they must be represented in numeric values for the machine to process them. To convert text to appropriate numeric values while preserving its meaning, word embedding has been used for various natural language processing tasks, such as machine translation and essay scoring. Word embedding is a technique to represent a word as a real number or vector without losing its semantic relationships. For example, word embedding maps similar words, such as "occupation" and "job" into a similar vector space, so that they appear close to one another when visualized. Word2vec (Collobert et al., 2011) is one of the most popular algorithms for conducting word embeddings. Word2vec acquires numeric representations of a word by using neural network algorithms to predict the occurrence of the word based on its surrounding words. More specifically, the word "occupation" is provided as an input to predict the probability of that word to be nearby randomly chosen words, such as "ability", "able", "income", and "jobs". Then, we can directly store the network weights used for prediction in a vector to represent the word "occupation". In this way, Word2vec preserves the original meaning of a word using its relationship with other words.

Many techniques have been explored to train word embeddings that are more adapted for particular scoring problems with the foundation of *Word2vec* (Collobert et al., 2011). One of the successful adaptations in AES is the score-specific word embedding (SSWE; Tang, 2015; Alikaniotis, Yannakoudakis, & Rei, 2016). Given that the usage of certain words (e.g., is, are, at, in) are not directly related to the final score, the score-specific word embedding attempts to increase the performance of scoring by re-

flecting each word's connection with the final score in learning the embeddings. Several studies have demonstrated the power of using the score-specific word embedding in conjunction with deep learning algorithms to boost the scoring prediction power significantly (e.g., Alikaniotis, Yannakoudakis, & Rei, 2016; Miklov et al., 2010; Kim, 2014; Dong, Zhang, & Yang, 2017).

Predicting Scores Using Deep Learning Algorithms

Long-short term memory (LSTM; Hochreiter, 1997) networks and convolutional neural networks (CNNs; Hubel & Wiesel, 1962) are the most frequently explored approaches in deep learning AES. LSTM takes each essay as a sequence of word tokens and the unique architecture allows the model to either remember important features or forget redundant features to reach a final decision. Intuitively, certain input words that are completely unrelated to form a scoring decision would be removed from the memory space because they do not contribute to the final score prediction. Unlike LSTM, CNNs have been used for image recognition and therefore treat an essay as an image. CNNs work by learning an abstract representation of input by applying filters and then repeating the process several times. Both approaches have shown to increase the prediction accuracy, thereby, achieving indistinguishable performance from the human raters (Ng et al., 2014). That is, models are able to successfully capture sequential information from the written responses which was considered to be one of the critical errors that traditional AES models failed to be captured. Many recent deep learning AES studies have demonstrated their model performance using an open data set released as part of an essay scoring competition called Automated Student Assessment Prize (ASAP), which was held in 2012. Quadratic weighted kappa was adopted as the main evaluation metric and the winning team demonstrated the kappa score of 0.81 in 2012. But in 2016, for example, Alikaniotis, Yannakoudakis, and Rei (2016) achieved a quadratic weight kappa score of 0.91 using the score-specific word embedding and a single-layer LSTM using the ASAP dataset. Also, an additional traditional machine learning AES model was trained for comparison purposes and it could only achieve a quadratic weight kappa score of 0.75.

In addition, some studies have focused on investigating the performance of the two approaches: LSTM and CNNs. For example, Taghipour and Ng (2016) implemented and compared the performance of LSTM, CNN, and a hybrid model of the two approaches. Taghipour and Ng reported that the LSTM model could achieve the highest accuracy with a quadratic weight kappa score of 0.76. According to Dong, Zhang, and Yang (2017), a hybrid model of LSTM and CNNs could achieve even better results with a score accuracy of 0.76. The unanimous results, once again, indicated the importance of using appropriate word embedding techniques (e.g., the score-specific word embedding) for improving the prediction accuracy.

Understanding the Scoring Patterns in Deep Learning AES

While deep learning AES produces robust prediction results without any laborious feature engineering, the black-box nature of the algorithms still remains one of the critical areas of improvement. In fact, educational assessment is one of the key areas where both the final score results as well as a description of the procedures for scoring the results are equally valued in the essay evaluation. That is, an unexplainable learning algorithm invariably leads to skepticism and rejection from the practitioners and educators using AES because the scores are difficult to interpret (Hearst, 2000).

To address the issue of score interpretability, three approaches can be used to uncover and understand the scoring patterns in deep learning AES. The first approach, called trait-specific essay scoring, can be used to increase diagnostic properties of deep leering AES. Trait-specific scoring refers to analytic scoring, where separate scores are given for each noted criteria or component instead of an overall score. By providing specific component scores, students can understand and focus on certain areas to improve their writing. Previous studies highlighted the importance of providing qualitative and constructive feedback, rather than binary feedback (i.e., correct/incorrect) to effectively encourage learners and help improve their performance (Bangert-Drowns et al., 1991). In traditional machine learning approaches, trait-specific scores were generated by extracting certain essay features that are empirically and theoretically related to specific traits, such as essay organization, grammar, prompt adherence, word choice, and the strength of the argument in the writing (Wachsmuth, Al Khatib, & Stein, 2016; Persing & Ng, 2015). However, in the deep learning AES frameworks, such writing traits could be captured very effectively without any feature engineering. For example, Taghipour (2017) demonstrated how argument strengths and essay organization could be captured using recurrent neural networks. The benefits of the trait-specific scoring approach come from its simple and straightforward idea and it is highly accessible as long as the trait-specific scores are separately given to train the AES model. The drawback of the trait-specific approach is that it does not disclose the hidden structure of the algorithm and is not sufficient to provide scoring rationales or validation to human raters.

The second approach, called visualization of the features, is used to evaluate pivotal features in scoring algorithms (Alikaniotis, Yannakoudakis, & Rei, 2016). The visualization approach works by identifying and visualizing the location of input words that are meaningful to understand the scoring system. For example, if the words and phrases that are pivotal to the final scoring decision are provided, they could be used as good validation evidence of machine scoring. Two methods have been explored for feature visualization: sensitivity analysis and layer-wise relevance propagation. A sensitivity analysis attempts to find 'noisy' inputs that distract the model from making a clear prediction using sensitivity analysis (Baehrens et al., 2010; Simonyan et al., 2013). To do so, it quantifies the importance of each input variable by looking at how sensitive the output variable is to the changes in the input variable. For example, in essay scoring, if changing certain words does not significantly affect prediction accuracy, then the words would be categorized as 'less important' according to the sensitivity analysis. As an alternative, one could attempt to locate input features that played deterministic roles in final scoring using a layer-wise relevance propagation (Bach et al., 2015). Layer-wise relevance propagation locates deterministic features that are pivotal to the final scoring. Simply put, the first method focuses on how much changes in the input feature could affect the prediction results, while the second method focuses on how much each input contributes to the final prediction. Zaidi (2016) demonstrated the application and benefits of using the visualization method to uncover scoring patterns. The purpose of the study was to visualize four categories of input words–the lowest quality to the highest quality vector. For the word to be considered a 'high-quality word', one would expect that there to be a minimal adjustment to the weights to predict the highest score possible. The results indicated that the method not only detected superficial word mistakes but also complicated contextual information. The results also indicated that the models could not effectively locate and visualize words to obtain sequential information from the essay, such as a subject-verb agreement.

The third approach focuses on directly uncovering scoring rules using a rule-based approach called 'a fuzzy inference'. A fuzzy inference system allows for complex problems to be approximated into simpler rules using if-then statements. The fuzzy inference approach allows human raters to incorporate

their hypotheses and beliefs about the connections between the input and output variables in algorithm training. Incorporating such unique property with the deep learning AES, the idea is to use the feature selection power from the deep learning algorithm and evaluate the hypothesized scoring rules using the fuzzy system. David et al. (2017) introduced a hypothetical system using the approach where features would be extracted using the deep learning algorithm, then the simple correlation between the feature and the output is evaluated. The features are used to model hypothesized scoring rules and evaluate the prediction accuracy. In the case of AES, after locating and extracting input texts in the first stage, they would be used to form human-raters' scoring rationales and patterns. Simple rules such as, 'if word choice is poor or too many spelling errors are found, then the score is low' can be evaluated using the approach. Because the approach incorporates human knowledge with the prediction power of the machine, one could expect fewer concerns about scoring validation.

SOLUTIONS AND RECOMMENDATIONS

Practical Considerations to Employ Deep Learning AES

Deep learning algorithms can be applied to various essay scoring tasks in order to overcome the previous challenges that traditional AES frameworks have encountered. We described how the developmental frameworks of deep learning AES could improve the laborious feature engineering, improving scoring accuracy, and enhancing the scoring transparency of the automated essay scoring. However, one practical challenge of implementing deep learning frameworks, which has not been discussed so far is securing a large number of essay responses. More specifically, due to a relatively complex structure, deep learning AES often require significantly large sample sizes to properly train the system. For example, a minimum of 1,000 responses is recommended for scoring essays of 250 – 300 words using deep learning approaches (Shin, 2018). While this recommendation could be perceived as a great hurdle to readily apply deep learning AES, one alternative approach is to use the previous year's responses to extend the training sample. Many high-stakes exams include essay responses where the same scoring criteria could be or have been applied to score essays from previous years. As long as the comparable scoring criteria have been applied, the previous responses could be accumulated and used to train the system. For example, the National Certification of Educational Achievement, which serves as a high school diploma exam in New Zealand, provides recurring curriculum standards to access students' responses in various domains. In this case, a deep learning scoring algorithm could be applied using the accumulated response from various years to overcome the sample size restrictions. Moreover, this allows the test administrators to compare and evaluate the soring reliability and equivalence of the various year's test administration effectively.

FUTURE RESEARCH DIRECTIONS

Two areas of future research are recommended. First, despite the development of methods that can be used to understand the hidden decision-making processes of deep learning algorithms, many of these methods are still hypothetical or have not been thoroughly studied in terms of their applications, particularly for essay scoring purposes. For example, scoring rules extracted from fuzzy inferences tend to lose their interpretability as more features are provided for prediction unless well-established scoring

theories or hypotheses are provided to manually define concrete scoring rules. In essay scoring, rules are too complicated to be broken down into several comprehensive rules, or the scoring rationales are often very vaguely defined, such as 'good' reasoning and 'strong' argument statements. Therefore, future research is required to investigate whether introducing new approaches that could be adapted to accommodate essay score rubrics can produce accurate score predictions. Second, more studies are required to explore how deep learning scoring procedures could be extended to provide feedback. One of the biggest advantages of written-response questions is the rich amount of information gathered about students' skills and knowledge. This information, in turn, can be used to provide students with specific and personalized feedback when improvements are warranted. Therefore, future studies focusing on effective feedback generation system utilizing the uncovered scoring structure in deep learning would benefit instructors who are expected to provide students with information on how to improve their writing skills.

CONCLUSION

As more written-response questions are implemented with digital assessment systems, automated essay scoring will be used increasingly to score the written text. Recent advancements in AES with deep learning algorithms have produced significant improvements in constructing a robust and consistent model with better scoring accuracy (Zaidi, 2016). However, due to the highly non-linear and complex structure, it was unclear how and what information in the input data contributed to arrive at the final score decisions (Samek, Wiegand, & Müller, 2017). High prediction accuracy established from the score agreement between the human rater and AES is insufficient to create a trustworthy relationship with the frameworks. Thus, the black-box nature of the deep learning prevented the wide-spread application of this approach despite all the benefits this method could bring to the testing process. In addition to the validation purposes, understanding the rationales and reasoning behind the machine learning algorithm produce other important benefits. First, experts will be able to locate the best model efficiently. To understand whether the current system makes a biased decision, it is critical to understand how the decisions are made. Also, parsimonious models are chosen in some cases for model building and learning efficiency. However, uncovering the hidden algorithms would allow human raters to make more informed decisions when choosing the 'best' model based on their hypothesis and the purposes of the assessment. Second, new insights about scoring decisions could be acquired from the machine algorithm. Oftentimes, scoring rubrics include obscure criteria such as 'good' word choice or 'poor' reasoning. Moreover, many of the skills and domains explored in the new assessment frameworks lack empirical evidence. For example, 'global competencies' are one of the newly adopted domains in many high-stakes exams, such as the Programme for International Student Assessment (PISA; OECD, 2018). With an explainable deep learning AES approach, researchers and practitioners could learn by identifying hidden algorithms and adopt the scoring algorithms to enhance both the assessment and rubrics. In this chapter, we introduced and described how deep learning AES could be used to overcome current challenges of essay scoring with the advent of a new digital-based assessment environment.

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KEY TERMS AND DEFINITIONS

Automated Essay Scoring: A process of a computer program to assign scores to essays in educational assessment.

Convolutional Neural Networks: A type of deep learning algorithm commonly applied in analyzing image inputs.

Deep Learning: A subarea of machine learning, which adopts a deeper and more complex neural structure to reach state-of-the-art accuracy in a given problem. Commonly applied in machine learning areas, such as classification and prediction.

Digital Assessment or Digitally-Based Assessment: A newly implemented types of educational assessment, where the whole assessment process, especially the delivery of the assessment to digital procedures. Often encompasses more creative and innovative item types compared to the traditional paper-based assessment.

Long Short-Term Memory Networks: A type of deep learning algorithm commonly applied for the of time-series data.

Machine Learning: A rising area in computer science, where the computer systems are programmed to learn information from rich data sets to produce reliable results to a given problem.

Word Embeddings: A language modeling technique in natural language processing commonly used to represent word tokens into computer-recognizable numeric values by projecting them into a vector space.

Chapter 4
A Study of Big Data Analytical Frameworks in Research Data Management Using Data Mining Techniques

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ABSTRACT

Research, which is an integral part of higher education, is undergoing a metamorphosis. Researchers across disciplines are increasingly utilizing electronic tools to collect, analyze, and organize data. This "data deluge" creates a need to develop policies, infrastructures, and services in organisations, with the objective of assisting researchers in creating, collecting, manipulating, analysing, transporting, storing, and preserving datasets. Research is now conducted in the digital realm, with researchers generating and exchanging data among themselves. Research data management in context with library data could also be treated as big data without doubt due its properties of large volume, high velocity, and obvious variety. To sum up, it can be said that big datasets need to be more useful, visible, and accessible. With new and powerful analytics of big data, such as information visualization tools, researchers can look at data in new ways and mine it for information they intend to have.

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INTRODUCTION

Research which is an integral part of higher education is undergoing a metamorphosis. Researchers across disciplines are increasingly utilizing electronic tools to collect, analyze, and organize data. They are now producing, storing, and disseminating digital data in much larger volumes than the text. Vast quantities of born-digital data are being produced in a wide variety of forms at a rapid rate in universities and research institutes. This "data deluge" creates a need to develop policies, infrastructures and services in organisations, with the objective of assisting researchers in creating, collecting, manipulating, analysing, transporting, storing and preserving datasets for future use. This explosion of born-digital research data (data that are created in digital form) means that the era of BIG DATA has arrived. Along with this digital overload comes the growing need for intelligent and effective Research Data Management (RDM).

The continued existence and access of this data is concern since the data is not currently well organised and stored in libraries. Research is now conducted in the digital realm, with researchers generating and exchanging data among themselves. Sharing research data and scholarship is of national importance due to the increased focus on maximizing return on the government's investment in research programs. Research funders are proactive and encourage good practices and to achieve greater return on investment and value for the sponsored research and therefore they have mandated certain specific standards of data management and sharing to be followed by the researchers.

DEFINITIONS

Research data management (RDM) is about "the organization of data, from its entry to the research cycle through the dissemination and archiving of valuable results" (Whyte and Tedds, 2011).

Big data is an evolving term that describes a large volume of structured, semi-structured and unstructured data that has the potential to be mined for information and used in machine learning projects and other advanced analytics applications.

INTRODUCTION

Research data management concerns the organization of data, from its entry to the research cycle through to the dissemination and archiving of valuable results. Research Data Management is part of the research process, and aims to make the research process as efficient as possible, and meet expectations and requirements of the university, research funders, and legislation. Pinfield,Cox and Smith (2014) mentioned that RDM consists of a number of different activities and processes associated with the data lifecycle, involving the design and creation of data, storage, security, preservation, retrieval, sharing, and reuse, all taking into account technical capabilities, ethical considerations, legal issues and governance frameworks.

Data produced as part of research take a wide range of forms, from statistics and experimental results to interview recordings and transcripts (Borgman, 2012). Data could exist as physical records or files on a researcher's computer or terabytes of data on shared servers. This chapter is divided into various sections viz. section I elaborates on the need of data processing whereas section II, III and IV exemplifies the Literature Review, Need of research data management and Role of Big Data in research data management. Section V describes role of research management in context with Big Data in Library

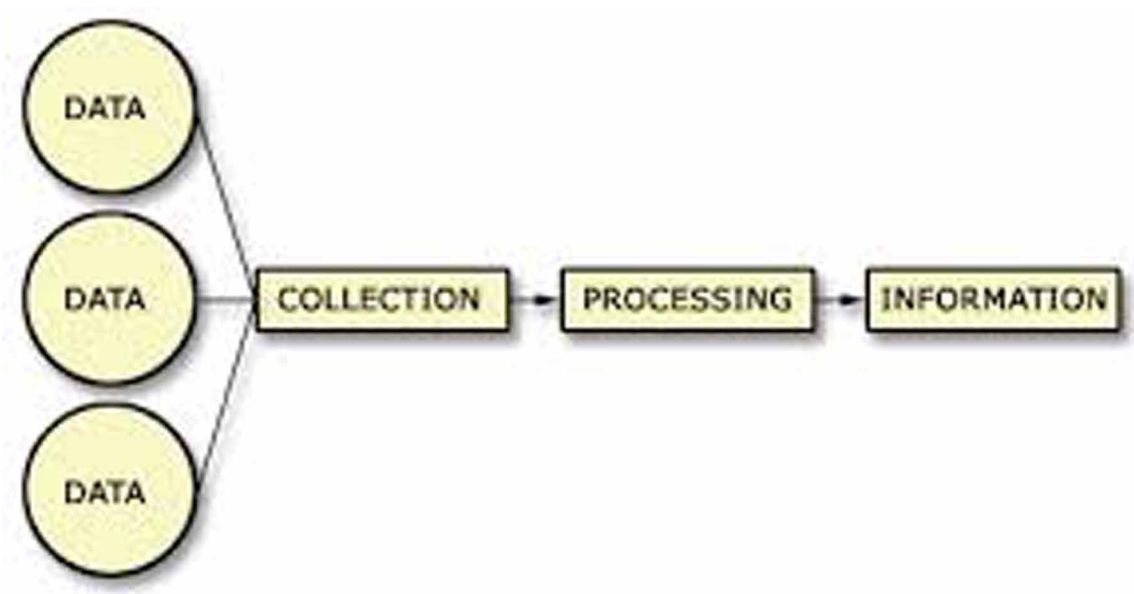
management. Section VI and VII elaborate on various techniques for Big Data Analysis in research data management and on cloud.

Before the data has to be stored it has to be processed. It is essential to st dy why the data has to be processed. There are certain reasons for which the data is being processed. The data can be:

- **Incomplete:** Lacking attribute values, containing attribute data.
- **Noisy:** Containing errors or outliers.
- **Inconsistent:** Containing discrepancies in code or names.
- The quality data should be available.
- To obtain the required information from huge, incomplete, noisy and inconsistent set of data is the need of data processing. Data Processing follows the following steps:
- Data Cleaning
- Data Integration
- Data Transformation
- Data Reduction
- Data Summarization

The above steps of Data Processing are discussed in Figure 1.

Figure 1. Data processing flowchart



- **Data Cleaning:** Data cleaning is especially required when integrating heterogeneous data sources. Data cleaning, also called data cleansing or scrubbing, deals with detecting and removing errors and inconsistencies from data in order to improve the quality of data. Data quality problems are present in single data collections, such as files and databases, e.g., due to misspellings during data entry, missing information or other invalid data.
- **Data Integration:** It combines data from multiple sources into a coherent data store, as in data warehousing. In short it is an integration of multiple databases, data cubes, or files.

- **Data Transformation:** Data Transformation operations, such as normalization and aggregation, are additional data pre-processing procedures that would contribute towards the success of mining process.
- **Data Reduction:** Data reduction obtains a reduced representation of the data set that is much smaller in volume, yet produces the same analytical results.
- **Data Summarization:** It is the process of representing the collected data in an accurate and compact way without losing any information, it also involves getting information from collected data referred (Son,2012) (Vaidya,2016).

Big Data is widely accepted that there is no one-size-fits-all solution for the inherent demands of big data. SQL and NoSQL approaches are the major paradigms in the landscape (Abadi, Agarwal, Ailamaki & Balazinska, M 2014).

BACKGROUND

The following section summarizes and reviews major and selected articles relating to various aspects of Research Data Management as per the following themes:

1. Need and Basics of Research Data Management
2. Big Data
3. Some existing Tools for Data management and Repositories

It has increasingly become a pressing issue in research organizations as they strive to assist researchers in addressing new public funding requirements surrounding data dissemination and preservation.

Research Data Services (RDS) and Research Data Management (RDM) services are two umbrella phrases authors have used to describe data curation (Pryor,Jones, & Whyte 2013; Tenopir, Sandusky, Allard,& Birch2013).

Charles Bailey's (2012) *Research Data Curation Bibliography w*ith over 200 citations and growing, is comprehensive bibliography on the subject. However, other distinctive bibliographies include The Westra, Parham, Susan (2010) bibliography of *Selected Internet Resources on Digital Research Data Curation which* presents a thematically organized bibliography of the more important Internet based resources. Witt and Giarlo (2012) provide a description of another unique guide, *Databib: An Online Bibliography of Research Data Repositories*. *Databib* currently provides records on over 500 repositories

worldwide and is an example of the growth and geographical breath in digital data repository services. Graham Pryor's *Managing Research Data* (2012) also compiles important literature on this topic.

Although a variety of research data life cycle models exist, most generally contain variations on several common stages as follows:

- Planning (potentially including creation of a formal data management plan, or DMP, to meet funder requirements)
- Data collection or acquisition,
- Data analysis or interpretation (including data visualization),
- Data preservation and curation, and
- Data sharing

Many articles used the theme of lifecycle management and long--term preservation of research data center as one of the primary reasons to preserve research data: **so it may be shared and reused**. A broad overview of the reasons for sharing (and not sharing) research data and an agenda for future research is provided by Borgman (2012).

Federer (2016) states that the ways that scientific research are practiced have shifted fundamentally in the last several decades. Researchers of the 21st century often rely on large digital datasets, and sometimes they are using data that they themselves did not gather, but that they obtained from public sources for reuse.

Big Data describes innovative techniques and technologies to capture, store, distribute, manage and analyze datasets that traditional data management methods are unable to handle. The concept of "Big Data" was first defined in 2001 in his research note. Laney (2001) described the characteristics of big data as which cannot be processed by traditional data management tools. Three Vs were first used to characterize the Big Data. With further study on big data, the "Three V's" have been expanded to "Five V's": volume, velocity, variety, veracity (integrity of data), value (usefulness of data) and complexity (degree of interconnection among data structures).

USEFULNESS OF VARIOUS TOOLS FOR RDM

Services specific to data management plans for grant--funded research may include consultations with grant writers, DMP training and workshops, and form--based tools for creating a DMP. Some libraries have begun to review larger sets of DMPs (Parham, Bodnar& Fusch 2012)

Understanding researcher needs, and presenting services with measurable positive impacts on those needs are critical to the success of DMP services. The data curation profile provides a framework for determining data management practices and needs of researchers (Carlson, J., & Stowell-Bracke, M. (2013).

The DMP Online tool developed in the United Kingdom, and its relative, the DMP Tool developed by the California Digital Library and partners in the U.S., are employed by some libraries to walk grant--writers through the process of developing a data management plan for submission with a grant proposal. Sallans and Donnelly (2012) compare and contrast these two forms--based web resources. The DMP Tool links to data plan requirements published by the funding agency units, and local guidance materials can also be incorporated into the web pages. Data Up is an open source tool used by researchers for Data Management

A Dataverse repository is the software installation, which then hosts multiple virtual archives called Dataverses. Each Dataverse contains datasets, and each dataset contains descriptive metadata and data files (including documentation and code that accompany the data). As an organizing method, dataverses may also contain other dataverses. (King, 2007)

Two valuable resources that focus on helping researchers understand how to effectively manage their data are:

- **DCC (Digital Curation Center):** Provides expert advice and practical help to anyone in UK higher education and research wanting to store, manage, protect, and share digital research data. www.dcc.ac.uk. The Digital Curation Center (2017) is indispensable resource for training in Research Data Management. The DCC not only provides materials, and a three hour introductory course covering: Research data and RDM, Data management planning, Data sharing, Skills, and RDM at Northampton, but also includes links to outside online training kits.
- **DMP Tool (Data Management Plan Tool):** Guides researchers on how to create, review, and share data management plans that meet institutional and funder requirements. https://dmp.cdlib.org

Understanding the strengths and limitations between the two is crucial toward intended goals of a data repository.

One more recently proposed data storage concept is elaborated in literature is the 'Data Lake'. It contains data masses in various settings that practically exist in many enterprise data centres (Halevy A, Korn F, Noy NF, (2016); Farid,2016,Madera, Laurent A.(2016).

Cloud Dataverse has brought a mature and widely used data repository platform, Dataverse, together with the OpenStack cloud platform. At the time of Big Data, when large and streaming datasets are becoming more common, it is necessary for repository and cloud platforms to converge so that data do not need to be moved constantly when they are processed, shared, and archived.

How to effectively goal a specific target or to unveil a pattern from a Data Lakeis challenging. One approach is non-invasive, meaning that the data in the 'Lake' remain in their native forms, only the path to their physical locations and metadata about the data sets (e.g. size, type, and provenance) will be systematically identified, indexed, categorized and organized in a searchable way so that the target data set becomes discoverable when needed (Havely etal..,2016)

Data wrangling is another approach, has processing source data remain to be systematically developed and categorized (Terrizzano I, Schwarz P, Roth M,2015).

In addition to the well-defined data processing methods, e.g. ETL, Extract, Transform and Load (Vassiliadis P, Simitsis A, Skiadopoulos S,2002), and MapReduce (Dean and Ghemawat 2004). Metadata from heterogeneous source data sets to facilitate the Lake data management and query and the processes of selecting, inspecting, analysing, sorting, cleansing, normalizing, integrating and provisioning to transform raw data into consumable and reusable forms .

For reaching the working of Data Lake the levels of data cleansing and processing are required to be carried out, depending on the purpose and requirements of data usage, in either or both SQL and NoSQL environments (Abadi et al.,2016)

One of the reviews has been found on the research data management carried out which have been done in the usage of big data technology in library (Wang, 2016). The research data are increasing very

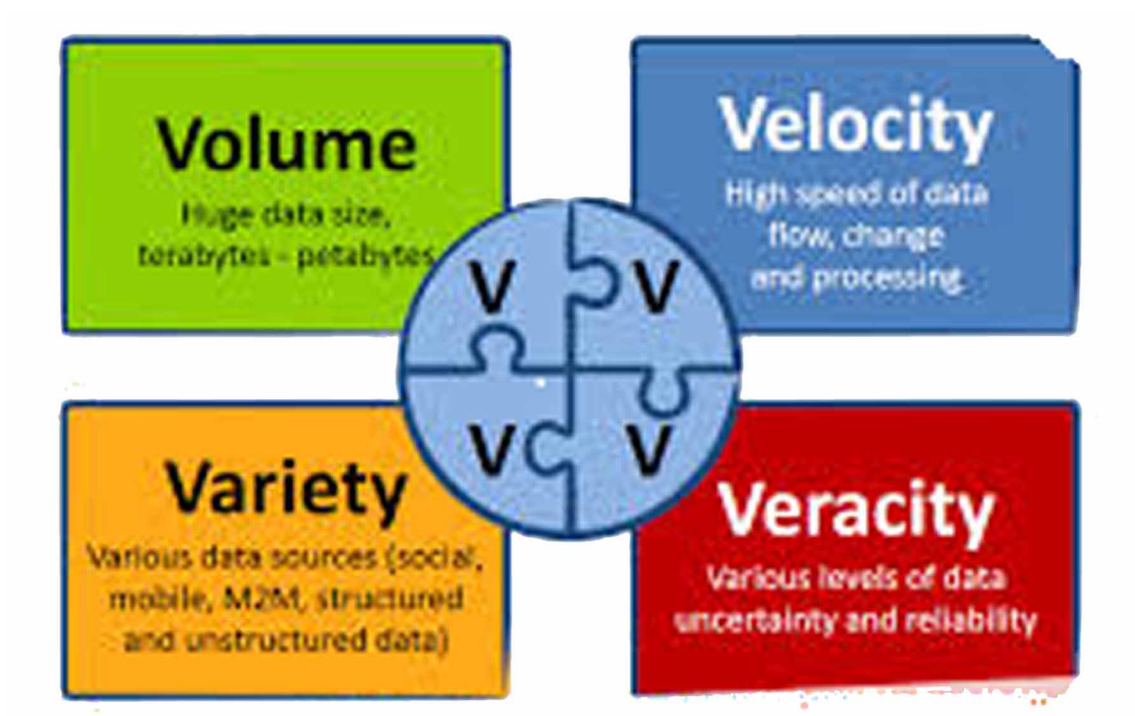
fast, and more and more researchers wish to use collections as a whole, analyzing and organizing the information in novel ways. Some patterns can be easily found using Big Data analysis.

Big data is a phenomenon that is characterized by the rapid expansion of raw data.

- **Volume:** Volume describes the amount of data generated by organizations or individuals. Big data solutions must manage and process larger amounts of data.
- **Velocity:** Velocity describes the frequency at which data is generated, captured and shared. Big data solutions must process more rapidly arriving data. By Velocity, they mean both the rate at which data arrive and the time in which it must be acted upon
- **Variety:** Big data solutions must deal with more kinds of data, both structured and unstructured in nature. By Variety, they usually mean heterogeneity of data types, representation, and semantic interpretation
- **Veracity:** Big data solutions must validate the correctness of the large amount of rapidly arriving data.

Actually, after reading the material on it, there is one more dimension one can think about, that is Complexity. The four V's can be referred from the Figure 2.

Figure 2. 4 V's of big data
Source: IBM (2016) The Four V's of Big Data



- **Complexity**: Organizations capture a variety of data formats and combinations through massive data sources in real-time to analyse and identify patterns within the data. There are some examples, identifying fraud for credit card customers, financial trends for investment organizations, predicting power consumption for energy companies.

USE OF BIG DATA IN RDM

Big Data allows corporate and research organizations to do things not previously possible economically.

It is used for:

- Analysis
- Business Trends

NEED OF RESEARCH DATA MANAGEMENT

Research data management (or RDM) is a term which describes the research process has the organization, storage, preservation, and sharing of data collected and used in a research project. It involves the management of research data during the lifetime of a research project. It also involves decisions about how data will be preserved and shared after the project is completed. It concerns how a researcher:

- **Create**s data and plan for its use,
- **Organizes**, structure, and name data,
- **Keeps** it – make it secure, provide access, store and back it up,
- **Finds** information resources, and **share** with collaborators and more broadly, publish and get cited.

Protecting research data from loss or accidental changes through good research data management is particularly important when generating data that are unique or laborious to obtain and reobtain the same.

There are ample of reasons why research data management is important:

- Data, like journal articles and books, is a scholarly product.
- Data (especially digital data) is fragile and easily lost.
- There are growing research data requirements imposed by funders and publishers.
- Research data management saves time and resources in the long run.
- Good management helps to prevent errors and increases the quality of your analyses.
- Well-managed and accessible data allows others to validate and replicate findings.
- Research data management facilitates sharing of research data and, when shared, data can lead to valuable discoveries by others outside of the original research team.

ROLE OF BIG DATA IN RESEARCH DATA MANAGEMENT

In this study, the big data concept is assumed to be extremely large amount of structured, semi structured or unstructured data continuously generated from diversified resources, which inundates business operation in real time and impacts on decision making through mining insightful information from rambling data. For research clarity, what constitutes big data include large structured datasets and unstructured data in the form of text(e.g. documents, natural languages), web data(e.g. web usage, web contents and web structure), social media data(e.g. virtual network), multimedia data(eg.image, audio,video) and mobile data(sensors. geographical location, application).

The research community has developed standards and best practices to induce and improve the quality of data sharing with large data.

Each dataset must have:

1. A data citation to credit data authors
2. A registered global persistent identifier to locate and reference the dataset indefinitely (e.g. a Digital Object Identifier or DOI)
3. Well-defined restrictions, licenses and terms of use to know how to access the data
4. Rich metadata describing the dataset to help find it and reuse it (Joint Declaration of Data Citation Principles (2014) ; FAIR Principles(2016)

The Dataverse repository platform enables the building of repositories without having to implement from scratch all the standards and best practices needed to fully support data sharing and archiving (Crosas,2017).

In real-world practice, the abundance of big data accelerates technology (Sheng, Jie, Joseph Amankwah-Amoah, and Xiaojun Wang,(2017)improvement. Recently, more advanced platforms and systems have been invented and employed to handle big data, which have advantages compared to traditional techniques in every aspect of data management and analytics. Russom (2011) foresees a future trend towards a growth in the adoption of visualisation, in-memory databases, SQL and other advanced analytics techniques in corporate IT commitment.

Managing research data is now becoming an integral part of the research process and extends over the entire life cycle of the data, from the point of creation to dissemination and archiving, and will usually continue long after the initial research project has concluded. Data management typically involves:

- Planning for and creating data
- Organizing, structuring, and documenting data
- Backing up and storing data
- Preparing data for analysis, to share with others or to preserve for the long-term

The goal of a data management plan is to consider the many aspects of data management, metadata generation, data preservation, and analysis before the project begins; this ensures that data are well-managed in the present, and prepared for preservation in the future.

In recent years, there has been emphasis of preserving and providing access to research data for the following reasons:

- To ensure research integrity and validation of results. Accurate and complete research data are an essential part of the evidence necessary for evaluating and validating research results and for reconstructing the events and processes leading to them.
- To increase research efficiency – good research data management will be helpful to organize files and data for access and analysis without difficulty.
- The most common reason to retain and manage research data, is to facilitate online sharing. Initiatives such as DataCite, a registry assigning unique digital object identifiers (DOIs) to research data, helps to make data citable, traceable and findable, so that research data, as well as publications based on those data, form an important part of a researcher's output.
- The culture of "Open Data" is gaining importance and credibility in the Scientific Community

Many libraries that serve research communities have begun to develop services to support researchers' data-related needs. Although a variety of research data life cycle models exist most generally contain variations on several common stages as follows:

- Planning (potentially including creation of a formal data management plan, or DMP, to meet funder requirements),
- Data collection or acquisition,
- Data analysis or interpretation (including data visualization),
- Data preservation and curation, and
- Data sharing.

There are various techniques by which the research data can be managed and analysed. Out of them, few have been illustrated as below –

1. The Dataverse software enables researchers to share and preserve their own datasets, and find, cite, and reuse datasets from others. In its current form, the software provides a rich set of features for a comprehensive, interoperable data repository for sharing and publishing research data, including:
   a. Control and branding of your own Dataverse (or individual archive), and widgets to embed your Dataverse in your website;
   b. Data deposit for any data file (up to a few GBs in size);
   c. Data citation, with a Digital Object Identifier (DOI), and with attribution to the data authors and the repository;
2. The fundamental structural problem of massive-scale data occurs when the data are too large to reside at any one processor, and so smaller fragments of the total data, referred to as shards, are created and distributed across processors, sometimes called workers. Many machine learning algorithms are conducive to operating with minimal communication on smaller problems and then combining for individual answers to form a grand solution. MapReduce (and its popular implementation Hadoop) is a more general technique for defining smaller tasks of a large scale problem, and distributing them across workers (the Map) and then communicating this information and combining the answers (the Reduce) in a fault tolerant fashion if some processes fail. However, many canonical statistical techniques cannot be implemented currently with sharded data. MapReduce (and its popular implementation Hadoop) is a more general technique for defining smaller tasks of a large scale problem, and distributing them across workers (the Map) and then communicating this information

and combining the answers (the Reduce) in a fault tolerant fashion if some processes fail. However, many canonical statistical techniques cannot be implemented currently with sharded data.

3. Similarly, many statistical models that are common, or even foundational, in traditional small fixed-scale data, have no analogous method of estimation in distributed settings. Pioneering work exists for solutions that simply run a large number of independent small-scale models, and then combine to an answer:

The absence of key statistical techniques for big data is notable given the general and growing abundance of published open source utilities for big data analytics. While there is no lack of Big Data tools, most of the tools do not communicate or interoperate with each other. However, the same issues arose in the previous decade with the emergence of the R language as the focal open sourced tool for applied statistics; there the language was common, and the training of the pioneering users much more focused and similar. The R statistical language is a giant open source project that spans all domains of applied statistics, visualization, and data mining. A drawback of this massive contribution base is that each contributed R package can often have its own definitions for how data.

4. As mentioned in literature that Zelig architecture devised for R can also solve this similar problem for big data science. It has been proposed that a fundamental need in big data science is the proper construction of an abstraction layer that allows users to see quantitative problems through their commonality and similar metaphors and attacks, while abstracting away the implementation of any algorithm in any given language on any particular storage device and computational setting.

These fixed-scale data sets are commonly downloaded to the researcher's computer where the analysis is performed locally. The trend towards Big Data -- including large scale streaming data -- is starting to transform research and has the potential to impact policy-making and our understanding of the social, economic, and political problems that affect human societies.

First of all, it is imperative that data not to be thrown away. Data management plans aim to ensure that research groups define the ways to store their datasets in advance of their experiments.

In the concluding remarks, it is necessary to mention that to study and analyse research data there is a need of various tools as the vast majority of social science research presently uses small (MB or GB scale) data sets. Downloading these data sets to a researcher's computer is infeasible or not practical; hence, analyses take place in the cloud, require unusual expertise, and benefit from collaborative teamwork and novel tool development. The advantage of these data sets in how informative they are also means that they are much more likely to contain highly sensitive personally identifiable information. However, this research poses new challenges in execution, accountability, preservation, reuse, and reproducibility.

- Re3Data provides a searchable directory of research data repositories.
- Research Pipeline is a guide to the world's free data
- Biosharing.org a curated, searchable portal of data standards, databases and policies in the life, environmental and biomedical sciences.

Vast quantities of born-digital research data are now being produced in a wide variety of forms and at a rapid rate in universities, creating the so-called ''volume'' ''variety'' and ''velocity'' challenges of

data. This ''data deluge'' generates a need to develop policies, infrastructures and services in institutions to manage data.

The research had four main objectives designed to analyse the library's contribution to RDM within the wider institutional context:

1. To examine roles and relationships involved in RDM
2. To identify the main components of RDM programmes
3. To evaluate the main drivers for RDM activities
4. To analyse the key factors influencing the shape of RDM developments

SCOPE

Organisations around the world have been using Big Data to better understand their audiences, tailor make their solutions and services, and deliver them in an effective, personal and timely way. Moreover, the exploitation of Big Data is driving literally £Billions in savings through efficiency gains across every industry that adopts practices that look to embrace it.

Drivers for Institutional Research Data Management and the Library

A number of drivers for RDM developments have been identified at an institutional level:

1. **Storage:** There has to be immediate storage facilities for a wide variety of datasets at large scale for the future requirements of researchers which represents value for money and is convenient to use.
2. **Security:** The data must be kept confidential or sensitive, should be held securely with relevant authentication and authorisation mechanisms in place.
3. **Preservation:** The need for medium and long-term archiving of data with associated selection protocols and preservation activities along with a supporting technical infrastructure.
4. **Compliance**: There must be a need to fulfil the requirements and policies of other relevant agencies, and funders, as well as legal obligations, such as data protection, and industry good practice.
5. **Quality:** There is a need to maintain and enhance the quality of research activity in general in order to demonstrate the robustness of findings and enable results verification and reproducibility.
6. **Sharing:** The need to share data amongst targeted users and also to provide mechanisms and systems to enable open access to data where appropriate.

RDM Developments Factors

There are few 'Influencing Factors' since they are prevailing conditions which may affect an institutional RDM programme in a variety of complex ways. Key Influencing Factors emerging from this research were:

- Acceptance
- Cultures
- Demand

- Incentives
- Roles
- Governance
- Politics
- Resources
- Projects
- Skills
- Communications
- Context

Added to this, perhaps one of the most significant challenges in implementing institution-wide initiatives were varying cultures which results in differing working practices. It was recognised to take varying cultures and practices for institution-wide RDM programme into account in the way it is designed and implemented.

It has been observed that there are technical differences in areas such as metadata standards and interoperability protocols, but also in cultures around sharing and reuse.

Nevertheless, despite the lack of detailed solutions discussed here, the importance of the issues of disciplinary differences should not be under-estimated. In many respects, there is a discussion held on all of the other Influencing Factors.

VARIOUS TECHNIQUES OF ANALYSIS OF BIG DATA GENERATED FROM RDM

Accessible and reusable data are fundamental to science to continuously validate and build on previous research.

In order to apply data science efforts in library collections, following tasks can be carried out, such as, but not limited to:

- Central data repositories, where data are stored, maintained, and cataloged;
- Data standards, to which collected data should follow;
- Data communities, which collect, maintain, and curate data;
- Analysis tool

The organizing framework reveals the great needs and space for big data research in management domain. First, theoretical development is in a need to provide general guidance for researchers to implement big data methods. Besides, it is also worth noting that "technology transfer" is critical for researchers to identify the best use of analytics techniques to achieve optimal performance.

The couple of major ones by first explaining the basic features of two fundamentally different data management approaches: the relational database which are SQL-based(Codd EF.,1970) and the non-relational which are No-SQL based(Parker, Poe and Vrbsky,2013) approaches. The former is often used for information integration and the latter for information centralization. Each has its unique strengths, limitations and suitable applications

Visualizations are often used to convey final research results and demonstrate the researcher's findings, but data visualization may also be exploratory in nature, providing a means to visually identify patterns that might otherwise have been difficult to discern in complicated data.

Many of the tools used in other stages of the data life cycle, such as R and Python, can be used for visualization, so librarians who develop expertise in these tools may find it a natural extension to provide visualization support for visualizing the research management data viewed in library.

The Dataverse software and the Zelig statistical software package offers a data-sharing framework and analytical tools for big data and which delivers an extensible, open-source software tools to help automate big data science, supports a web page for each dataset with metadata and complementary files. Supporting metadata and curation for big data requires additional tools to automate retrieving metadata from a variety of large, dynamic data files.

Dataverse supports iRODS, non-SQL databases, and adaptive storages of storage options more suitable for big data by integrating an API to submit and query large amounts of data at high speeds.

For the data-analysis frameworks, extensions are two-fold: implement models required to analyze big data using distributed computation for performance, and enable Zelig to make use of other programming languages that can handle data processing and computing faster than R. Finally, to fully support big data research, it is critical to provide tools that help to preserve the privacy of sensitive data, while still allowing researchers to validate previous analysis.

DMP Tool (Data Management Plan Tool) – Guides researchers on how to create, review, and share data management plans that meet institutional and funder requirements.

Many machine learning algorithms are helpful to form a grand solution. MapReduce, which is the popular implementation Hadoop, is a more general technique for defining smaller tasks of a large scale problem and distributing them across various workers and then communicating this information and combining the answers under a Reduce stage in a fault tolerant fashion if some processes fail.

Consensus Monte Carlo (Scott, Blocker, Bonassi, Chipman, George, McCulloch, 2013) runs independent Markov Chain Monte Carlo (MCMC) chains on small samples of the data and combines sampled draws.

RESEARCH DATA MANAGEMENT ON CLOUD

Cloud computing is a term that encompasses a wide range of use cases and implementation models. In essence, a computing 'cloud' is a large shared pool of computing resources including data storage.

There are around 1,800 public research data repositories used in academia, government, and business, supported by either open-source repository platforms viz. Dataverse, DSpace, CKAN, and Fedora, proprietary software like Figshare, or Protein Data Bank, one-off databases, this is one of the observation by re3data website. There has been seen an increase in the use of open source software for creating private and open clouds viz. OpenStack and OpenNebula, as well as the use of various commercial public clouds viz. Amazon Web Services, Microsoft Azure, Google Cloud, by academia, government, and various businesses (Crosas,2017).

SaaS is a method of software distribution based on cloud computing (Riungu, L.M., Taipale, O., & Smolander, K. 2010). Offline use of SaaS technologies is a decreasing problem to the extent that these applications can operate on local devices and merge data when connectivity becomes available(Godse, and Mulik, 2013)

Cloud computing uses remote networked servers to perform tasks that previously would have been conducted on a local server or personal computer. Storage options are growing rapidly, not only with Dropbox and Box, but cloud services for larger volumes of data offered by Amazon, Microsoft, and others (Madduri, R.K., Dave, P., Sulakhe, D., Lacinski, L., Liu, B., & Foster, I.T. 2013).

AWS users browse the AWS repository, can locate a dataset, and then analyze the in-situ data using Amazon Elastic Map Reduce. While AWS's public datasets service demonstrates the value of integrating access to datasets with cloud computing, it lacks the power of today's fully functional research data repositories, which follow best practices on data sharing (Crosas,2017).

Due to the increasing demands on institutions to provide open access to research outputs, there has been considerable interest in using cloud resources to provide back-end storage for digital repositories. A meeting organised by EduServe and JISC in London in 2010 entitled "Repositories and the Cloud" explored some of these issues. The trust issues surrounding use of cloud for storage of data, particularly sensitive personal data are explored in (Pearson, S., & Benameur, A. 2010, November) performed a customer survey investigating perceptions of storing personal data in the cloud, which illustrates the considerable concerns of end users.

DuraSpace are expected to launch a commercial cloud storage service in 2011. The service is based on the DuraCloud, middleware, which itself runs in the cloud. Institutions can replicate existing repository collections to the cloud, for example for backup purposes. Kindura pilots the use of hybrid cloud storage infrastructure to provide repository services to researchers. The project is developing management middleware to provide improved and efficient storage management (Waddington, Knight, Zhang, Hedges, & Downing, R, 2012). This approach also enables generation of business intelligence information by provisioning a centralised service for allocating storage resources, both in-house and external. Making use of cloud storage via a hybrid cloud approach enables elastic extension of in-house storage resources. By providing a single point of access to multiple storage services, data security is increased by providing automated data replication across multiple providers. Such providers can be in-house and external, and spread across multiple geographic locations.

Researchers should be able to ensure, for instance, that particularly valuable data such as source datasets that cannot be regenerated are adequately backed up. There was particular concern about the costs and payment models for longer term storage.

SECURITY OF RESEARCH DATA

The institution, as data controller, is responsible for ensuring that personal data is held appropriately, taking into account the nature of the data, e.g. if it is sensitive personal data, it may justify requiring greater protective measures, viz. access controls, encryption and audited disposal.

In the institution, a researcher has to ensure about the nature of the research data, the scale of data to be collected, how you intend to protect data gathered during field work, whether and when data will be pseudonymised or anonymised, how long it needs to be maintained etc.

For maintaining the security on the data which is used in an organization must have following features –

- Identify the means and mechanisms that have been employed for collecting, processing and storing the research data

- Demonstrate your understanding of the particular legal and ethical risks pertaining to those means and mechanisms, e.g. use of internet based tools
- Provide details of measures taken to secure research data e.g. physical security of equipment and notes (at work, at home and in the field), and digital security mechanisms, such as system, program and file password and use of encryption.

Failure to address security issues appropriately, particularly where data is unlawfully disclosed, may result in breaches of the institution's research ethics rules.

RECOMMENDATIONS AND FUTURE DIRECTIONS

Research data is fundamental to scholarly inquiry, providing the raw material for empirical investigation and inference. It is essential to work with stakeholders to increase the awareness and importance of research data management. It is imperative for institutions to take up the stewardship and to develop research data management services. It is equally essential to establish preservation and method to process and operationalize suitable data repositories. Many of the tools used in other stages of the data life cycle, such as R and Python, can be used for visualization, so librarians who develop expertise in these tools may find it a natural extension to provide visualization support for visualizing the research management data viewed in library.

There is a dire need to facilitate coordination of and build on existing initiatives. The techniques through which big data is managed have to be researched and implemented further in this context. It is necessary to Invest in training and skills development across the research data management lifecycle.

CONCLUSION

To some extent, the reuse of data as a consequence of data sharing distorts the classic distinction between primary and secondary data. Researchers will likely need assistance in learning how to access and utilize these datasets. It is being observed that, because of digitally archived research objects such as broadcasts and websites, new aspects have been added for data sharing. The amount of freely- and publicly-available research data continues to increase exponentially. This reflects the term "Data Deluge".

In conclusion, research data management in context with library data could also be treated as big data without doubt due its property of large volume; high velocity and obvious variety.

To sum up it can be said that to make big datasets more useful, visible and accessible. With new and powerful analytics of big data, such as information visualization tools, researchers can look at data in new ways and mine it for information they intend to have.

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KEY TERMS AND DEFINITIONS

Big Data: Extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions.

Curation: Data curation is the management of data, to ensure that data is reliably retrievable for future research purposes or reuse.

Dataverse: The Dataverse repository platform enables the building of repositories without having to implement from scratch all the standards and best practices needed to fully support data sharing and archiving.

DMP Tool (Data Management Plan Tool): Guides researchers on how to create, review, and share data management plans that meet institutional and funder requirements.

RDM: Research data management (or RDM) is a term which describes the research process has the organization, storage, preservation, and sharing of data collected and used in a research project. It involves the management of research data during the lifetime of a research project.

Chapter 5
Sequence Clustering Techniques in Educational Data Mining

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ABSTRACT

Digital technology has profound impacts on modern education. Digital technology not only greatly improves access to quality education, but it also can automatically save all the interactions between students and computers in log files. Clustering of log files can help researchers better understand students and improve the learning program. One challenge associated with log file clustering is that log files are sequential in nature, but traditional cluster analysis techniques are designed for cross-sectional data. To overcome this problem, several sequence clustering techniques are proposed recently. There are three major categories of sequence clustering techniques: Markov chain clustering, sequence distance clustering, and sequence feature clustering. The purpose of this chapter is to introduce these sequence clustering techniques and discuss their potential advantages and disadvantages.

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INTRODUCTION

Recent advances in computer technology have offered opportunities for new ways of measuring complex performance and higher order skills using dynamic, interactive, and real-world-like tasks. Computer technology also makes it possible to record every problem solving action a student made in a log file. Analysis of log files can help researchers and instructors understand how students arrive at a conclusion. It also helps personalize the e-learning environment for each student, and provides specific automatic feedbacks to students. To analyze log files, student problem solving sequences often need to be clustered. However, due to log files' complexity, there are several challenges for applying traditional cluster analysis. Kerr (2015) summarized the literature and pointed out three major challenges for clustering log files. First, log files contain large quantity of information. Second, log files contain diverse actions, not all are necessarily related to the problem. Third, students' log files may have little overlap as different students may do completely different behaviors. In addition to the above three challenges, it is also important to note that log file information is sequential in nature. That is, doing action A and then doing action B may be different from doing action B first and then doing action A, even though the same actions are performed. The orders in which students perform certain actions may be crucial to understand their problem solving strategies.

Traditional cluster analysis methods designed for non-sequential problems cannot be directly applied to the clustering of log data. To overcome the problem, many sequence clustering algorithms were proposed. These algorithms can be grouped into three major approaches: Markov chain clustering approach (Hansen, Hansen, Hjuler, Alstrup, & Lioma, 2017), sequence distance clustering approach (Shen & Chi, 2017), and sequence feature clustering approach (Wang, Weng, Su, & Tseng, 2004). The goal of this paper is to introduce these approaches and demonstrate each approach with some recently proposed algorithms. In the background section, basic cluster analysis algorithms are introduced to provide a foundation for the main focus of the paper. Next, the main ideas of the three sequence clustering approaches are explained. To demonstrate each approach, several example algorithms are presented. In the solution and recommendation section, practical recommendations are given to guide when to use what approach. In the end, future research directions and significance of the topic are discussed.

BACKGROUND

Throughout the modern history of education, educators always attempt to make education more realistic, more performance-based, and more like one-on-one coaching (Mayrath, Clarke-Midura, & Robinson, 2011). Instead of letting students remember knowledge, educators want them to apply knowledge to solve real world problems. Instead of simply giving students a single test score, educators want to give students unique feedback, and recommend them to learn what they need to learn. However, in reality, educators simply do not have enough time and resources to achieve these goals. Allowing students to solve real world problems can be costly and risky. Observing students solving problems requires lots of instructors, and the observation process may interfere students. One-on-one coaching is not affordable when an instructor needs to teach a large class with students from diverse backgrounds.

Modern education technologists attempt to solve these problems using computer-based learning environments. Computer technology can simulate real world problems, allowing students to do endless practices with minimal costs and risks. Computers can also non-intrusively record all the actions (i.e., all

the buttons students pressed) students performed during learning and problem solving. Based on students' performances, computer-based learning environments can provide specific feedbacks and learning plans. All these wonderful functionalities depend on analysis of *log files* (also called log data), files that store students' interactions with the computer systems. Depending on the nature of the computer-based learning environment, log data could contain information as general as what learning resources and exercises students accessed, which test items students correctly and incorrectly answered, or as detailed as what actions students performed on computer to solve a particular problem. For example, Moodle, one of the most popular learning management systems, offers the capacity to log student actions (Moodle Pty Ltd, 2016). A typical Moodle log file contains variables such as time, username, action context, action name, description of the action, and IP address. Each row of a log file represents a unique action (e.g., access a learning resource, create a post in the forum, view grade report, etc.) performed by a student in the Moodle environment.

To personalize the learning environment for each student, understand students' learning and problem solving processes, and provide specific feedback and learning plans, students' log files need to be clustered. Each cluster represents a unique learning or problem-solving strategy (Kerr, 2015). Then, feedback and recommendations can be given based on which cluster a student belongs. In addition, log data clustering could reveal unprofitable student behavioral patterns, such as gaming the system (i.e., abusing the flaws of the learning software to pass assessments without real learning). When such unprofitable behavioral patterns are detected, the learning system needs to adjusted to avoid future exploitation. One challenge to cluster log data is that log data are sequential in nature. Performing the same actions in different orders or timings could lead to completely different outcomes. It is for this reason, researchers proposed various sequence clustering algorithms, which are the focus of this chapter.

BASIC CLUSTERING ALGORITHMS

Most if not all sequence clustering algorithms are built based on basic clustering algorithms. Therefore, before introducing different sequence clustering algorithms, it is important to first review the basic clustering algorithms. In simplistic terms, the goal of cluster analysis is to assign each of N data points to one of K possible clusters (Vellido, Castro, & Nebot, 2011). However, cluster analysis methods are very diverse and some do not exactly obey this definition very well. Vellido, Castro, & Nebot (2011) proposed three major properties of cluster analysis. First, a clustering algorithm can be either hard or soft. In hard clustering algorithms, each case can only be assigned into one cluster. In soft clustering algorithms, each case can belong to different clusters in different degrees (e.g., case 1 is 70% cluster 1, 30% cluster 2). Second, a cluster analysis method can also be seen as partitional or hierarchical. In partitional clustering algorithms, clusters are not nested in one another. In contrast, hierarchical clustering algorithms allow smaller clusters to be nested within large clusters. Third, a clustering algorithm can be probabilistic or heuristic. Probabilistic clustering algorithms assume data in each cluster reflect a certain probability distribution. Consequently, optimization depends on probabilistic methods such as maximum likelihood or Bayesian estimation. In contrast, heuristic clustering algorithms do not make probabilistic assumptions about data, and they depend on heuristic algorithms for optimization. To demonstrate these distinctions, the next subsections present three most commonly used cluster analysis algorithms: *k*-means, agglomerative, and Gaussian mixture model. These algorithms will be frequently referred to in the sequence cluster analysis section.

K-Means Clustering

K-means clustering was first proposed by Steinhaus (1957), and it is one of the mostly commonly used cluster analysis algorithm due to its simplicity and computational efficiency. Based on Vellido et al.'s (2011) distinctions, k-means cluster analysis is a hard, partitional, and heuristic algorithm. The goal of k-means clustering is to assign each data point to one of K clusters. Researchers need to arbitrarily choose the number of clusters, K. K-means algorithm can be briefly described as follows:

1. choose K random points as the cluster centroids.
2. For each data point, assign it to the cluster with centroid that is closest to the data point.
3. Compute new cluster centroids based on the cluster membership assigned in step 2.
4. Repeat step 2 and 3 until cluster membership becomes stable.

Finite Mixture Model

Finite mixture model (Everitt, 2011) is a soft, partitional, and probabilistic cluster analysis algorithm. Finite mixture models assume that the observed data are generated by a mixture of different probability distributions. For cluster *k*, the probability distribution is $g_k(\vec{x};\vec{\theta}_k)$, where $\vec{x}$ is a p-dimensional random vector, and $\vec{\theta}_k$ is a vector of parameters of the probability distribution. The general formula for finite mixture model is:

$$f(\vec{x};\vec{p},\vec{\theta}) = \sum_{k}^{K} p_k g_k(\vec{x};\vec{\theta}_k),$$

where $f(\vec{x};\vec{p},\vec{\theta})$ is the probability distribution of the observed data, and $\vec{p} = (p_1, p_2, ..., p_K)$ is a vector of cluster proportions. When $\vec{x}$ is continuous, $g_k(\vec{x};\vec{\theta}_k)$ is often set to be the multivariate normal distribution and $\vec{\theta}_k$ includes the mean vector and variance covariance matrix for cluster *k*. This model is often called the *Gaussian Mixture Model* or *Latent Profile Analysis*. When $\vec{x}$ is categorical, $g_k(\vec{x};\vec{\theta}_k)$ can be set to be the multinomial distribution and $\vec{\theta}$ includes a list of event probabilities. This model is commonly referred to as the *Latent Class Analysis*.

Finite mixture model can be optimized using the *Expectation Maximization* (EM) algorithm. The detailed EM procedures for finite mixture model are not the focus of this paper. Interested reader could check Everitt (2011).

Hierarchical agglomerative clustering. Agglomerative clustering is a hard, hierarchical and heuristic clustering algorithm. Unlike both *K*-means cluster analysis and finite mixture model, which require the specification of the number of clusters and estimation of cluster centers before assigning cases to clusters, agglomerative clustering directly combines cases that are close to each other to form clusters (Everitt, 2011). More specifically, agglomerative cluster analysis starts with a collection C of N singleton clusters. Each cluster contains one data point. Next, the following procedures are repeated until only one cluster is left: 1) compute distances between all clusters and store the distances in a matrix for efficiency; 2) find a pair of clusters that has the shortest distance; 3) combine the two clusters into a new cluster;

and 4) remove these two clusters from collection C and add the newly combined cluster into collection C. There are many ways to define the distance between two clusters. For a detailed description of each distance, see (Everitt, 2011).

Determining of the Number of Clusters

As mentioned in the previous section, many algorithms require researchers to specify the number of clusters. There are four major approaches to determine the number of clusters. Each has unique assumptions. The graphical approach relies on plots and visual intuition to determine the number of clusters. Complex data can be reduced to two or three dimensions using techniques such as principle component analysis. After dimension reduction, data can be plotted, and the number of clusters can be determined visually (Everitt, 2011). The information criterion approach uses relative model fit indices such as Akaike Information Criterion (Akaike, 1971) and Bayesian Information Criterion (Schwarz, 1978) to determine the number of clusters. To use this approach, a range of clusters are specified (e.g., from 2 to 10), for each k, relative fit indices are computed, the k that yields the lowest relative fit indices is set to be the number of clusters. The within cluster approach is based on the intuition that when k is smaller than the true number of clusters, increasing k will greatly decrease the within cluster variances, but when k is greater than or equal to the true number of clusters, increasing k will only result in minor decrease in within cluster variances. Based on this intuition, a plot of within cluster variance (sometimes likelihood) with respect to different number of clusters can be constructed. The point where slope of the plot shows the largest change is set to be the number of clusters. This method is also called the elbow method (Everitt, 2011). The last approach is the significance test approach. This approach is often used for finite mixture model because of its probabilistic nature. Commonly used tests include the bootstrap likelihood ratio difference test (von Davier, 1997) and the Vuong-Lo-Mendell-Rubin test (Lo, Mendell, & Rubin, 2001). These tests examine whether k-clusters model fits the data significantly better than k-1 clusters model. To determine the number of clusters, keep increasing the number of clusters until the test is no longer significant. The cluster number is set to k-1.

The Limitation of Basic Clustering Algorithms

Basic clustering algorithms covered above can be applied to cluster log data. Log data need to be first converted into frequency data (i.e., counting how many times an action in log data was performed). Then, basic clustering algorithms can be applied to the frequency data. The disadvantage of this approach is that the order of the actions is completely ignored. This may be potentially problematic because in real learning and problem solving, the order of actions can significantly influence the outcomes. For example, learning geometry before calculus may be more intuitive than learning calculus before geometry. In math problem, performing addition before multiplication would lead to completely different outcome than performing multiplication before addition. For this reason, basic clustering algorithms need to be modified to cluster sequential data. The following section reviews three major approaches to sequence clustering.

MAJOR APPROACHES OF SEQUENCE CLUSTERING

Markov Chain Clustering

Markov chain clustering is a group of sequence clustering algorithms that assume each cluster of sequences can be explained by a unique Markov chain model. The goal is to identify *k* Markov chains that represent *k* clusters of sequences. While Markov chain clustering has several variations, the paper will demonstrate the gist of the approach using Hansen, et al.'s (2017) method, which is intuitive to understand, easy to implement, and computationally efficient. Hansen, et al.'s (2017) method assumes that each sequence in the data is generated by one of *k homogeneous discrete Markov chains*. The formal definition of homogeneous discrete Markov chain is:

Let S be a countable set called the state space, and let $\boldsymbol{X}=(X_n: n\geq 0)$ *be a sequence of random variables taking values in S. The Sequence* **X** *is called a Markov chain if it satisfies the Markov property*

$$P(X_{n+1}=i_{n+1} \mid X_0=i_0, X_1=i_1, ..., X_n=i_n)=P(X_{n+1}=i_{n+1} \mid X_n=i_n)$$

for all n≥0 and all $i_1,...,i_{n+1} \in S$ *. The Markov chain is called* **homogeneous** *if, for all i,j∈S, the conditional probability* $P(X_{n+1}=j \mid X_n=i)$ *does not depend on value of n. (Grimmett & Welsh, 2014, p. 205)*

In simple words, the probability distribution of the next variable, X_{n+1}, depends only on the current variable, X_n, and after controlling for X_n, X_{n+1} is conditionally independent of any previous variables. Using student problem solving sequence as an example, this property implies that a student's next action at time t+1 depends only on his/her current action. After controlling for the current action, the student's next action is independent from any earlier actions. The homogeneous assumption implies that each Markov chain model can be defined by a transition probability (i.e., $P(X_{n+1}=i_{n+1} \mid X_n=i_n)$) table. While this assumption may seem too strict for log data, it is very practical and widely used in educational data mining (Faucon, Kidzinski, & Dillenbourg, 2016).

With the basic understanding of homogeneous discrete Markov chain, Hansen, et al.'s algorithm is described as follows.

1. For every log file, a sequence of actions, X_1, …, X_n, are extracted. The first action is always the 'begin session' action, and the last action is always the 'end session' action. This is to ensure transition probability table is sufficient to describe the Markov chain. If students start with different actions, then prior probability of the first action also needs to be estimated for each Markov chain.
2. Next, k Markov chains' transition probability tables are randomly generated. To generate the transition probability tables, random numbers are sampled from a uniform distribution between 0 and 1, then they are normalized to ensure $\sum_{i_{n+1}} P(X_{n+1}=i_{n+1} \mid X_n=i_n)=1$.
3. Each sequence is assigned to a Markov chain based on which Markov chain provides the maximum likelihood for that sequence. The likelihood can be calculated as follows:

$$\arg\max_{1\le j\le k}\left(\prod_{n=1}^{m} P_j(X_{n+1}=i_{n+1}\mid X_n=i_n)\right),$$

where $P_j(X_{n+1}=i_{n+1}\mid X_n=i_n)$ is the jth Markov chain's transition probability from state i_n to state i_{n+1}.

4. After each sequence is assigned to a Markov chain, the Markov chains' transition probability matrices are updated based on the sequences assigned to them. This is done by counting the number of transitions from state i_n to state i_{n+1}, and then normalize them.
5. Step 3 and 4 are iterated many times (much like the *k*-mean algorithm) until more than 95% of the sequences' cluster membership (i.e., assigned Markov chain) no longer change.

To determine the number of clusters, a plot of sum of log likelihoods with respect to number of clusters can be constructed. The sum of log likelihood is defined as:

$$sumof\ \log likelihood=\sum_{s=1}^{S}\log\left(\prod_{n=1}^{m_s} P_{j_s}(X_{n+1}=i_{n+1}\mid X_n=i_n)\right),$$

where S is the total number of sequences, m_s is the number of actions in sequence s, j_s is the Markov chain that best fits sequence s, and $\prod_{n=1}^{m_s} P_{j_s}(X_{n+1}=i_{n+1}\mid X_n=i_n)$ is the likelihood of observing sequence s, given Markov chain j_s. Then, the elbow plot method described in the background section can be used to help determine the number of clusters.

To interpret the meaning each cluster, the transition probability table for each cluster's Markov chain can be examined. The transition probabilities are sorted from largest to smallest until 70% of the probability mass is retained. The largest transition probabilities are of interest because they can tell the unique transitions that characterize the Markov chain. For example, one Markov chain could have high probability to transition from action X_1 to X_2. Another Markov chain could have low probability to transition from action X_1 to X_2, but high probability to transition from action X_1 to X_5.

Using this method, Hansen et al. (2017) clustered 1.08 million students' log data from Edulab, the largest provider of digital learning for mathematics in Denmark. The results revealed 6 distinct interpretable clusters of student strategies. Some of the strategies clearly indicated unproductive use of the system. The automated identification of these students can help them learn more efficiently, and improve the system.

There are many variations to Hansen et al.'s (2017) method. For example, instead of using the *k*-mean like heuristic algorithm to find out the cluster membership, a probabilistic mixture model approach with EM algorithm can be used (Gupta, Kumar, & Vassilvitskii, 2016). Instead of using a simple discrete Markov chain to model each cluster, hidden Markov model can be used (Beal, Mitra, & Cohen, 2007). These methods are conceptually similar to Hansen et al.'s (2017) method, but they are more comprehensive and have higher computational costs. Researchers need to consider the complexity and sample size of their data to choose the most practically optimal method.

Sequence Distance Clustering

Another major approach to cluster sequences is the sequence distance approach. The intuition of this approach is to calculate a sequence distance matrix that contains the pairwise distances for all sequences, and then apply hierarchical clustering algorithm (e.g., agglomerative clustering) to this distance matrix. Since hierarchical cluster analysis is introduced in the background section, this section will focus on different type of sequence distances. There are many ways to define distance between two sequences. First, it is important to distinguish numeric sequences and string sequences. In a numeric sequence, a numeric variable's state is recorded over time. For example, we could record the amount of time a student spends on an online tutor program each week. The resulting sequence would be a numeric sequence. To calculate the distance between two numeric sequences (e.g., how similar two students' learning patterns are), we could use the *Dynamic Time Warping* (DTW) distance (Shen & Chi, 2017). In contrast, a string sequence records a categorical variable's state over time. For example, we could record what actions a student performs to solve a simulation-based problem. To compute the distance between two string sequences, edit distance can be used (Smith & Waterman, 1981). While there are many ways to define and compute sequence distances, the following sections will demonstrate the most foundational ideas of sequence distance by introducing DTW and edit distance.

Dynamic Time Warping

DTW is designed to best match the points of two numeric sequences to minimize the overall distance. The intuition can be visualized in Figure 1, which shows that the dotted and the solid sequence are really similar in shape: they both start flat, then show a peak, and become flat again. The difference lies in the timings of the peaks. DTW is designed to align the sequences by pairing point a with a', b with b', and c with c'. DTW distance between two sequences is simply the sum of all paired distances. There are two major steps to calculate DTW. The first step is to calculate a DTW distance matrix. The second step is to find out an optimal path between the top right corner and the bottom left corner of the matrix such that the sum of this path is a minimum. We will first provide the formal definition, and then demonstrate the computation using an example.

The formal algorithm is showed below (Shen & Chi, 2017):

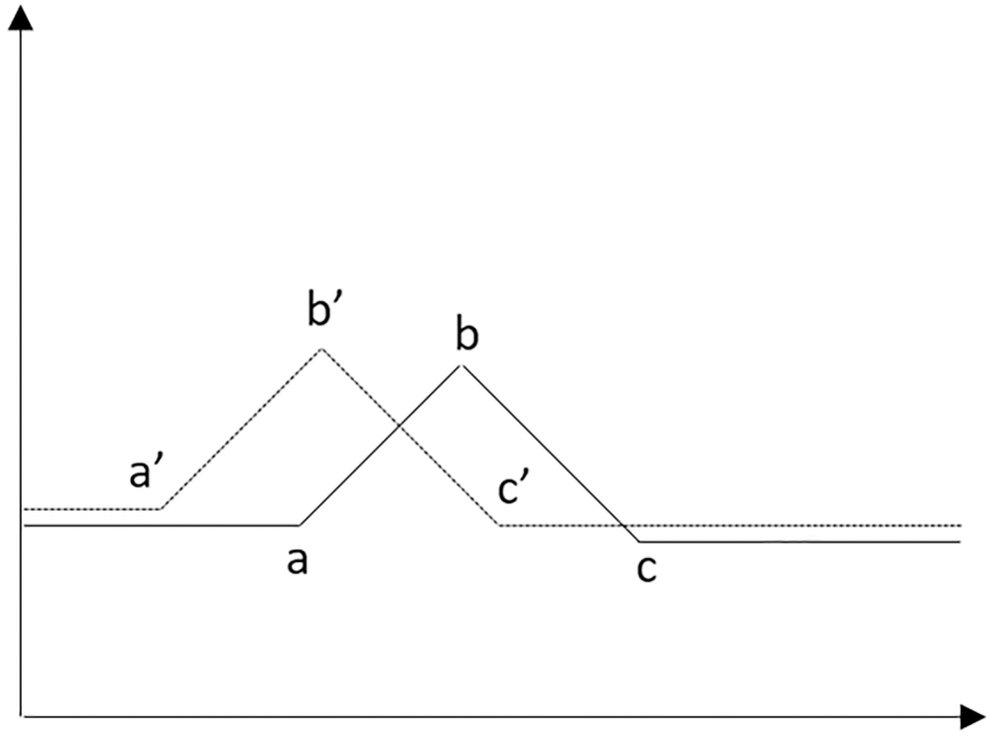
First, define

$$DTW(i,j) = \begin{cases} \infty & \text{if (i = 0 or j = 0) and i} \neq \text{j} \\ 0 & \text{if i = j = 0} \end{cases}$$

Next, recursively compute the following formula for all i and j.

$$DTW(i,j) = \min \begin{cases} DTW(i-1,j) + w_h \cdot dist(i,j) \\ DTW(i,j-1) + w_v \cdot dist(i,j) \\ DTW(i-1,j-1) + w_d dist(i,j) \end{cases},$$

Figure 1.



where w_h, w_v, and w_d are weights that are commonly set to (1, 1, 1), dist(i, j) is the Euclidean distance between i's point and j's point's values. To demonstrate the computational process, consider the following two sequences: A (0, 1, 2), and B (1, 0, 1). In this case, the DTW computation matrix is shown in Table 1. To compute this matrix, the bottom left corner is first calculated (i.e., i=0, and j=0; note that in this example, i and j start from 0 instead of 1). Since the Euclidean distance between 1 and 0 is 1, and i-1, and j-1 do not exist, DTW(0,0)=0+1=1. Next, DTW(1,0) can be computed. Since the Euclidean distance between 1 and 1 is 0, and

min(DTW(1–1,0), DTW(1,0–1), DTW(1–1,0–1)) = DTW(1–1,0)=DTW (0,0)=1, DTW(1,0)=1+0=1.

Similarly,

DTW(0,1) = min(DTW(0–1,1), DTW(0,1–1), DTW(0–1,1–1)) + dist(0,1)

= DTW(0,1–1) + |0–0| = 1+0 = 0

For DTW(1,1), the computation involves all three components in the minimum operation.

DTW(1,1) = min(DTW(1–1,1), DTW(1,1–1), DTW(1–1,1–1)) + dist(1,1)

= min(DTW(0,1), DTW(1,0), DTW(0,0)) + |1–0| = min(1,1,1)+1=2

Using this method, the rest of the DTW distances in the matrix can be calculated similarly.

Table 1. DTW computation matrix

2	2	3	**2**
1	1	2	**1**
0	**1**	**1**	2
	1	0	1

After the DTW distance matrix is computed, the optimal path between the top right corner and the bottom left corner of the matrix needs to be determined. This is simply done by starting from the top right corner and choosing the minimum number from its left, bottom left, and bottom position, and this process is iterated until bottom left corner is reached. For example, the top right corner's number is 2, the minimum of its left (3), bottom left (2), and bottom (1) position is 1. Therefore, its bottom position will be chosen. Following this logic, the optimal path is 2, 1, 1, 1 as highlighted in the DTW matrix. After the path is determined, DTW distance between the two sequences is the sum of all the numbers on its path, which is 5.

Using this method, Shen and Chi (2017) clustered 542 undergraduate students' log data from a logic tutor software. Three clusters of strategies were identified, and these clusters were useful for predicting the posttest score. According to the authors, the method can be implemented in the logic tutor software to help early detection of students with unprofitable learning behaviors.

In practice, the DTW distances between all possible pairs of sequences are computed and stored in a distance matrix, and agglomerative clustering can be applied to the distance matrix. Since the sequences are numerical in nature, plot can be used to help the interpretations the clusters. There are several minor variations to this methods (Shen & Chi, 2017; Boubekki, Jain, & Brefeld, 2018), interested readers are referred to the original articles.

Edit Distance

When the sequences contain string variables, edit distance (Smith & Waterman, 1981) can be used to measure the differences between two sequences. Edit distance is the minimum number of operations (i.e., adding a character, deleting a character, or replacing a character) that is needed to convert one string sequence into another. Although edit distance and DTW are conceptually different, the algorithms to identify the distances are rather similar: both of them use the technique of dynamic programming, in which the optimal solution is find in an iterative and sequential fashion. To demonstrate the procedure, consider the following two string sequences: S1 ("d, c, b"), and S2 ("a, b, c"). To formally find out the minimum number of operations to change S1 into S2, first construct a matrix (Table 2, left). As can be seen, for each sequence, there is an extra "null" element, which means a sequence's subsequences can

consist of 0 to 3 elements. The number in the (1, 1) position (i.e., top left corner) in the table is 0, which means it takes 0 action to change a null element of S1 to the null element of S2. The number in the (1,2) position is 1, which means it takes one operation (addition) to change a null subsequence of S1 into subsequence 'a' of S2. Similarly, the number in the (1, 3) position is 2, which means it takes 2 operations (additions) to change the null element of S1 into subsequence 'a, b' of S2. In contrast, the number in the (3, 1) position is 2, but it means it takes 2 operations (deletions) to change subsequence 'd, c" of S1 into the null element of S2. After constructing the table, the elements in the table are filled iteratively and sequentially row by row from left to right. The intuition is that a sequence can be perceived as the combination of previous elements (namely, previous subsequence) and the last element. If the last elements of two sequences are the same, then, the minimum number of operations required to change S1 to S2 equals the minimum number of operations required to change the previous subsequence of S1 to the previous subsequence S2. If the last elements of the two sequences are different, then there are three possible ways to make them the same. First, change the previous subsequences of S1 to the previous subsequence of S2, and then replace the last element of S1 with the last element of S2. Second, change the previous subsequence of S1 to S2, and then delete the last element of S1. Third, change S1 to the previous subsequence of S2, and then add the last element of S2. The minimum number of operations to change S1 to S2 is the minimum number of operations required by the above three methods. To use this intuition, the minimum number of operations required to change the previous subsequence of S1 to the previous subsequence of S2 needs to be computed. However, it cannot be directly computed. Therefore, the same intuition is repeatedly applied to the previous subsequences of S1 and S2 until the previous subsequences of S1 and S2 consist of only the null element. To demonstrate the intuition computationally, consider the filling in the blank in (2,2) position, which represents the number of operations required to change 'd' into 'a'. 'd's previous subsequence is the null element; its last element is 'd'. Similarly, 'a's previous subsequence is the null element, and its last element is 'a'. Since 'd' does not equal to 'a', there are three ways to change 'd' into 'a': 1) change the null element of S1 into the null element of S2 (0 action required as shown in position (1,1)) and replace 'd' with 'a' (total 1 operation); 2) change the null element of S1 into 'a' (1 action required as shown in position (1,2)), and delete 'd' (total 2 operations); 3) change 'd' into the null element of S2 (1 action required as shown in position (2,1)), and add 'a' (total 2 operations). Since method 1 requires the least number of operation, the (2,2) position or the edit distance between 'd' and 'a' is 1. The rest of the blanks can be computed in a similar fashion, and the resulting table is shown in the right. The total edit distance between S1 and S2 is shown in the bottom right corner of the table, which is 3.

Table 2. Edit distance computational matrix

	null	**a**	**b**	**c**			**null**	**a**	**b**	**c**
null	0	1	2	3		**null**	0	1	2	3
d	1					**d**	1	1	2	3
c	2					**c**	2	2	2	2
b	3					**b**	3	3	2	3

Similar to DTW cluster, the edit distances for all possible pairs of sequences are computed and stored in a table. Hierarchical cluster analysis is then applied to this distance table to obtain the class membership (Gitinabard, 2017). Number of clusters can be determined using any techniques mentioned in the background section. Process mining techniques (Trcka, Pechenizkiy, & van der Aalst, 2011) can be used to help interpret the clusters (Gitinabard, 2017).

Sequential Feature Clustering

As the name implies, the main intuition of this approach is to extract features that contains sequential information from the data, and then apply traditional cluster analysis methods to the sequential features. This subsection will demonstrate the concept of sequential feature clustering using sequential pattern clustering (Wang, Weng, Su, & Tseng, 2004), and *Long Short Term Memory* (LSTM) clustering (Guo & Cui, 2017).

Sequential Pattern Mining

Sequential pattern mining is a data mining technique that aims to identify frequently occurring subsequences in sequential data. A sequence S1 is a subsequence of S2 if S1 can be formed by deleting elements in S2 without changing the order of the elements in S2. For example, sequence 'a, d, e' is a subsequence of 'a, b, c, d, e' because 'a, d, e' can be formed from 'a, b, c, d, e' by deleting element b and c. In contrast, sequence 'a, c, b' is not a subsequence of 'a, b, c, d, e' because there is no way to obtain 'a, c, b' from 'a, b, c, d, e' without changing the order of its elements. If S1 is a subsequence of S2, then we can also say S2 contains S1. If in a dataset, there are k sequences that contain subsequence S1, then k is called the support of subsequence S1. If subsequence S1's support is greater than the minimum support threshold set by the researcher, then S1 is called a sequential pattern. The minimum support threshold can be set based on percentage, or based on frequency, based on research goals. The goal of sequential pattern mining is to find all sequential patterns in the data set. There are various algorithms designed to iteratively search for sequential patterns. These algorithms differ in computational speed, but they return the same results. Zhou et al. (2011) recommended PrefixSpan (Pei, et al., 2001) as the currently most efficient algorithm.

In practice, sequential pattern mining may return too many sequential patterns (Zhou, Xu, Nesbit, & Winne, 2011). It is important to eliminate redundant patterns. For example, if S1 and S2 are both sequential patterns, but S1 is also a subsequence of S2, then S1 can be removed. Also, researchers can decide the minimum number of elements in a sequential pattern. Any sequential patterns that have less than desired number of elements can be removed. If certain elements are of theoretical interest, then sequential patterns contain those elements can be selected. After important sequential patterns are selected, dichotomous variables that indicate whether a sequence contains those sequential patterns can be created. Then, hierarchical cluster analysis techniques can be applied to these dichotomous variables to determine the cluster membership for each sequence (Wang, Weng, Su, & Tseng, 2004). Using this method, Wang et al. (2004) developed a learning system that can cluster students' interaction with the system and create personalized learning plans for students. Evaluations of the learning system suggested that the system improved high school students' achievements and satisfactions.

LSTM Clustering

LSTM cluster's main component is LSTM (Goodfellow, Bengio, & Courville, 2016; Hochreiter & Schmidhuber, 1997), which is a recurrent neural network that takes sequential information as input, extracts hidden nonlinear features from the input, and uses these nonlinear features to predict the outcome. More specifically, LSTM takes information sequentially, and each time it reads a new piece of information, it updates its hidden units, which correspond to extracted features. After reading all the elements in the sequence, it forms a "final impression" (hidden unit values) of the sequence, and uses this "final impression" to predict the outcomes. LSTM is a flexible sequential prediction model that can learn to ignore outcome irrelevant information, retain early information in a long sequence if they are still relevant, and forget previously stored information when they become irrelevant (Goodfellow, Bengio, & Courville, 2016). The mathematical model of LSTM is too complex to explain in this short manuscript. Interested readers could see Goodfellow et al.'s (2016) book for details.

The basic idea of LSTM cluster (Guo & Cui, 2017) is to use LSTM to extract problem relevant features from student problem solving sequences, and use cluster analysis to cluster the extracted features. More specifically, it has three steps. First, it trains a LSTM to predict students' problem scores based on student problem solving sequences. The major goal of this step is to extract problem relevant features (as LSTM hidden unit values) from the input sequences. Second, cluster analysis (e.g., *k*-means or finite mixture model) is used to cluster the LSTM hidden unit values. Third, exemplar sequences that have hidden values closest to the centroid of each cluster are presented to help interpret the meaning of each cluster. Using this approach, Guo and Cui (2017) clustered 193 grade 8 students' log data from the TRE science laboratory, a simulation-based assessment designed to teach balloon science. Four student problem solving strategies were identified: optimal (most efficient strategy to solve the problem), curious (optimal strategy followed by random exploration), try-them-all (randomly trying every possible action without logic), and guessing strategy (minimum attempts to interact with the system, quickly proceed to guess the answer). The results can help instructors better understand students' problem solving strategies, at the same time, help the assessment system to provide meaningful feedback and recommendations.

SOLUTIONS AND RECOMMENDATIONS

In previous section, several sequence clustering methods are introduced. The question is when to use which technique. Unfortunately, there is a lack of studies that rigorously compare these approaches. Consequently, the authors will give tentative recommendations based on theory. When the problem is very complex (e.g., students try to solve a very complex problem on computer) and the sample size is large (>2000), LSTM cluster may be the best method because it clusters sequences based on problem relevant features and has less rigid assumptions than other approaches. When the sample size is not large, the problem is less complex and most actions student make are relevant to the problem, the Markov chain clustering can be computational more efficient due to its simplistic assumption. When the sequences of interest are numerical and sequential patterns are less time dependent (i.e., as long as the sequential pattern occurs, it does not matter where it occurs), DTW clustering can be the more efficient approach. Edit distance clustering need to be used with caution because it may group sequences based on lengths. But more empirical studies are needed to confirm its performance.

FUTURE RESEARCH DIRECTIONS

Currently, there is a lack of study that compares different sequence clustering techniques for different types of data. More empirical evidences are needed to provide better recommendations about when to use which techniques. Therefore, future research should focus on evaluation and comparison of these sequence clustering algorithm. Another exciting research direction is related to the recent rise of discrete variational autoencoder (Rolfe, 2017) in the field of deep learning. A discrete variational autoencoder attempts to reduce the data into categorical variables (clusters), and then uses these categorical variables to reproduce the original data. This method shows very promising results in different areas of applications (Rolfe, 2017), and it may be adapted to solve sequence clustering problem.

CONCLUSION

The advantages of modern computer-based learning environments lie in their capacities to provide performance-based assessment, individualized feedbacks and learning plans. Sequential clustering of log data is an essential technique to achieve these goals. In addition, sequential clustering of log data could also help identify unprofitable behavioral patterns, and fix potential flaws in the learning system. This chapter provides a basic introduction to the major approaches of sequence clustering. Educational researchers could use these techniques to improve their e-learning programs, and understand students' learning and problem solving processes. Data scientists could use these approaches as a basic framework to develop more

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KEY TERMS AND DEFINITIONS

Discrete Markov Chain: A probabilistic model that assumes a categorical variable's future state depends only on the current state. After controlling for the current state, the variable's future state is independent of its states.

Dynamic Time Warping: An algorithm to measure the distance between two numerical sequences.

Edit Distance: A string distance which equals to the minimum number of operations (i.e., adding a character, deleting a character, or replacing a character) that is needed to convert one string sequence into another.

Long Short-Term Memory Network: An artificial neural network architecture that can process sequential information as input and/or output, and have the capacity to retain information in earlier part of a long sequence.

Markov Chain Clustering: A sequence clustering approach that attempts to cluster sequences by assigning them to K unique Markov chains.

Sequence Distance Clustering: A sequence clustering approach that first computes a sequence distance matrix, and then applies hierarchical clustering to the distance matrix.

Sequence Feature Clustering: A sequence clustering approach that first extracts sequential features from each sequence, and then apply traditional cluster analysis algorithms to the sequential features.

Sequential Pattern Mining: A data mining technique that aims to identify commonly occurring subsequences from sequential data.

Chapter 6
Estimating Levels of Learning Outcomes Acquirement Based on Fuzzy Sets, Relations, and Their Compositions

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ABSTRACT

New curriculum designers should prepare the set of learning outcomes that will be studied by students, and their acquirement will be verified by teachers. It is not easy to estimate whether students achieved the required learning outcomes even in the range of knowledge and skills, but when the competencies are considered, it becomes harder. Because of the convenience of using the linguistic terms (excellent, poor, good, and so on), it is better to apply fuzzy relations (type 1 if the numbers are chosen or type 2 if the sets are used), which can handle with the linguistic terms better than classical relations. The estimation of the learning outcome's acquirement can be conducted on the bases of a test or tests. For calculating the levels of learning outcome's acquirement, two fuzzy input relations are designed. Experts build one based on their knowledge, and the second one is based on the test results. The output relation, showing levels of learning outcome/outcomes' acquirement, is built with the application of the S-T composition of the first and second relations.

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INTRODUCTION

Learning outcomes are statements describing what a person should know and be able to do after completing the course. Thus, nowadays, new curriculum designers should prepare the set of learning outcomes that students will learn, and teachers and examiners will verify their acquirement. Moreover, all education entities have to develop their curricula to help their students and teachers fulfill these requirements. It is not easy to estimate whether students achieved the required learning outcomes even in the range of knowledge and skills, but when the competencies are considered, it becomes harder. The problem of learning outcome assessment is not easy for educators and pedagogues but, for other specialty teachers, is highly demanding.

Estimating, for example, the level of the ability to work under stress or in the group should take very much time and preparation to produce the stressful situation and putting students in different groups with various roles. To assess the student's abilities, the teachers and educators use expressions like, for example, "s/he works well," or "his/her work was poor" because that way our language works. However, the head of the school or the rector of the university wants teachers to prepare levels of learning outcomes acquirement, which will be transformed into grades. To deal with these linguistic terms (excellent, poor, good and so on), it is better to apply fuzzy relations (type 1 – if the numbers are chosen or type 2 – if the sets are used) which can handle with the linguistic terms better than classical relations. The application of fuzzy relations can be useful in the case of written tests. Before, the teachers, while preparing tests for students, created the items to check the acquirement of some knowledge and skills. Now they have to take into account the learning outcomes. Most of the teachers were not taught this approach, and now they have to study it by themselves or take part in some workshops. Hence, the method of learning outcomes assessment, referring to knowledge and skills based on fuzzy relations developed for written tests is beneficial. The presented way of the estimation of the learning outcome's acquirement will be presented based on a final secondary school examination test. For calculations the levels of learning outcome's acquirement, two fuzzy input relations are designed. The first relation, between learning outcomes and tasks/items showing the level of learning outcome/outcomes verification by a given item, is built by experts (teachers, educators or other people involved in the designing and realization of the curriculum). Thanks to them, not all teachers must understand the concept of learning outcome acquirement very profoundly, especially in the area of competences.

The second relation, between items and students showing levels of understanding the problem discussed in the given item measured by, for example, the number of marks, consists of the test results transformed to the interval [0,1]. The third output relation, between learning outcomes and students consisting levels of learning outcome/outcomes acquirement, is built with the application of the S-T composition of the first and second relations.

BACKGROUND

Presently in Poland, the concept of the European Qualification Framework (EQF) has been introduced in all curricula designed for all levels of education. According to the European Commission, 'the European Qualifications Framework is a European-wide qualifications framework which joins the qualifications of different EU members together' (European Qualifications Framework, 2012). One of the main aims of the EQF is to help institutions (among them higher educational institutions, HEIs), employers and

individuals understand the qualifications of applicants, university candidates, and get to know their own, respectively. Understanding the applicant's qualifications is especially important when they come from a different country. Qualification comprehension facilitates acceptance of students to universities and colleges, employment of graduates and reemployment of people already employed. The next aim is to help people get to know their set of qualifications and develop it some of them applying the process of lifelong learning (European Qualifications Framework (EQF), 2012).

Ministers responsible for higher education started looking for a tool to compare qualifications of people from different countries, and after discussions in 1999 they prepared and signed the document called 'The Bologna Declaration of 19 June 1999' (The Bologna Declaration…, 1999) which was the joint declaration of some European Ministers of Education. Based on this document, some countries, the signatories, introduced the system of credits, called the ECTS (the European Credit Transfer and Accumulation System), to help compare students' achievements. Then in 2008, the European Parliament and the Council prepared the Recommendations on the establishment of the EQF for lifelong learning (Recommendations…, 2008).

European countries, starting in 1999, have begun to develop their education systems to be compatible with the EQF. The European Qualification Framework consists of eight reference levels described in the language of learning outcomes. Each level describes what individuals should know, understand and be able to do at the end of a learning curriculum. Every country develops its national qualification frameworks (NQFs) and implements the EQF (European Qualification Framework, 2008). Before introducing the EQF concept, the curricula designers described goals of teaching, which teachers and students tried to achieve, so they concentrated more on the beginning of the teaching process. Nowadays, they design the set of learning outcomes, so concentrate more on studying than teaching and at the end of the studying process, not on the aims of curricula.

The European Qualifications cover all types of qualifications from those acquired by children (Level 1) to the highest described for Ph.D. students (Level 8). The EQF also includes vocational qualifications. Each country decides how many levels the NQF should have. The Polish Qualification Framework consists of 8 levels, similarly to the EQF.

Nowadays, new curriculum designers should prepare the set of learning outcomes that will be studied by students, and teachers or educators will find out levels of their acquirement. It is not easy to estimate whether the students achieved the required learning outcomes, even in the area of knowledge and skills. However, the evaluation of competence acquirement by the students becomes much harder. The assessment of the competence' acquirement is not easy for pedagogues but, for teachers of other specialties like, for example, engineers, mathematicians, it is highly demanding.

For instance, estimating the level of the abilities to be responsible for his or her work should take much time and plenty of preparation to produce situations when students can show that their responsibility. To assess the students' abilities is more useful to use expressions like, for example, 's/he works well,' 'his/her work was poor' because that way human languages work. However, heads of the school or rector of the university want teachers to prepare levels of learning outcomes' acquirement transformed into grades.

Because of the convenience of using the linguistic terms, like for example, excellent, mediocre, satisfactory and so on, it is better to use the fuzzy logic, which can deal with these terms much better than classical logic. The estimation of learning outcomes' acquirement is conducted on the bases of different methods. However, a written test is one of the common methods for student's achievement assessment.

The idea of applying fuzzy logic to develop educational systems, especially in the area of assessment, is not new. In 1995, R. Biswas presented two methods of students evaluation based on fuzzy approach

(Biswas, 1995), and called them: Fuzzy Evaluation Method (FEM) and its generalization (GFEM). To develop more reliable educational systems, various applications of the idea of fuzzy sets/relations was applied. Chen and Lee (1999) expanded Biswas' work by proposing two new methods for assessing student response scripts using fuzzy sets and managed to avoid performing complicated matching operations. Ma and Zhou (2000) showed an integrated fuzzy logic method developed for assessing learning outcomes in the case of student-centered studying. Then, new kinds of fuzzy sets were proposed for assessing students' achievements, and based on them, new systems were designed. One of them was the concept of soft fuzzy sets introduced by D. Molodsov (1999) and developed by Ahmad and Kharal (2009). Next, P. Majumdar and S.K, Samanta (2011) presented the new technique, based on generalized soft fuzzy sets, of determining students grades and then preparing rankings of them.

Weon and Kim (2001) proposed a new strategy to assess the learning achievements of students, called fuzzy evaluation, based on assigning fuzzy linguistic variables to items representing its meaning, complexity, and difficulty by the application of fuzzy membership features and evaluating results on the degree of these functions. Bai and Chen (2008) continued the research on the application of fuzzy sets in educational grading systems by using membership functions and fuzzy rules considering difficulty, importance, and complexity of items. S. Ingoley and J.W. Bakal (2012) proposed the system based on complexity, difficulty, and importance of questions designed students to assess their achievements. F. Dayan, M. Zulqarnain and N. Hassan N. (2017) presented the method, which applied socio-economics backgrounds and defined by them the social difficulty coefficient, based on generalized fuzzy soft matrix theory, for comparing students achievements.

I.A. Hameed and C.G. Sorensen (2010) examined systems for evaluation of students' achievement with Gaussian membership functions. They showed that such systems with the standard deviation equal to 0.4 or more were more reliable. Moreover, C. Huapaya (2012) presented the diagnosis model of the fuzzy educational system representing interpretable knowledge and based on 27 intuitive fuzzy rules. The research must also be carried on criteria for the assessment of educational systems. J.Z. Csaba (2008) developed four conditions which should be fulfilled by based-on-fuzzy-logic systems for preparing students evaluation.

FUZZY RELATIONS AND THEIR COMPOSTIONS

Education, similarly like other social sciences, uses very often imprecise expressions to describe deliberated ideas like, for example, 'a very gifted student,' 'an easy examination' or 'a difficult item.' Teachers, educators, students, and their parents understand the meaning of these phrases in the special context, but a speaker cannot be certain whether other people understand such expression in the same way. What does the expression 'be good at geometry' exactly mean? Trait 'being good at geometry' is latent and educators try to find the way how to describe in the more precise way and measure.

The situation is similar when the acquirement of learning outcomes is discussed. Almost nobody says 'I know 47.981% of learning outcomes which are defined for the curriculum' or 'I can do 51.8% of the assumed skills'. Students usually say 'I have studied half of the learning outcomes' and 'I should study more skills to get four.' Therefore, they typically use the imprecise language to describe their educational achievements. Teachers also use blurred expression while they describe the knowledge, skills, and competencies which their students acquire, for example, they say 'Tom has acquired learning outcome LO_1. on the high level' or 'Sandy's level of learning outcome LO_2.acquirement is low'.

The use of imprecise language, while describing the acquirement of learning outcomes, is not convenient when the ranking of students has to be prepared, or the teachers have to tell whether their students pass some learning outcomes or some subjects. It is much easier for teachers, students, employers, and recruitment officers when levels of learning outcome's acquirement are numbers from the same interval.

In the case of classical logic, for the question: 'Has Jan acquired learning outcome LO_1.' there are only two possible answers 'yes' or 'no' which means that 'Jan has acquired this learning outcome completely' or 'Jan has not acquired this learning outcome at all.' Of course, typically students have acquired learning outcomes on the levels which are between these extreme values. Because of that, fuzzy logic is better than the classical one to calculate levels of learning outcome' acquirement by students.

Lofti Zadeh (Zadeh, 1965) introduced fuzzy logic in 1965, starting at this moment much research on fuzzy logic has been carried out, and many applications were developed. The following quoted definitions are on the bases of the book by Rutkowski (Rutkowski, 2012). Let *X*.be a non-empty space. A fuzzy set *A*.is a set of pairs $(x, \mu A(x))$ where $x \in X$ and $\mu A: X \to [0,1]$ is called a membership function. Value $\mu A(x)$ describe the level of the membership of x to A.

Let us consider the following example. Let us assume that the minimal number of marks that students can earn is 0 and the maximal is 1 so $X=[0,1]$. Let A.be a fuzzy set describing the 'good' student and its membership function is defined as follows:

$$\mu_A(x) = \begin{cases} 0 & 0 \le x < 0.25 \\ 4x-1 & 0.25 \le x < 0.5 \\ -4x+3 & 0.5 \le x < 0.75 \\ 0 & 0.75 \le x \le 1 \end{cases}$$

Figure 1 presents the graph of the membership function of the fuzzy set *A*.

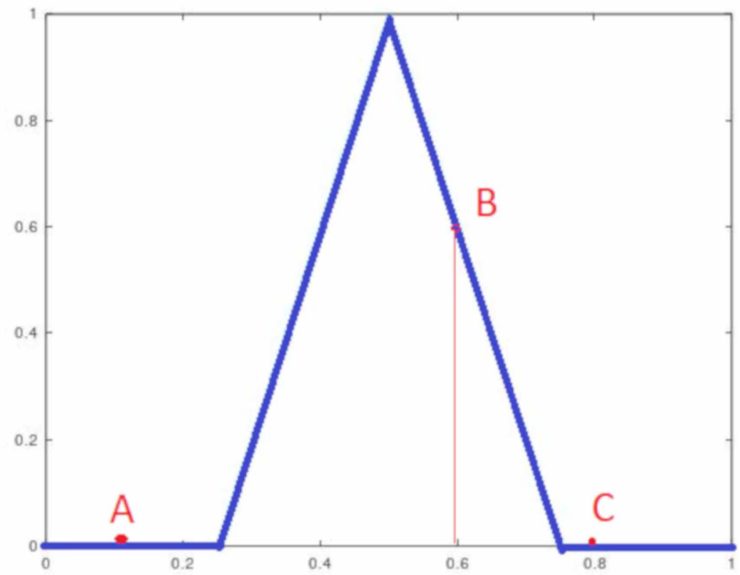
Let us consider three students. The first one (*A*. got 0.1 marks, so $\mu A(0,1)=0$ then s/he is not a good student. The second one (B. got 0.6 marks, so $\mu A(0.6)= -4\times0.6+3=0.6$ hence the certainty that s/he is a good student is 60%. The last student (C. got 0.8, then $\mu A(0.8)=0$ so s/he is not a good student because s/he is an excellent student.

If the problem of the level of acquirement of learning outcome LO.by student S.is considered, there are two spaces taken into account, namely the space of learning outcomes and the space of students. In this case, fuzzy relations are used. Let X. and Y. be two non-empty spaces. A fuzzy relation R is a set of pairs $((x,y), \mu R(x,y))$ where $(x,y) \in X \times Y$ and $\mu R: X \times Y \to [0,1]$ is a membership function.

As it was mentioned before, to the S–T composition of fuzzy relations will be applied. At first, the T-norm is defined. Assume that two fuzzy sets $(X,\mu A)$, $(X,\mu B)$ are defined in the same space X. The product of these sets is a fuzzy set $(X, \mu_{A\cap B})$ whose membership function is described in the following way: $\mu_{A\cap B}(x) = T(\mu_A(x), \mu_B(x))$, where a T-norm is a function $T: [0,1]\times[0,1]\to[0,1]$ which satisfies the following properties:

(**T1**) $T(a,b)=T(b,a)$ for each $a,b \in [0,1]$ (Commutativity)
(**T2**) $T(a,b) \le T(c,d)$ if $a \le b$ and $b \le d$ for each $a,b,c,d \in [0,1]$ (Monotonicity)
(**T3**) $T(a,T(b,c))=T(T(a,b),c)$ for each $a,b,c \in [0,1]$ (Associativity)
(**T4**) $T(a,1)=a$ for each $a \in [0,1]$ (The number 1.is an identity element)

Figure 1. The graph of the membership function μA



The three most popular T-norms functions are presented below. Let $a_1,a_2 \in X$, then

- T-norm, called minimum: $T(a_1,a_2)=\min\{a_1,a_2\}$,
- Łukasiewicz T-norm: $T(a_1,a_2)=\max\{a_1+a_2-1,0\}$,
- Algebraic T-norm: $T(a_1,a_2)=a_1,a_2$.

Assume that two fuzzy sets $(X,\mu A_j$, $(X,\mu B)$ are defined on the same space X. The union of these two setsisafuzzyset $(X,\mu_{A\cup B})$ whosemembershipfunctionisdefinedasfollows: $\mu_{A\cup B}(x)=S(\mu_A(x),\mu_B(x))$ and a S-conorm is a function S: $[0,1]\times[0,1]\rightarrow[0,1]$ which satisfies the following properties:

(S1) $S(a,b)=S(b,a)$ for each $a,b\in[0,1]$ (Commutativity)
(S2) $S(a,b)\leq S(c,d)$ if $a\leq b$ and $b\leq d$ for each $a,b,c,d\in[0,1]$ (Monotonicity)
(S3) $S(a,S(b,c))=S(S(a,b),c)$ for each $a,b,c\in[0,1]$ (Associativity)
(S4) $S(a,0)=a$ for each $a\in[0,1]$ (The number 1.is an identity element)

Below, there are the three most popular S-conorms, let $a_1,a_2\in X$, then

- S-conorm, called maximum: $S(a_1,a_2)=\max\{a_1,a_2\}$,
- Łukasiewicz S-conorm: $S(a_1,a_2)=\min\{a_1+a_2, 1\}$,
- Algebraic S-conorm: $S(a_1,a_2)=a_1+a_2-a_1,a_2$.

After defining T-norm and S-conorm, the S–T composition can be defined. Let $R=\{(x,y),\mu_R(x,y)\}\subset X\times Y$ and $P=\{(x,y),\mu_P(x,y)\}\subset Y\times Z$ be two fuzzy relations with

membership functions denoted by μR and μP, respectively. The S-T composition of relations R *a*nd P *i*s a fuzzy relation $R \circ P \subset X \times Z$ with the membership function defined as follows

$$\mu_{RoP}\left(x,z\right) = S_{y\hat{I}Y}(T\left(\mu_R\left(x,y\right),\mu_P\left(y,z\right)\right). \tag{1}$$

for each $x \in X$, $y \in Y$, and $z \in Z$.

FOUNDATIONS OF THE FUZZY MODEL FOR VERIFICATION OF LEARNING OUTCOME' ACQUIREMENT BY STUDENTS

In Poland, in the Regulation (Regulation…, 2008) of the Ministry of National Education, in the case of mathematics, there are defined five learning outcomes which acquirement by secondary school students should be verified during the final secondary school examination. The translation of these learning outcomes in English is presented in Table 1.

Table 1. Learning outcomes in mathematics from the regulation of the Ministry of National Education (Regulation…, 2008)

Symbol	Description of learning outcome
LO_1	The student interprets the mathematical text. After solving the item, the student interprets the obtained result.
LO_2	The student uses simple, well-known mathematical objects.
LO_3	The student chooses a mathematical model for a simple situation and critically evaluates the validity of the model.
LO_4	The student uses a strategy clearly in line with the content of the item.
LO_5	The student conducts simple reasoning, consisting of a small number of steps.

The goal of the paper is to calculate the levels of learning outcomes' acquirement by students based on the final secondary school examination test. Thus, the following spaces are defined:

- The space of learning outcomes described to the given curriculum described for verification during the maturity examination in mathematics – $LO=\{LO_j, j \in J\}$ (here $J=5$);
- The space of test items chosen for the verification of these learning outcomes acquirement – $\Im = \left\{I_k, k \in K\right\}$;
- The space of students – $S=\{S_i, i \in I\}$.

Based on these three spaces, two fuzzy input relations are built.

- Let $R_1 \subseteq LO \times \Im$. The fuzzy relation ($R_1$,$\mu$1$_)$, between learning outcomes and items, is prepared by experts, and μ1($_L$Oj,$_I k$) denotes the level of verification of acquirement of learning outcome LOj $_b$y item Ik, where j$\in J$ *a*nd k$\in K$.

- Let $R_2 \subseteq \mathfrak{I} \times S$. The fuzzy relation $(R_2, \mu 2)$ between items and students and $\mu 2(I_k, S_i)$ denotes the transformed to interval [0,1] number of marks which student S_i earned after solving item I_k, where $i \in I$ and $k \in K$.

According to the goal of the test, values of fuzzy relation R*1* can be described by one teacher or by a group of teachers and educators. Achievements of the students based, for example, in one chapter of a book, one teacher is sufficient. However, when tests are prepared for final secondary school examinations, there should be more teachers to avoid subjectivity. In general, to prepare values of fuzzy relation R*1* the experts must be employed because they know all knowledge and skills and can estimate values of this relation accurately.

For the calculation of the levels of learning outcome's acquirement by students, the third output fuzzy relation is developed. Let $(R_3, \mu 3)$, where $R_3 \subseteq LO \times S$, be a fuzzy relation between learning outcomes and students such that $\mu 3(LOj, Si)$ denotes the level of acquirement of learning outcome L*Oj* by student S*i*. To find values of this fuzzy relation, the S-T composition of fuzzy relations R*1* and R*2* is applied (comp. Rutkowski, 2012).

As it was stated before, there are three pairs of *T*-norm and *S*-conorm, their properties will be analyzed to choose the best one for the method developed for verification of learning outcome's acquirement by students (comp. Mrela and Sokolov, 2015). Since the result of application of *T*-norm and *S*-conorm are numbers belonging to the interval [0,1], the *S*–*T*-composition gives numbers belonging to the same interval, so levels of acquirement of each learning outcome by each considered student is a number from the interval [0,1]. Thus, if this number is equal to 0, then this student has answered all items defined for the verification of this learning outcome incorrectly, and it can be said that this student has not acquired this learning outcome at all.

Requirements for the system designed for verification of learning outcome's acquirement by students are presented below.

(R1) Student S_i has not acquired learning outcome LO_i at all if and only if $\mu 3(LOj, Si)=0$.
(R2) If the student answers the next item which is vital for this learning outcome, then the level of this learning outcome's acquirement should be higher.

In the following sections, these three S-T-compositions will be checked for requirements (R1) and (R2).

S-T-Composition Type Max-Min

In the case of S-T-composition type max-min, *T* and *S* norms are defined as follows (Rutkowski, 2012):

1. 1. For two elements a_1, a_2:

$$T_M(a_1, a_2) = \min\{a_1, a_2\},$$

$$S_M(a_1, a_2) = \max\{a_1, a_2\},$$

2. 2. For n elements $a_1,\ldots,a_n$.

$$T_M(a_1, a_2, ..., a_n) = \min_{i=1,2,...,n}\{a_i\},$$

$$S_M(a_1, a_2, ..., a_n) = \max_{i=1,2,...,n}\{a_i\}.$$

The values of the membership function of relation R_3 between learning outcomes and students which show the levels of learning outcome' acquirement by students are calculated using the following formula

$$\mu_3\left(LO_j, S_i\right) = \max_{k=1,2,\ldots,K}\left\{\min\left\{\mu_1\left(LO_j, I_k\right), \mu_2\left(I_k, S_i\right)\right\}\right\}. \quad (2)$$

for each j=1,2,…,J and i=1,2,…,I. It is easy to see that the max-min composition fulfills requirement (R1). The max-min composition does not fulfill requirement (R2) what will be shown in the following example. The following table presents the values of the membership functions of the exemplary fuzzy relation $\mu 3(LO1, I1, Si)$.

Table 2. Values of the membership function $\mu 3(LO1, I1, Si)$.

Students **Learning outcomes**	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
LO_1	0	0.6	0.6	0.6	0.6	0.6	0	0

Let $\mu 1(LO1, I2)$=0.4>0 and $\mu 2(I2, S2)$=1>0. Then $\mu 3(LO1, I1, 2, Si)$=0.6. The following table shows the values of the membership functions of the exemplary fuzzy relation $\mu 3(LO_1, I1, 2, Si)$.

Thus, $\mu 3(LO1, I1, S_2)$=$\mu 3(LO_1, I1, 2, S2)$ although $\mu 1(LO1, I2)$>0 and $\mu 2(I2, S_2)$>0. Hence, requirement R2 is not fulfilled.

Table 3. Values of the membership function $\mu 3(LO1, I1, 2, Si)$.

Items **Learning outcomes**	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
	0.4	0.6	0.6	0.6	0.6	0.6	0.4	0.4

S-T-Composition Type Łukasiewicz

In the case of the S-T-composition type Łukasiewicz, functions T and S are defined as follows (Rutkowski, 2012):

1. 1. For two elements a1,a_2:

$$T_L(a_1, a_2) = \max\{a_1 + a_2 - 1, 0\},$$

$$S_L(a_1, a_2) = \min\{a_1 + a_2, 1\},$$

2. 2. for n elements $a_1,\ldots,a_n$.

$$T_L(a_1, a_2, ..., a_n) = \max\left\{\sum_{i=1}^{n} a_i - (n-1), 0\right\},$$

$$S_L(a_1, a_2, ..., a_n) = \min\left\{\sum_{i=1}^{n} a_i, 1\right\}.$$

In this case, the values of the fuzzy relation between learning outcomes and students which gives the levels of learning outcome' acquirement by students are calculated using the following formula

$$\mu_3\left(LO_j, S_i\right) = \min\left\{\sum_{k=1}^{K} \max\left\{\mu_1\left(LO_j, I_k\right) + \mu_2\left(I_k, S_i\right) - 1, 0\right\}, 1\right\}. \tag{3}$$

for each j=1,2,…,J and i=1,2,…,I. The S-T composition type Łukasiewicz fulfills requirements (R1) and (R2) (Mrela, Sokolov and Katafiasz, 2015).

S-T-Composition Type Algebraic

In the case of the composition type algebraic, functions T and S are defined in the following way (Rutkowski, 2012):

1. 1. for two elements a_1,a_2:

$$T_P(a_1, a_2) = a_1 a_2,$$

$$S_P(a_1, a_2) = a_1 + a_2 - a_1 a_2,$$

2. 2. For n elements $a_1,\ldots,a_n$.

$$T_P(a_1, a_2, ..., a_n) = \prod_{i=1}^{n} a_i,$$

$$S_P(a_1, a_2, ..., a_n) = 1 - \prod_{i=1}^{n} (1 - a_i).$$

Similarly, as in previous sections, the S-T-composition type algebraic is defined as follows

$$\mu_3\left(LO_j, S_i\right) = 1 - \prod_{k=1}^{K} (1 - \mu_1\left(LO_j, I_k\right) \mu_2\left(I_k, S_i\right)) \tag{4}$$

for each j=1,2,…,J and i=1,2,…,I. The algebraic S-T composition fulfills requirements (R1) and (R2) (Mrela, Sokolov and Katafiasz, 2015).

Summing up, the max-min composition does not fulfil requirement (R2), so not chosen for the considered model. The $S-T$ .composition type Łukasiewicz and algebraic can be chosen the model. In the following section, one of the will be chosen.

Comparing S-T-Compositions: Type Łukasiewicz and Algebraic

Since there are two *S–T* -compositions which fulfill requirements (R1) and (R2), so the possibility of having more values will be checked because of the convenience of preparing the ranking of students. It is easy to observe that *S–T* -composition type Łukasiewicz might have only a small number of different values. Indeed, if levels of membership functions $\mu 1$ and $\mu 2$ are estimated to the nearest tenth and Łukasiewicz T and S norms are chosen, then relation $\mu 3$ might take at most 11 different values. However, in the case of S–T -composition type, if levels of membership functions $\mu 1$ and $\mu 2$ are estimated to the nearest tenth and algebraic T and S norms are chosen, calculated and rounded to the nearest hundredth, then relation $\mu 3$ might take at most 101 different values.

Summarizing, S-T-composition type Łukasiewicz can take only 11 values, and algebraic one can take more, so the algebraic S-T-composition is more convenient for educational purposes.

Type 1 and Type 2 Fuzzy Relations

Sometimes, as in our example, there is only one expert and the relation built by this expert is called the fuzzy relation type 1. However, sometimes there are a few experts, and all the experts estimates the levels of learning outcome's verification by items individually. Then one of the methods of aggregation can be used to achieve one value (for example, the average) or type 2 fuzzy relations may be applied (Zadeh, 1975). If values of a membership function of the fuzzy set are not numbers, but they are fuzzy sets, then this set is called type 2 fuzzy set (comp. Piaget, 1999). Thus, type 2 fuzzy set, denoted as $\tilde{A}$, is a set of all pairs $(x, \mu_{\tilde{A}}(x))$, where x∈X and the degree of its membership $\mu_{\tilde{A}}(x)$ do the set $\tilde{A}$ is a type 1 fuzzy set defined on the set $D_x \subset [0,1]$ with a membership function f_x called the secondary membership function. If the space $X \times Y$ is the Cartesian product of X and Y the type 2 fuzzy relation $\tilde{R}$ is a type 2 fuzzy subset of Cartesian product $X \times Y$. If $D=\{u\}$ is finite and secondary memberships of two

type 2 fuzzy relations $\widetilde{R_1}$ .and $\widetilde{R_2}$ .are defined on D, then using algebraic T-norm and S-conorm, the S-T composition, can be calculated in the following way:

$$f_3(x,z)(u) = 1-\left(1-f_1(x,y_1)(u)\,f_2(y_1,z)(u)\right)\cdot\ldots\cdot\left(1-f_1(x,y_K)(u)\,f_2(y_K,z)(u)\right),$$

where f_1,f_2,f_3 denote the secondary membership functions of relations $\widetilde{R_1}$, $\widetilde{R_2}$ and $\widetilde{R_3}$ respectively (see Figures 2,3 and 4).

Making Decisions Based on the System of Learning Outcome's Acquirement

After estimating levels of learning outcome's verification by the test items, the experts have to set passing scores (comp. Angoff, 1971) which can be different or equal for all learning outcomes. Thus, let $\boldsymbol{v(i,j)}$ be a value of learning outcome $\boldsymbol{LO_j}$ by student $\boldsymbol{S_i}$ ($\boldsymbol{j=1,2,\ldots,J}$; $\boldsymbol{i=1,2,\ldots,I}$). Value $\boldsymbol{v_j}$ is called a passing score, if the expert/experts decide that if $\boldsymbol{v(i,j)\geq v_j}$ then student $\boldsymbol{S_i}$ acquired learning outcome $\boldsymbol{LO_j}$ on the sufficient level.

Furthermore, in the case of type 2 fuzzy relations, one more value, called the range will be taken into consideration. Let $f_3(LO_j,S_i)$ be a secondary membership functions of the type 2 fuzzy relation between learning outcome LO_j and S_i where j=1,2,…,5 and i=1,2,…,8. Let the range of learning outcome LO_j acquirement by student S_i be the argument of the maximum of $f_3(LO_j,S_i)$. Let the range be equal to the difference between the greatest and the smallest arguments at which the secondary membership function is equal to 0.5.

If the range is smaller, then it means that values are closer to the levels of learning outcome's acquirement, so the level of the acquirement of this learning outcome by this student is more likely, and the higher the range is, the lower the likelihood that this student has acquired the specific learning outcome is.

SOLUTION: EXAMPLE OF THE MODEL OF THE SYSTEM DESIGNED FOR CALCULATION OF LEARNING OUTCOME'S ACQUIREMENT

Learning outcomes LO_1–LO_5 defined for this example are presented in Table 1. Their acquirement by students will be assessed, and the levels of their acquirement will be calculated based on the test with items prepared by the teacher and shown in Table 4. Since these tasks are of multiple choice, for solving them correctly, the students can earn one mark.

It is difficult for the teacher to describe the levels of learning outcomes' acquirement of a few learning outcomes by the given student based on a K item test (K=10), so the method based on fuzzy relations will be proposed. Before this test is administered to the students, the teacher, who acts as an expert, prepares the table which contains the values of the membership function of fuzzy relation R_1 showing the levels of learning outcome' verification by the test items.

The values of the membership function of second fuzzy relation R_2 are estimated after the test. The results of the test might be numbers of earned marks or marks transformed to interval [0,1]. Assume that the test was administered to I=8 students S_1–S_8. Since the test consists of multiple-choice items, students

Table 4. The list of items chosen for the assessment of learning outcomes LO_1–LO_5

Symbol	Description
I_1	Let $a = \log_{\frac{1}{4}} 16,\ b = -\frac{1}{4},\ c = \log_3 9$. The product of *abc* is equal A. -9 B. -1 C. 1 D. 3
I_2	Equality $\frac{m}{3-\sqrt{5}} = \frac{3+\sqrt{5}}{4}$ occurs for A. m=5 B. m=-1 C. m=1 D. m=-3
I_3	The system of equations $\begin{cases} 2x - y = 1 \\ x + 0.5y = 4 \end{cases}$ describes in the coordinate system on the plane: A. empty set B. exactly one point C. exactly two different points D. infinite collection.
I_4	The sum of all elements of the equation (x -2) (x -3) (x+7) = 0 is equal A. -1 B. 2 C. 1 D. -2
I_5	Equation $\frac{x-3}{x+6} = x - 3$ has A. exactly one solution: x = 3 B. exactly one solution: x = 0 C. exactly one solution: x = 1 D. exactly two solutions: x = -5, x = 3
I_6	Point S = (1, -4) lies on the graph of the linear function defined by the formula $f(x)=(2m-1)x+1$. Therefore: A. m= -1 - B. m= -2 C. m=0 D. m=2
I_7	The quadratic function is given by formula $f(x)=x^2+bx+2$. If $f(1)=2$, then A. $f(2)=4$ B. $f(2)=0$ C. $f(2)= -4$ D.$f(2)=1$
I_8	In the increasing geometric sequence (a_n), for $n\geq 1$, the condition $a_4=4a_1$ is met. The quotient q of this sequence is equal A. $q = \frac{1}{2}$ B. $q = \frac{1}{\sqrt[3]{4}}$ C. $q = \sqrt[3]{4}$ D. q=2
I_9	The straight line a with equation y=(m2 – 1)x+1 is parallel to the line i with equation $y=(4m-5)x-3$. Therefore A. m=2 B. m= -2 C. m= -2 - $\sqrt{2}$ D. m=2+ $2\sqrt{2}$
I_{10}	The arithmetic mean of the data set: 1,5,7,8.9 is the same as the arithmetic mean of the data set: 1,5,7,8,9,x. It follows that A. x=0 B. x=3 C. x=6 D. x=7

Table 5. Values of the membership function of fuzzy relation R_1

Items Learning outcomes	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
LO_1	0.6	0.4	0.2	0	0	0.2	0.1	0.1	0.1	0.2
LO_2	0	0	0.2	0.2	0.4	0.3	0.4	0.5	0.5	0.1
LO_3	0	0	0.6	0	0.2	0.2	0.6	0.6	0	0.5
LO_4	0.1	0.3	0	0.6	0.6	0.6	0.3	0.2	0.6	0.4
LO_5	0	0.1	0.1	0.2	0	0.1	0	0.2	0.2	0.1

can earn one mark for solving each item correctly and 0 marks otherwise. Let the sample values of the membership function of fuzzy relation R_2 between items and students be presented in Table 6.

Table 6. Values of the membership function of fuzzy relation R_2

Student Item	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
I_1	0	1	1	1	1	1	0	0
I_2	1	1	1	1	1	1	1	1
I_3	0	1	0	0	1	0	1	0
I_4	1	0	1	1	1	1	1	1
I_5	0	1	1	1	1	0	0	0
I_6	0	0	0	0	1	1	1	1
I_7	0	1	1	1	1	0	1	0
I_8	0	1	1	1	1	0	1	1
I_9	1	0	1	1	1	1	0	1
I_{10}	0	1	1	1	1	0	1	1

Based on these two fuzzy relations R_1 and R_2 the teacher estimates the levels of learning outcome' acquirement by the students. To calculate the values of the membership function of the fuzzy relation between learning outcomes and students, R_3 the S-T composition is applied. Three pairs of T-norms and S-conorms were presented, but only two of them fulfilled requirement (R1) and (R2), so two S-T-compositions will be developed.

Type 1 Fuzzy Relations

S-T-Composition Type Łukasiewicz

Based on (4), the levels of learning outcome's acquirement by the students are calculated and presented in Table 7.

Table 7. Values of the membership function of relation R_3

Items Learning outcomes	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
LO_1	0.5	1	1	1	1	1	1	1
LO_2	0.7	1	1	1	1	1	1	1
LO_3	0	1	1	1	1	0.2	1	1
LO_4	1	1	1	1	1	1	1	1
LO_5	0.5	0.5	0.8	0.8	1	0.6	0.8	0.9

Next, the calculations of one of the values of the membership of this fuzzy relation are performed:

$$\mu_3\left(LO_1, S_1\right) = \min\left\{\sum_{k=1}^{K} \max\left\{\mu_1\left(LO_1, I_k\right) + \mu_2\left(I_k, S_1\right) - 1, 0\right\}, 1\right\}.$$

So

$$\begin{aligned}\mu_3\left(LO_1, S_1\right) = \min\{&\max\{0.6+0-1,0\} + \max\{0.4+1-1,0\} + \max\{0.2+0-1,0\} \\ &+\max\{0+1-1,0\} + \max\{0.2+0-1,0\} + \max\{0.1+0-1,0\} + \max\{0.1+0-1,0\} \\ &+\max\{0.1+1-1,0\} + \max\{0.2+0-1,0\}\} \\ &= \min\{0+0.4+0+0+0+0+0+0+0.1+0,1\} = 0.5.\end{aligned}$$

S-T-Composition Type Algebraic

Based on (5), the levels of learning outcome's acquirement by the students are calculated and presented in Table 8.

Table 8. Values of the membership function of relation R_3

Items **Learning outcomes**	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
LO_1	0.46	0.88	0.86	0.86	0.91	0.83	0.75	0.69
LO_2	0.60	0.87	0.94	0.94	0.96	0.72	0.88	0.87
LO_3	0.00	0.97	0.94	0.94	0.98	0.20	0.97	0.84
LO_4	0.89	0.92	0.99	0.99	0.99	0.96	0.96	0.98
LO_5	0.42	0.42	0.59	0.59	0.66	0.48	0.58	0.63

Next, calculate one value of the membership of this fuzzy relation. Thus,

$$\mu_3\left(LO_1, S_1\right) = 1 - \prod_{k=1}^{K}\left(1 - \mu_1\left(LO_1, I_k\right)\mu_2\left(I_k, S_1\right)\right).$$

Hence,

$$\begin{aligned}\mu_3\left(LO_1, S_1\right) &= 1 - (1-0.6\cdot 0)\cdot(1-0.4\cdot 1)\cdot(1-0.2\cdot 0)\cdot(1-0\cdot 1)\cdot(1-0\cdot 0) \\ &\cdot(1-0.2\cdot 0)\cdot(1-0.1\cdot 0)\cdot(1-0.1\cdot 0)\cdot(1-0.1\cdot 1)\cdot(1-0.2\cdot 0). \\ &= 1 - 1\cdot 0.6\cdot 1\cdot 1\cdot 1\cdot 1\cdot 1\cdot 1\cdot 0.9\cdot 1 = 1 - 0.54 = 0.46.\end{aligned}$$

Table 9. Values of the membership function of fuzzy relation R_1 described by expert E_1–E_4

Items Learning outcomes	I_1	I_2	I_3	I_4
LO_1	0.6,0.9,0.7,0.6	0.4,0.7,0.5,0.9	0.2,0.5,0.6,0.9	0.1,0.4,0,0.3
LO_2	0.5,0.8,0,0.3	0,0.3,0.1,0.4	0,0.3,0.2,0.5	0.4,0.7,0.2,0.5
LO_3	0.3,0.6,0,0,3	0.4,0.7,0,0.3	0.6,0.9,0.5,0.5	0,0.3,0.2,0.5
LO_4	0.2,0.5,0.1,0.3	0.5,0.8,0.3,0.6	0.3,0.6,0,0.2	0.3,0.6,0.6,0.9
LO_5	0.3,0.6,0,0.3	0.3,0.6,0.1,0.3	0.2,0.5,0.1,0.4	0.4,0.8,0.2,0.5

Type 2 Fuzzy Relations

The goal of this section is to present the method of calculation of the levels of learning outcome's acquirement by students based on type 2 fuzzy relations.

Next, define two input fuzzy relations $\widetilde{R_1}$ and $\widetilde{R_2}$ and one output fuzzy relation $\widetilde{R_3}$.

- $\widetilde{R_1}$ denotes the type 2 fuzzy relation between learning outcomes *LO*. and test items $\mathfrak{I}$ and its membership function describes the levels of verification of learning outcomes test items;
- $\widetilde{R_2}$ denotes the type 2 fuzzy relation between test items $\mathfrak{I}$ and students *S*. and its membership function shows, the transformed to interval [0,1], numbers of marks of students for solving test items;
- $\widetilde{R_3}$ denotes the type 2 fuzzy relation between learning outcomes *LO*. and students *S*. and its membership function presents the levels of learning outcome's acquirement by students.

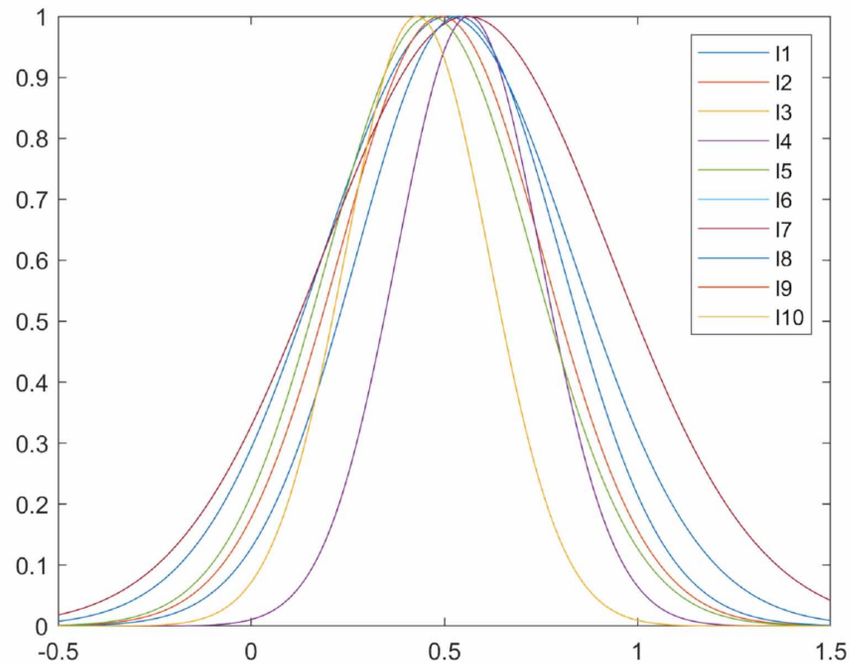
Assume that four experts E_1–E_4 are employed and they estimate levels of learning outcomes' verification by these ten items. Based on their estimation Table 9 is prepared (it is a part of fuzzy relation R_1). The first values, in each cell, are estimations prepared by the first expert, the second values are prepared by the second expert and so on.

Assume that the secondary membership functions be Gauss-like functions $f_{1,2}(x)= \exp(-(x-a)^2/b)$ where, for relation $\widetilde{R_1}$, a and b denote the mean and the standard deviation of experts' estimations and for relation $\widetilde{R_2}$, $a=f_2(k,i)$ and b=0.1 respectively. The type 2 fuzzy relation between learning outcome LO_1 and all items I_1–I_{10} is presented in Figure 2.

Since there are only two different values of the secondary membership functions for $\widetilde{R_2}$ the type 2 fuzzy relation for all students who answered at least one item correctly and at least one incorrectly consists of two Gauss-like functions.

For the calculation of the values of the secondary membership of type 2 fuzzy relation between learning outcomes and students, the algebraic composition was chosen because, in the case of learning outcome's verification, the more students have been studying, the greater levels of learning outcome's acquirement should be (Mrela, Sokolov, Katafiasz, 2015). Hence, after calculating the algebraic S-T-composition of type 2 fuzzy relations $\widetilde{R_1}$ and $\widetilde{R_2}$ type 2 fuzzy relation $\widetilde{R_3}$ between learning outcomes

Figure 2. The type 2 fuzzy relation between learning outcome LO_1 and all items I_1–I_{10}



and students was received. Thus, for example, type 2 fuzzy relation showing the learning outcome LO_1–LO_5's acquirement by the first students is presented in Figure 3.

Moreover, Figure 4 presents the secondary membership functions of type 2 fuzzy relation $\widetilde{R_3}$ between learning outcomes LO_1 and students S_1–S_8 are presented.

Now, the calculations of the level of learning outcome's acquirement (one number) will be performed. Let $f_3(LO_j,S_i)$ be a secondary membership functions of the type 2 fuzzy relation between learning outcome LO_j and S_i where j=1,2,…,5 and i=1,2,…,8. Let the level of learning outcome LO_j acquirement by student S_i be the argument of the maximum of $f_3(LO_j,S_i)$.

Let Table 10 presents the levels of learning outcomes LO_1–LO_5 acquirement by students S_1–S_8.

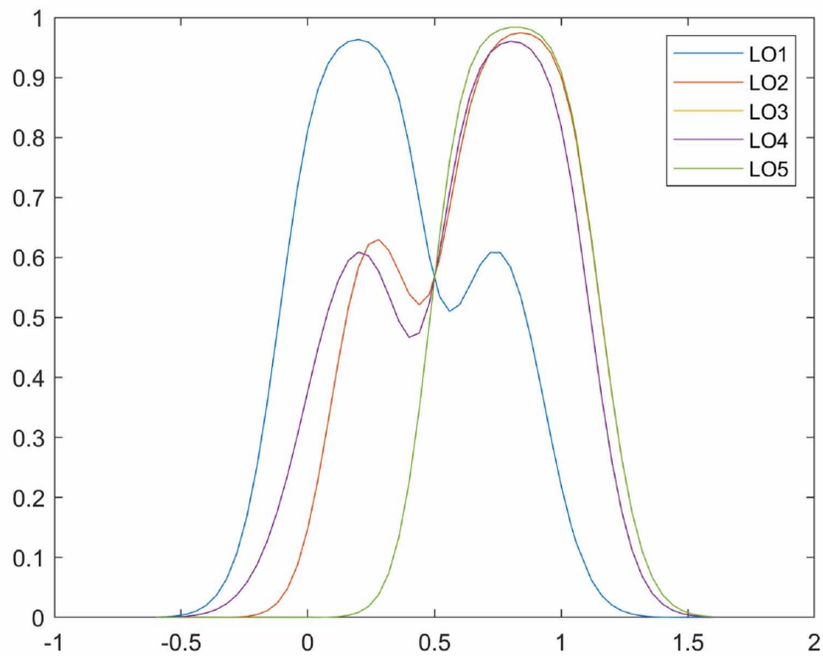
Making Decisions Based on the System of Learning Outcome's Acquirement

In 3 cases values of learning outcome's acquirement by the students were calculated (Table 7 – S-T-composition type Łukasiewicz, Table 8 –S-T-composition type algebraic, Table 10 – type 2 S-T-composition).

Notice that the passing scores might be estimated individually for each learning outcome. Assume that passing scores are estimated by the expert/experts and presented in Table 11.

Hence, in the case of S-T composition type Łukasiewicz, all students acquired all learning outcomes on the sufficient level excluding students S_1 and S_6, who did not acquire learning outcome LO_3 (comp. Table 7).

Figure 3. The type 2 fuzzy relation between learning outcomes LO_1–LO_5 and student S_1



In the case of S-T composition type algebraic, all students acquired all learning outcomes on the sufficient levels excluding students S_1 who did not acquire learning outcomes LO_1 and LO_3 and S_6 who did not acquire learning outcome LO_3(comp. Table 8).

In the case of type 2 S-T composition, students S_2–S_5, S_7 acquired all learning outcomes on the sufficient level. Student S_1 did not acquire any learning outcome and students S_6 and S_8 did not acquire learning outcomes LO_1 and LO_3(comp. Table 10).

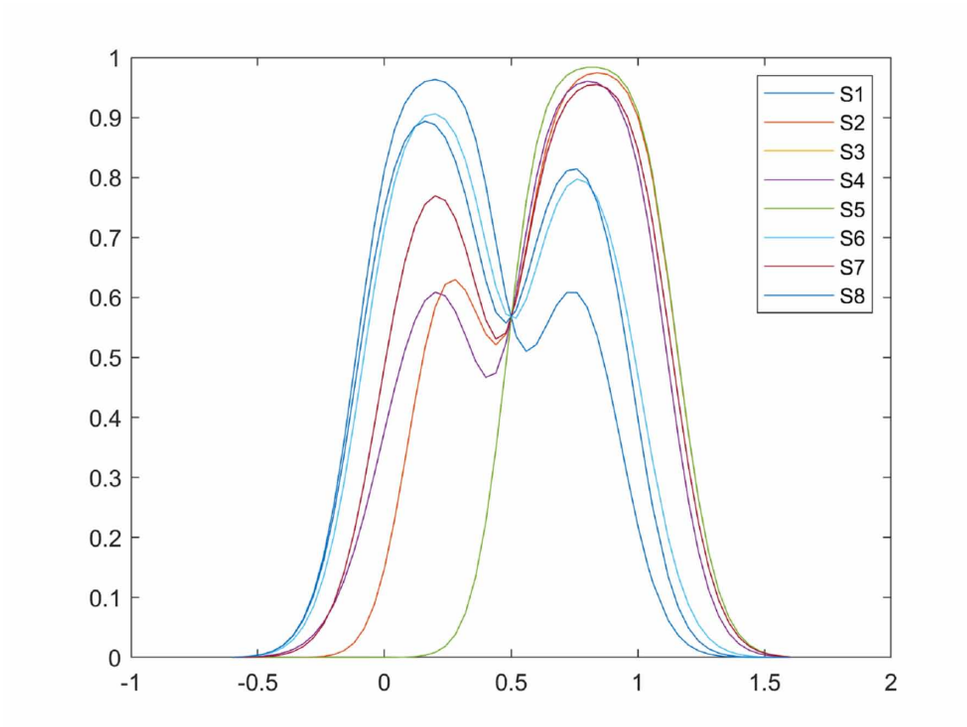
Furthermore, in the case of type 2 fuzzy relations, one more value, called the range will be taken into consideration.

Based on the date from Table 12, the teachers will get more information about student S_1. The acquirement of LO_2 is the most likely because the range is the smallest and the acquirement of LO_5 is the least likely.

FUTURE RESEARCH DIRECTIONS

After designing the model of the expert system based on fuzzy relations for learning outcome's verification, the expert system will be developed and programmed. It can be applied by teachers to assess their students' achievements at the beginning for written tests and eventually for all tasks. After describing the model, an expert system will be programmed and tested whether its results coincide with the teachers' estimations. This system will cover two problems. It will be developed to the help for teachers estimate

Figure 4. The type 2 fuzzy relation between learning outcome LO_1 and students S_1–S_8



their students' results, and then plan the following way of teaching. It is also interesting to develop the system which will prepare a ranking of students based on the levels of learning outcome acquirement. Next, the closed system with a feedback is planned to be designed: teacher – science – student – competence – assessment – change of learning content etc. Hence, this system will be prepared to help students self-assess learning outcomes acquirement, and then choose the path of studying based on their goals and results of learning outcomes achievements.

Table 10. Levels of earning outcomes LO_1–LO_5 acquirement by students S_1–S_8

Learning outcomes Students	LO_1	LO_2	LO_3	LO_4	LO_5
S_1	0.2	0.16	0.24	0.2	0.16
S_2	0.84	0.84	0.8	0.84	0.84
S_3	0.8	0.84	0.84	0.84	0.84
S_4	0.8	0.84	0.84	0.84	0.84
S_5	0.84	0.84	0.84	0.84	0.84
S_6	0.2	0.16	0.84	0.84	0.84
S_7	0.84	0.8	0.8	0.84	0.84
S_8	0.16	0.16	0.84	0.84	0.84

Table 11. Passing scores

Learning outcome	LO_1	LO_2	LO_3	LO_4	LO_5
Passing score	0.5	0.6	0.5	0.4	0.3

Table 12. Levels of learning outcome's acquirement by student S_1 with their ranges

Learning outcome	LO_1	LO_2	LO_3	LO_4	LO_5
Level	0.2	0.16	0.24	0.2	0.16
Range	0.92	0.64	1.120	1.120	1.160

The concept of application of fuzzy relations can be used to develop systems for different areas of social sciences, for example for marketing (evaluation trust in the product dissemination functions) or modeling of scientific publications disciplinary collocation (evaluation the contribution of scientists into scientific disciplines) based on fuzzy aggregation norms (optimistic, pessimistic and realistic).

CONCLUSION

The method proposed for estimation of learning outcome's acquirement based on the results of the test is convenient for teachers because they have to estimate the levels of learning outcome's verification by items of the test. It is much easier because the teachers have to do this estimation once before the test is administered to the students. This method requires the employment of experts (one in the case of the after-one-chapter test or more experts if the test is prepared for final verification like for example estimation of learning outcome's acquirement after secondary school).

Fuzzy relations let the experts and teachers use values from interval [0,1]. After describing two fuzzy relations between learning outcome's verification by test items and between the test items and students, the S-T-composition is used to calculate values of the fuzzy relation between the learning outcomes and the students. In the case of type 1 fuzzy relations, the S-T-composition type algebraic is the best because it fulfills two requirements and gives many different values, so there is more comfortable to distinguish the students.

Fuzzy relations type 2, apart from levels of learning outcome's acquirement, give also likelihoods of them, so the teachers get more information about the students. Moreover, the type 2 fuzzy relations do not force the experts to meet and decide about one level of learning outcome's verification by the items.

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KEY TERMS AND DEFINITIONS

Crisp Set: A set, which each element has got the degree of membership 1 and for a complement of this set, each element has got the membership equals 0.

Fuzzy Relation: A fuzzy set contained into the Cartesian product of spaces.

Fuzzy Set: A set, which each element is accompanied by the degree of membership.

Learning Outcome: A statement which describes the knowledge, skills, and competencies which students should acquire during the course and teachers should assess their acquirement.

S-Conorm: A function of two fuzzy sets which is equivalent to the union of sets in classical logic.

S-T-Composition: A function, based on T-norm and S-conorm, for calculating the composition of two fuzzy relations.

T-Norm: A function of two fuzzy sets which is equivalent to the intersection of sets in classical logic.

Type 2 Fuzzy Relation: A type 2 fuzzy set contained into the Cartesian product of spaces.

Type 2 Fuzzy Set: A set in which each element is accompanied by type 1 fuzzy set.

Chapter 7
Development of the Internet Literacy Indicator for Students (ILAS) and Longitudinal Analysis of Scores

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ABSTRACT

Owing to the fact that ownership of telecommunication devices such as smartphones and tablets has spread among young people, the internet has become very familiar to them. On the other hand, they face the risks of encountering various internet problems. In this study, the authors analyzed and evaluated longitudinal survey data focusing on awareness education policies in order to periodically evaluate the internet environment for young people in line with the Youth Internet Environment Improvement Act Supplementary Provisions Article 3. From the results of the analysis and evaluation, the following were found: 1) although awareness education has spread through school education and family education, its presence in family education is not sufficient and 2) to learn internet literacy, school education plays a major role.

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INTRODUCTION

In recent years, Internet use among young people has been associated with various social problems in many different countries. Examples of these include miscommunication by text, billing fraud, access to illegal content, and contact with ill-intentioned people. Especially in Japan, the use of smartphones has spread very rapidly among teenagers and young people since 2012, generating tremendous changes in their online environment. These changes have triggered the abovementioned problems.

To tackle these problems, "the Act on the Development of an Environment that Provides Safe and Secure Internet Use for Young People" (Act No. 79 of 2008) was enforced in April 2009 in Japan. Because Article 3 defines the skills needed to use the Internet efficiently, it is vital to empower teenagers and young people to develop risk management skills by using the Internet effectively.

Accordingly, it is crucial to optimize educational policy to meet the needs of young people. Doing so will require criteria on which to review the current policy. It is also important to evaluate the Internet literacy of teenagers and young people and to reform educational policy and its implementation to reflect the results of this assessment.

This study aims to develop ILAS, the Internet Literacy Assessment Indicator for Students, making it a more effective and visible tool for developing young people's coping skills, reducing their online risks, and enabling them to use the Internet more safely. This indicator will be evidence-based and designed to optimize educational policy; it can be a decision-making system for designing effective educational policy.

BACKGROUND

Review of Evidence-Based Policy Making

OECD (2012) advised all stakeholders to reduce online risks and provide a safer Internet environment. This recommendation obliges every stakeholder to provide a safer online environment for teenagers and young people. To provide effective protection, it is important to implement a youth protection policy at every level of government and in the private sector and educational organizations. Without clear role definitions, it will be challenging to implement a concrete protection policy.

The most effective way to solve these problems is to think about each problem separately, clarifying the political tasks each sector should deal with. One tactic that can help to achieve this is to adopt an Evidence-Based Policy (EBP).

An EBP is an approach derived from Evidence-Based Medicine proposed by Gordon Guyatt at Manchester University in Canada (Tsutani, 2000). EBP is used in areas such as social policy, educational policy, and welfare policy (Sowaki, 2010). The OECD (2007) has argued that EBP-based policy making enables people and organizations to choose clear and straightforward evidence from among many options. EBP has been widely adopted in various policy areas for evidence-based policymaking.

Nishimura (2005) indicated that evidence should be based on "objective and politically neutral statistical indicators." Such evidence would gain public understanding and help to establish trust between the government and society (OECD, 2004). Additionally, the OECD (2012) has emphasized the need to set indicators as metrics of the evidence, allowing people to visualize the actual condition of each political area.

From these discussions, it seems clear that EBM can be effective in supporting rational decision making for effective educational policy implementation. One key measure to promote the policy will involve establishing an indicator to evaluate the evidence.

Review of the Indicators Adopted in Each Educational Policy Area

In reviewing previous studies related to EBP, this section will focus on studies conducted at the level of government. Examples include the "Flash Eurobarometer" implemented for EU member countries and the "Fact-finding Survey on Young People's Online Usage Environment" conducted by the Japanese Cabinet Office. Additionally, this study will clarify the differences between these earlier studies and ILAS, touching on the social and academic impact of this study.

Review of the International Situation

The EU has been a pioneer in researching this problem, launching the "Safer Internet Program," which conducted actual condition surveys on Internet use in member countries. The EU also conducted quantitative research on children in 2003 and 2004. In 2005, the European Commission conducted a face-to-face questionnaire survey of children from member countries (European Commission, 2005); in 2007, they used a group interview method (European Commission, 2007). In 2008, the EC conducted an actual condition survey of children's Internet use and guardian control policies (European Commission, 2008).

These studies focused on children's actual usage of the Internet, geographic features, psychological conditions, parental controls, and educational policies at home. Their results offered insight into the Safer Internet Program and provided basic data to both InSafe, an international organization that advocates information literacy and morals (European Commission, 2009).

In the UK, former Prime Minister Tony Blair appointed Dr. Tanya Byron (2008) to study children's Internet use and address emerging related social problems. Her results produced detailed policy proposals aimed at clarifying the different roles of the government and private sector. Following Byron's review, the Office of Communications released "Ofcom's Response to the Byron Review" in March 2008, highlighting the need to enhance the media literacy of children and their guardians and to implement self-regulation by industry groups. This report also identified the regulation of content delivery and user access as crucial methods for the self-regulation of industry groups (Office of Communications, 2008).

In the United States, additional surveys were conducted by private and non-political organizations and think tanks. For example, the Family Online Safety Institute (2013), which advocates online safety for children and their families, conducted qualitative and quantitative studies on 558 children between the ages of 13–17, living in the US. Their results showed that the number of children connecting online through mobile phones increased from 43% in 2012 to 64% in 2013. The Pew Research Center (2012) researched the experience of parental control, surveying 802 guardians of children aged 12–17. Their results revealed that women (51% vs. 49% of men) under 40 years old (54% vs. 48% over 40), who were white (59% vs. 31% African American), and had higher household incomes were the main users of parental control methods. Additionally, the Cyberbullying Research Center (2015) reported the results of a survey on the impact of cyberbullying on the lives of 15,000 American children since 2002. The Center's results suggested that the number of children exposed to cyberbullying had increased from 18.8% in 2007 to 36.6% in 2014.

The Organization for Economic Cooperation and Development (OECD) has emphasized the importance of evidence-based policymaking. The OECD Council adopted a "Recommendation on the Protection of Children Online" in February 2012, aiming to establish a foundation to promote co-regulation by each stakeholder for efficient policy implementation to address the identified problems (OECD, 2012). This recommendation focused on the need for an evidence-based policymaking approach for managing complex policy through enhanced policy coordination. For example, it suggested that enhanced Internet literacy among children and their guardians would be a viable solution, to be determined by evaluating usage.

Saito (2015) reported the results of an Internet Literacy Assessment Indicator for Students (ILAS) developed through a collaborative effort by the OECD Science, Technology and Industry Directorate, and the Japanese Ministry of Internal Affairs and Communications. This project targeted adolescents, measuring their capacity to use the Internet safely and securely. This report investigated the differences in the ILAS test score of students who had bad experiences online and those who had not. It found that the percentage of questions answered correctly by students who had bad experiences online was higher than that of those who had no bad experiences (71% vs. 65%). Thus, adolescents can develop online literacy by coping with bad experiences through Internet usage. These reports recommended that the policy not be too strict (e.g., an online ban), and that worldwide policy should support adolescents in developing online literacy through online experience, while promoting filtering measures, to be implemented through a step-by-step approach.

Review of the Japanese Situation

In Japan, the Cabinet Office has conducted an annual "fact-finding survey on young people's online usage environment" to assess the online usage of teenagers and young people, and their guardians' approach to protection since 2009. The main data gathered reveal hours of online use, geographical locations, and aspects of youth behavior (Cabinet Office, 2014). Guardians were asked about filtering and rules at home.

Article 3 of the "Act on Establishment of Enhanced Environment for Youth's Safe and Secure Internet Use" Appendix defines the role of the government in terms of conducting reviews: three years after implementation, appropriate measures will be summarized and undertaken. Following Article 3, a survey has been conducted to evaluate the improvement of young people's online environment. Its primary purpose was to gather basic data to evaluate the online use and behavior of teenagers and young people, as well as filtering recognition, filtering usage, and the drawbacks of filtering.

The Importance of the Internet Literacy Assessment Indicator

As mentioned, every government organization is constantly evaluating children's online usage. These results reveal the situation regarding children's online usage, education, parental education, and views of parental control. By reflecting these results for educational policymaking, it will be possible to establish a protection policy for children and their parents. Political costs will be kept to a minimum by appropriately implementing effective policies.

To enhance the effectiveness of EBP, "children's ability to avoid online risks" should be evaluated, even though this factor was not included in the EU's "Flash Eurobarometer" or the Japanese Cabinet Office research. In this section, it will be argued that problems can be tackled by evaluating "children's ability to avoid online risks."

Adjusting the Strength of Child Protection Measures

By evaluating children's ability to avoid risks, it is possible to adjust the strength of technical measures for child protection, such as filtering. When filtering became obligatory, the Ministry of Internal Affairs and Communications working team focusing on illegal and harmful online content argued that there were three major problems.

The first is the uniformity problem: the question of whether uniform filtering is appropriate, given the full range of risk competency among children of elementary school to high school age. The second problem involved filtering technology. Under the white list algorithm, many harmless websites are excluded; only official websites can be accessed. Conversely, a blacklist algorithm blocks all websites in certain categories, regardless of whether these websites are harmful or not. The last problem involves convenience: whether controlling access to community websites that are essential to children's social life is appropriate or not (Ministry of Internal Affairs and Communications, 2008).

By evaluating children's ability to avoid risks, it will be possible to adjust the strength of technical measures for child protection to reflect a child's developmental status and computer literacy level. This adjustment will not only optimize the level of online protection but will also ensure that children have as much freedom in their online activities as possible.

Optimization of the Awareness Educational Policy

By evaluating the children's ability to avoid risk, it will be possible to optimize the content of awareness education. Awareness education has depended on the discretion of educators and a limited discussion about whether to include or make teaching children about online risks a priority.

The indicator will make every risk avoidance ability that children should visibly acquire; consequently, educational content will be optimized. The optimization of educational content can and should also be customized to reflect children's skills.

Previous research results were not able to offer enough adjustment for child protection. For example, earlier research evaluated the number and type of educational experiences but failed to assess how much online risk avoidance ability was acquired. It was challenging to assess child protection policies because it was impossible to evaluate which types of ability were inadequate.

If online risk avoidance ability is evaluated, it will be possible for education to focus on building the abilities that children lack. Moreover, by knowing which ability is insufficient, changing the specifications of online services for children, and reviewing several policies based on current lows, such as the "Act for the Establishment of an Enhanced Environment for Young People's Safe and Secure Internet Use," will be possible.

Policy-Making That Reflects Personal and Regional Backgrounds Will be Possible Through This Analysis

Although this study has aimed to establish indicators that can evaluate the online risk avoidance ability of children, it will also help to design protection policy that reflects personal and regional backgrounds; it can achieve this by analyzing the relationship between children's test scores and background information. For example, by analyzing the relationship between risk avoidance ability test scores and regional data, it will be possible to show children's average risk avoidance ability in each region. This will make it

possible to establish child protection policies that reflect regional differences. Implementing customized awareness education in each region will enhance children's risk avoidance ability and lead to a regional and national enhancement of skills.

SOLUTIONS AND RECOMMENDATIONS

The Development and Implementation of ILAS by the Japanese Government

These discussions show that evaluating young people's online literacy and reforming and implementing an educational policy that reflects these results will optimize the educational policies of all stakeholders for each childhood developmental phase. It is, therefore, important to develop Internet literacy indicators based on previous EBP to evaluate children's risk avoidance ability. By using risk avoidance ability as evidence, offering appropriate protection to children, while ensuring their online freedom, will be possible.

In Japan, the Ministry of Internal Affairs and Communications developed the Internet Literacy Assessment Indicator for Students (ILAS) in 2012 to implement the OECD recommendations at a government level. ILAS aims to measure children's online literacy skills and to evaluate their ability to cope with typical online risks.

ILAS systematically defined "the ability all children should acquire against online risks" (see Table 1). It is the indicator used to evaluate these abilities using a test (the National Institute for Information and Communications Policy, 2012). It is similar to the OECD's PISA test, which evaluates the academic skills of 15-year-old students; however, ILAS evaluates online risk coping skills. Like the PISA test, ILAS evaluates children's ability to cope with online risks and visually represents its results by area. It also provides "criteria for judgment" for governmental and regional decision-making, online companies' social responsibility, the activities of child protection organizations, and school decision-making.

Analysis Concept

Indicators for the Longitudinal Analysis

To evaluate the progress of the youth's ability to use the Internet appropriately and dissemination of the awareness educational policy propagated by the "Act on the Development of an Environment that provides Safe and secure Internet use for Young People," it is useful to analyze longitudinal data on adolescents' ability to properly use the Internet and on the awareness educational experience at school and home.

Therefore, the progress of the awareness educational policy is evaluated by analyzing the data collected through the ILAS national survey. The ILAS was developed as an index to evaluate two areas. The first area is testing the knowledge domain to measure online literacy proficiency[1], and the second is a questionnaire used to examine subjects' Internet usage, awareness educational, and cognition statuses for safe and secure use (National Institute for Information and Communications Policy, 2012).

Data Used for the Longitudinal Analysis

The data used in this analysis were collected in the longitudinal survey of "Adolescent's Internet literacy etc." conducted by the Ministry of Internal Affairs and Communications from 2012–2014.

Table 1. Classification table of online risks

Main Category	Significant Category	Sub-Category
I Illegal & Harmful Information Risks	A Illegal Information	1 Copyright, portrait rights, criminal threats, dating sites, etc.
	B Harmful Information	1 Content offensive to public order and morality, adult-only content, etc.
II Inappropriate Usage Risks	A Inappropriate Contact	1 Libel
		2 Anonymous SNS
		3 Non-anonymous SNS
		4 Spam
		5 Applications
	B Improper Transactions	1 Fraud, sale of improper products, etc.
	C Inappropriate Usage	1 Excess Internet consumption
		2 Dependence
III Privacy & Security Risks	A Privacy Risks	1 Leakage of private and/or personal information, inappropriate disclosure
	B Security Risks	1 Impersonation through unauthorized access, etc.
		2 Viruses

Source: National Institute for Information and Communications Policy (2012)

In 2012, surveys were conducted on 2,937 high school first graders from 23 schools nationwide. In 2013, surveys were conducted on 3,598 high school students from 24 schools nationally. In 2014, surveys were conducted on 3,672 high school students from 22 schools nationally (Table 2). Each year, the contents of the survey included responses to 49 test questions used to measure the online literacy

Table 2. Survey outline for 2012, 2013, and 2014

Year	Period	Districts	Method	Number
2012	June–July 2012	Total: 23 high schools Hokkaido district: 1, Tohoku district: 2, Kanto district: 5, Hokuriku district: 2, Shinetsu district: 2, Tokai district: 3, Kinki district: 3, Chugoku district: 1, Shikoku district: 1, Kyushu/Okinawa district: 3	CBT (Computer Based Test)	2,937 (Number of valid answers: 2,464)
2013	May–July 2013	Total: 24 high schools Hokkaido district: 1, Tohoku district: 1, Kanto district: 5, Hokuriku district: 1, Shinetsu district: 2, Tokai district: 3, Kinki district: 5, Chugoku district: 1, Shikoku district: 1, Kyushu/Okinawa district: 4		3,598 (Number of valid answers: 3,512)
2014	June–July 2014	Total: 22 high schools Hokkaido district: 1, Tohoku district: 1, Kanto district: 5, Hokuriku district: 1, Shinetsu district: 2, Tokai district: 3, Kinki district: 3, Chugoku district: 1, Shikoku district: 1, Kyushu/Okinawa district: 4		3,672

Source:Listed by author referring to the Ministry of Internal Affairs and Communications (2012, 2013, and 2014)

of 15-year-old adolescents, and questionnaires to investigate the actual use of the Internet and their psychological aspects.

In this study, the data obtained in the tests and questionnaires were evaluated.

The Focus of Longitudinal Survey Data Analysis

To assess whether the ability to use the Internet properly has progressed, changes in the average correct answer rate of the ILAS literacy test from 2012–2014 were analyzed to determine any statistically significant differences. This analysis enabled judging whether the ability of 15-year-old adolescents to use the Internet properly is probabilistically significant. Additionally, an itemized evaluation of online literacy for various risks was conducted. In ILAS, each risk that may be encountered using the Internet is systematically compiled. In the significant risk categories of ILAS, "Illegal Information (Ia)" and "Harmful Information (Ib)" are defined as the ability of groups to cope appropriately with illegal and harmful content on the Internet. Additionally, "Inappropriate Contacts (IIa)," "Improper Transactions (IIb)," and "Inappropriate Usage (IIc)" are defined as the ability of groups to communicate appropriately on the Internet. Furthermore, "Privacy Risks (IIIa)" and "Security Risks (IIIb)" are defined as the ability of groups to protect privacy and security online. By statistically clarifying the progress of online literacy for each of these seven risk items, it was possible to evaluate what type of risk knowledge has progressed.

Evaluating the progress of the awareness educational policy from 2012–2014 reveals the direction of the awareness education policy for the future.

ANALYSIS OF LONGITUDINAL SURVEY DATA

The analysis of the survey data for 2012–2014 clarifies the progress of the ability of Japanese 15-year-old youths to use the Internet appropriately and measures the changes in the actual conditions of use. First, the changes in the average correct response rate of the ILAS test is analyzed to determine whether these are statistically significant to assess the ability of 15-year-old adolescents to cope with risk.

Analysis of the Changes in the Average Correct Answer Rate of the Literacy Test

Analysis of Changes in the Total Score of ILAS Literacy Test

The Ministry of Internal Affairs and Communications (2015) compared the average correct answer rate of the ILAS literacy test results from 2012–2014. Reportedly, the average correct answer rate demonstrated an increasing trend: 67% in 2012, 68.9% in 2013, and 70.2% in 2014. Therefore, an analysis of variance was performed to examine whether this upward trend in online literacy could be statistically secured. The results of the analysis of variance were $F(2, 9644) = 2.997$, $p < .001$, indicating that online literacy significantly increased statistically. Furthermore, to clarify the degree of the upward trend of online literacy, the rate of change in 2014 was calculated as 4.8%, assuming that the correct answer rate in 2012 was 100 (see Table 3).

Based on the analysis, the knowledge of adolescent 15-year-olds on Internet risk is gradually deepening.

Table 3. Transition of average correct answer rate in ILAS, 2012–2014

Year	Sample Number	Average Number of Correct Answers	Average Correct Answer Rate (%)	SD
2012	2,463	32.8	67.0	8.26
2013	3,512	33.7	68.9	7.33
2014	3,672	34.4	70.2	6.96

Analysis of Changes in Average Correct Answer Rate in Each Risk Category

Next, examining changes in the average correct answer rate for the seven significant risk categories defined in the ILAS clarifies what type of Internet risk knowledge has statistically progressed (see Table 4). In the significant category of Illegal Information (Ia: Copyright, portrait rights, criminal threats, dating sites, etc.), which is on the lower layer of the ILAS Main Risk Category "I: Illegal and Harmful Information Risk," a slight increase was evident in the average correct answer rate to 76.1% in 2014 from 75.5% in 2012. However, the analysis of variance was $F(2,964) = 2997$, $p>.05$. Thus, statistically, no change was evident for the learning situation regarding literacy. Conversely, regarding Harmful Information (Ib: Content offensive to public order and morality, Adult-only content, etc.), a slight increase was indicated in the average correct answer rate to 67.5% in 2014 from 66% in 2012, and the rate of change was 2.3%. The result of the analysis of variance was $F (2, 964) = 2997$, $p <.001$, confirming statistical progress in terms of online literacy.

In the significant category of Inappropriate Contact (IIa: Libel, Anonymous social networking site [SNS], Non-anonymous SNS, Spam, Applications), which was on the lower layer of the ILAS Main Risk Category "II: Inappropriate Usage Risk," a substantial increase was evident in the average correct answer rate to 78.3% in 2014 from 71.7 in 2012. The rate of change was 9.2%. The result of the analysis of variance was $F(2, 964) = 2997$, $p <.001$, verifying statistical progress in terms of online literacy. Additionally, regarding Improper Transactions (IIb: Fraud, Sale of improper products, etc.), the average correct answer rate in 2014 was 58.7% compared to 55.1% in 2012. The change rate was 6.47%. The analysis of variance resulted in $F(2,964)=2997$, $p<.001$, demonstrating statistical progress in terms of online literacy, even for Improper Transactions. Furthermore, for Inappropriate Usage (IIc: Excess Internet consumption, Dependence), the average correct answer rate in 2012 was 74.92% and 79.3% in 2014, and the rate of change was 5.8%. The results of the analysis of variance were $F(2,964)=2,997$, $p<.001$, indicating statistical progress in online literacy for Inappropriate Usage.

In the significant category of Privacy Risks (IIIa: Leakage of private and/or personal information, Inappropriate disclosure), which was on the lower layer of the ILAS Main Risk Category "III: Privacy and Security Risks," the average correct answer rate increased to 68.9% in 2014 from 66.4% in 2012. The rate of change was 3.8%. The results of the analysis of variance were $F(2,964)=2,997$, $p <.001$, showing statistical development in terms of online literacy. Additionally, regarding Security Risks (IIIb: Impersonation through unauthorized access, Viruses), the average correct answer rate in 2014 increased to 62.9% from 59.5% in 2012. The change rate was 5.6%. The results of the analysis of variance were $F(2,964)=2997$, $p<.001$, also confirming statistical progress in online literacy for Security Risks.

Table 4. Transition and rate of change of correct answer rate in each risk category

Category	Year	Sample Number	Average Number of Correct Answers	Average Correct Answer Rate (%)	SD	Rate of Change (%) (2012=100)	P-Value
1a	2012	2,463	5.29	75.5	1.44	0.80	n.s.
	2013	3,512	5.34	76.3	1.36		
	2014	3,672	5.33	76.1	1.31		
1b	2012	2,463	4.62	66	1.36	2.32	***
	2013	3,512	4.77	68.2	1.24		
	2014	3,672	4.73	67.5	1.19		
2a	2012	2,463	5.02	71.7	1.59	9.16	***
	2013	3,512	5.28	75.4	1.44		
	2014	3,672	5.48	78.3	1.37		
2b	2012	2,463	3.86	55.1	1.53	6.47	***
	2013	3,512	3.99	57.0	1.46		
	2014	3,672	4.11	58.7	1.46		
2c	2012	2,463	5.24	74.9	1.58	5.82	***
	2013	3,512	5.40	77.1	1.44		
	2014	3,672	5.55	79.3	1.41		
3a	2012	2,463	4.65	66.4	1.64	3.78	***
	2013	3,512	4.74	67.7	1.48		
	2014	3,672	4.82	68.9	1.45		
3b	2012	2,463	4.17	59.5	1.55	5.62	***
	2013	3,512	4.27	61	1.46		
	2014	3,672	4.40	62.9	1.44		

Evaluation and Challenges of Youth Protection Policy Based on the Analysis

In this chapter, based on the results of the analysis, the progress of the awareness education policy propagated in the "Act on the Development of an Environment that Provides Safe and Secure Internet Use for Young People" will be evaluated and the future direction of the policy examined.

Article 3 of the Act on the Development of an Environment that Provides Safe and Secure Internet Use for Young People defines the importance of young people acquiring the skills needed to use the Internet efficiently. The analysis in this study revealed that the ability of 15-year-old adolescents to use the Internet properly had progressed statistically. Furthermore, regarding the progress of literacy for each risk item, progress in online literacy was evident for the six risk items, excluding Illegal Information (Ia), and the difference was statistically significant. The rate of change in online literacy was particularly large for the following three risk items: 9.16% for Inappropriate Contact (IIa: Libel, Anonymous social networking site [SNS], Non-anonymous SNS, Spam, Applications), 6.47% for Improper Transactions (IIb: Fraud, Sale of improper products, etc.), and 5.82% for Inappropriate Usage (IIc: Excess Internet

consumption, Dependence). Thus, it was statistically shown that the development of online literacy in the ability to communicate properly on the Internet was remarkable.

As the correct answer rate for Inappropriate Contact (IIa) increased significantly to 9.16%, it is believed that the use of SNS has spread among adolescents and become more constant. With the increasing number of adolescents constantly using SNS, it is presumed that opportunities to acquire knowledge on the risks related to SNS use are also increasing. This is because, in the case of awareness education in schools, there is a tendency to focus on high risks faced by young people as learning items.

Next, Improper Transactions (IIb) increased by 6.47%. The underlying factors, fraud, sales of inappropriate products, and so on are classified as sub-categories of Improper Transactions; however, these risks are closely monitored as social risk issues, not only for adolescents. Consequently, it is speculated that these risks are becoming increasingly important in learning in awareness education.

Inappropriate Usage (IIc) increased by 5.82%. Expanding opportunities for online communication, including SNS, is believed to increase the opportunity to recognize the risk of overconsumption and dependency, for example.

Additionally, the risk category with a high change rate is Security Risks (IIIb), which includes the sub-categories of impersonation through unauthorized access, viruses, and so on. Given today's risk environment, it is presumed that awareness of security risks is not only increasing in Japan but also in the international community, meaning there is a growing need to provide coping strategies for such risks.

As discussed, the ability of 15-year-old adolescents to use the Internet appropriately is increasing, reflecting the effects of the awareness education policy.

FUTURE RESEARCH DIRECTIONS

From the analysis in this study, future research issues have been identified. This study assessed the progress of the awareness education policy from the perspective of acquiring the literacy required to avert adolescents' Internet usage risks. However, even if literacy has been acquired, the possibility of getting into trouble without actual action cannot be denied.

Evans (2008) indicates two important behavioral patterns: behavior based on consideration and behavior based on instinct and emotion. Even if adolescents have acquired knowledge to avert risks, they will still not be able to exercise self-restraint if driven by their emotions (Walter, 2014). Thaler and Sunstein (2008) highlighted a policy strategy that guides such emotional behavior in a socially appropriate way from a public policy perspective.

Research on this behavioral public policy approach to balance knowledge and emotion provides a new policy approach to youth protection issues that cannot be solved by focusing on literacy alone. This research theme will be addressed in a future research topic.

CONCLUSION

This study focused on the development, operation, and evaluation of the Internet Literacy Index to ensure that the youth protection policy is effectively implemented to counter various risks emerging from the Internet to maximize the youth's freedom in using the Internet. The policy to improve the Internet environment of adolescents can be optimized by adopting an evidence-based policy through a probabilistic

approach. This is because human decision-making tends to take limited information and practice unreasonable decision-making from the psychological viewpoint, causing various biases among policymakers. Adopting evidence-based policies will streamline youth protection policies by reducing such biases.

In particular, this study aimed to develop an index system to measure adolescents' ability to cope with Internet risk as an evidence-based policy. This enables visualizing real risks regarding adolescents' coping ability, which could thus far not be clarified by previous research. Moreover, it provides a quantitative basis to the government and private organizations to balance adolescents' freedom and protection in Internet use.

Furthermore, this study focused on the progress of the awareness education policy to perform a longitudinal evaluation of the progress of the protection policy for adolescents who use the Internet, which was the aim of Article 3 of the "Act on the Development of an Environment that Provides Safe and Secure Internet Use for Young People." The results of the analysis of data from longitudinal surveys of 15-year-old adolescents confirmed the progression of their Internet literacy.

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KEY TERMS AND DEFINITIONS

Awareness Education: Education designed to enhance knowledge/attitudes that can help to avoid various online risks and ensure appropriate internet use.

Evidence-Based Policy: A policy-making method based on evidence. It was first advocated as Evidence-Based Medicine by Gordon Guyatt, University of Manchester, Canada, in 1991. It has subsequently been used widely in social policy, educational policy, and social welfare policy.

Internet Literacy Assessment indicator for Students (ILAS): An indicator developed to evaluate online literacy, especially the effectiveness of coping skills/morals in reducing online risks/threats. It was released by the Ministry of Internal Affairs and Communications in September 2012.

Online Risks: Inclusive term covering various online risks, including cyberbullying, online addiction, cyber grooming, security problems, and the leakage of personal information.

Risk Categories: Classification of online risks defined by ILAS. ILAS classifies three major online risks as Illegal & Harmful Information Risks, Inappropriate Usage Risks, and Privacy & Security Risks. It also defines seven significant categories and 13 sub-categories. Additionally, it defines 186 coping skills, which can be used to protect against online risks.

ENDNOTE

[1] In developing the ILAS test system, verification is performed using classical test theory (reliability coefficient, discrimination index, and factor analysis by principal axis method) to ensure reliability as an index. Refer to the verification results, which are included in the Ministry of Internal Affairs and Communications Information and Communications Policy Research Institute (2012).

Chapter 8
Quality Videos and Integrated Performance Assessments Are Essential in the World Language edTPA

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ABSTRACT

For more than 60 years, educational reform in the United States of America has been driven by four major questions revolving around teacher attributes, effectiveness, knowledge, and outcomes. Today, outcomes for not only students but also for those who teach them have become a focal point. The purpose of this chapter is to discuss the World Language edTPA—a performance-based, subject-specific assessment for pre-service teachers in 27 content areas that is now in place in 41 states and the District of Columbia. The authors begin by highlighting educational policy and best practices in teaching languages before providing research-based suggestions regarding the development of a high-quality portfolio by focusing on video recording considerations and the use of the integrated performance assessment.

INTRODUCTION

For decades teacher education has been under siege (Swanson, 2017), and teacher preparation in the United States continues to be in educational reformers' crosshairs more than ever these days (Cochran-Smith, 2000). While the Trump administration has focused largely on financial and geopolitical issues, teacher preparation has been the focus since the 1960s when President Lyndon B. Johnson introduced legislation known as the War on Poverty, which Congress passed into law as the *Elementary and Secondary Education Act of 1965* (ESEA) in 1965 (P.L. 89-10). With such massive impact, the ESEA act

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essentially jump-started the next 60 years of educational reform in the United States (US). Cochran-Smith (2000) advanced the notion that since the mid-1950s educational reform can be documented in terms of four major driving questions: teacher attributes, effectiveness, knowledge, and outcomes. She noted that the political climate shaped the order in which these questions emerged, the kind and degree of public attention afforded to K–12 education, the demand for and supply of teachers, state and federal policies regarding funding, and even perceptions of teacher education as a profession.

Attributes

Beginning with the Eisenhower administration through the 1960s, the Attributes question inquired about the characteristics and of potential teachers, qualities of good teachers and teacher education programs at the time when President Eisenhower and other world leaders noted a severe shortage of language teachers (Swanson, 2012). In terms of teaching world languages (WLs), there were few empirical studies focused on language teachers. Researchers investigated the personal characteristics of teachers, and those that trained them, such as having a friendly voice free of a strong foreign accent and good pronunciation based on accepted standards of usage (Los Angeles City Schools, 1963). Language teaching organizations such as the Modern Language Association promoted the notion that language teachers must be able to command the target language (TL), and they must have factual and conceptual knowledge from various disciplines as well as strong pedagogical knowledge (Axelrod, 1966).

Effectiveness

From the late 1960s through the first Reagan administration in the 1980s, a shift of focus began to emerge with a focus on examining the attributes of teachers and preparation programs. The emphasis on studying teacher and preparation program attributes was replaced with what it means to be an effective instructor. Questions revolved around effective teaching processes and strategies and what teacher education processes were most effective in ensuring that pre-service teachers learn these strategies. Researchers placed attention on effective teaching processes and strategies and what teacher education practices were the most successful in confirming that pre-service teachers learn and use these strategies. It was at this time that many teacher preparation programs invested in and developed systems for evaluating pre-service teachers according to certain objectives as well as performance criteria (Gage, 1972).

With respect to language teaching, for example, world language (WL) program improvement was developed for Indiana colleges and universities focusing on five stages: (1) identifying practices in foreign language (FL) methods in colleges and universities, (2) creating dialogue among methods teachers, (3) enlisting administrator and cooperating teacher support, (4) establishing priorities from the *Guidelines for Teacher Education Programs in Modern Language*, and (5) developing seminars on content, materials, and teaching practices for methods courses in WL teaching (Strasheim, 1967). Other research focused on comparing the effectiveness of different language teacher preparation programs (McInnis & Donoghue, 1980)

Knowledge

From the midpoint of the Reagan administrations in the 1980s and continuing through the Clinton administrations in the 1990s, governmental, and later public, concern about teacher education and teacher

quality became the focus (Cochran-Smith, 2000) with the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983)—a scathing portrayal of the American educational system. Reform reflected a shift from *what effective teachers do* to focus on *what they know*, and perhaps even more important, *what they need to know and be able to do*. Additionally, questions revolved around what the teacher knowledge base should be. Research on WL teaching and learning, for example, focused on comparative analyses of expert WL teachers' reflective-narrative discourse (Olshtain & Kupferberg, 1998) and pedagogical knowledge (Gatbonton, 1999).

Outcomes

Arguably what can be considered one of the most debated educational topics of the new millennium is the Outcomes Question— "how to measure and demonstrate the outcomes of teacher education" (Cochran-Smith, 2000, p. 18). Policy makers at all levels and educational testing companies began to formulate questions about "how we should conceptualize and define the outcomes of teacher education for teacher learning, professional practice, and student learning, as well as how, by whom, and for what purposes these outcomes should be documented, demonstrated, and/or measured" (Cochran-Smith, 2001, p. 1). The question's foundation posits that the definitive goal of teacher education is student learning, and that there are certain objective measures that can be used to determine the degree of success or failure for learners, pre-service teachers, teacher education programs, and institutions of higher education that prepare teachers (Cochran-Smith, 2000).

Noting the educational landscape of the Outcomes question, the Stanford Center for Assessment, Learning, and Equity (SCALE, n. d.) began to develop edTPA as a "uniform and impartial process to evaluate aspiring teachers" (p. 1). After working directly with teachers and teacher educators along with drawing from experience "gained over 25 years of developing performance-based assessments of teaching (including the National Board for Professional Teaching Standards, the InTASC Standards portfolio, and the Performance Assessment for California Teachers)" (p. 1), this high-stakes assessment of beginning teacher readiness was developed, pilot tested in the field, refined, and ultimately branded for use. Early research on the WL edTPA highlighted serious problems with the portfolio, (Hildebrandt & Swanson, 2014), especially in the area of assessment of student learning. In this chapter, the authors present edTPA in the context of WLs and then discuss the importance of two facets of creating a high-quality WL edTPA portfolio.

BACKGROUND

As advanced by legislation at the local, state, and national levels since the introduction of the ESEA act in 1965, the goal for education in the US is improving student learning for all students. While Muijs (2006) noted that such a goal remains challenging, it is without a doubt that the measurement of teacher effectiveness is a critical component of reaching such a lofty objective.

Teacher Portfolio Assessment

For decades, "teachers have been increasingly required to prove that they have demonstrable teaching competencies" (Hammadou-Sullivan, 2004, p. 390), and portfolios have served as a medium for such

assessment. A review of the literature suggests that there is a quandary as to what to include in a teaching portfolio, which can be particularly challenging for WL teachers (Hammadou-Sullivan, 2004) because administrators that seek to hire these novice teachers have little to no experience in teaching and learning a second language (L2). Wright, Knight, and Pomerleau (1999) suggested at the turn of the century that there was a "lack of good research evidence about their impact" (p. 92).

Nevertheless, pre-service teacher candidates' performance was measured via portfolio assessments. At the turn of the century, pre-service teachers created an assessment plan, provided evidence of instructional decision-making, gathered and interpreted student data, demonstrated that they used student learning assessment data to adjust their teaching, and communicated with others about students' progress via *The Teacher Work Sample* (Renaissance Partnership for Improving Teacher Quality, 2002). A few years later, researchers designed the *Performance Assessment for California Teachers* (PACT) in order to measure a teacher candidate's knowledge, skills and abilities to teach and assess K-12 students (Sato, 2014). Grounded in the National Board for Professional Teaching Standards for veteran teachers, the PACT served as the basis for the development of edTPA (Sato, 2014.)

edTPA

As noted earlier, edTPA was developed by SCALE, pilot tested in several states beginning in 2011, and marketed as a nationally-available performance assessment of novice educators' readiness to teach in 27 different content areas (SCALE, 2013). Collaborating with the American Association of Colleges for Teacher Education and administered online by Pearson, edTPA is administered across institutions and states and reliably scored by experts in teaching (Sato, 2014). Presently, edTPA is in various stages of implementation in 929 educator preparation programs in 41 states and the District of Columbia (American Association for Colleges of Teacher Education, 2020) in order to inform initial teacher licensure and certification decisions. For example, in the state of Alaska there is at least one educational provider exploring edTPA's use as a performance-based assessment at present. In other states such as Georgia and Illinois, edTPA was being pilot tested beginning in 2012 and became a requirement for certification in September 2015.

In most cases, pre-service teachers create their portfolios during their final field placement, also known as student teaching. The portfolio centers on three tasks: (1) Planning for Instruction and Assessment, (2) Instructing and Engaging Students in Learning, and (3) Assessing Student Learning. Success on the WL edTPA is measured by thirteen 5-point Likert-scale rubrics. The 5-point scale describes a person's pedagogical knowledge and skills on a continuum ranging from teacher candidates who are not ready to teach to being very well-qualified individuals to teach (SCALE, 2013). A teacher candidate's total score can range between 13 to 65 points. Given that individuals creating an edTPA portfolio are novice educators at best, they are not expected to be in the advanced range of the rubrics (i.e. earning scores of 4 and 5 on the rubrics).

As noted by SCALE (2019A), "states may set their own passing scores based on state standard-setting panels that take into account state-specific data, measurement data, and state's policy considerations" (p. 1). While official cut scores for edTPA have yet to be set at the national level, individual states have established cut scores that currently range between 32 and 35 for the WL edTPA (SCALE, 2017). For example, a cut score of 29 for the WL edTPA was set in Georgia for Fall 2015 enactment (Georgia Professional Standards Commission, GAPSC, 2015). And each year the score can be increased. In 2019, the required score in Georgia increased to 32 for WL teacher candidates (SCALE, 2019).

Early research on the WL edTPA in two programs, one in Georgia and one in Illinois, indicated that of the three tasks, teacher candidates "were most successful in the planning tasks and least successful in the assessment tasks" (Hildebrandt & Swanson, 2014, p. 584). The researchers stated that such findings may be explained by typical curricula in WL teacher preparation programs. That is, while pre-service teachers spend substantial time on developing pedagogical prowess and even have opportunities to teach lessons with students in K-12 schools when placed in schools for practicum placements and student teaching, very infrequently are they creating assessments and analyzing student performance data. During field placements like student teaching, these individuals most likely have access to K-12 student data because they are in charge of the classroom typically. However, it is during this time when they are creating their edTPA dossiers. Thus, prior to student teaching, teacher candidates do not have sufficient opportunities to collect and analyze data, which is required by edTPA. By the time they have access to student data, the researchers posit that it is too late for them to learn how to analyze data and determine a course of action for later instruction.

BEST PRACTICES IN WORLD LANGUAGE ASSESSMENT OF STUDENT LEARNING

The teaching and learning of WLs has seen a paradigm shift in recent years. This shift has moved language instruction away from adherence to strict grammar translation, the audio-lingual approach, and other methodological emphases toward the current belief that language learners need and want to engage in activities that involve significant TL communication (Shrum & Glisan, 2016). Once known as teaching the four skills (i.e., reading, writing, listening, and speaking) in the TL, WL instruction and assessment is now conceptualized in the communicative language teaching (CLT) approach that places the emphasis on language function rather than form (Nunan, 1991). Learners want to be able to *use* the language rather than merely learn *about* the language. To that end, CLT promotes instruction that primarily incorporates activities using the TL in myriad authentic tasks that learners recognize as real-life possibilities and situations (Lee & VanPatten, 2003). Buttressed by the position statement of the American Council on the Teaching of Foreign Languages (ACTFL, 2010) stating that the classroom goal should be 90% TL use by *both* teachers and learners, CLT has revolutionized how instruction in language classrooms is conceptualized and carried out.

This paradigm shift has generated a ripple effect spreading from the classroom back to teacher preparation programs, as pre-service language teachers must be prepared to focus their instruction on developing student communicative proficiency in the language. In other words, pre-service FL preparation needs to include CLT as a mainstay of pedagogical content knowledge for teacher candidates (Garcia, Moser, & Davis Wiley, 2019; Hlas, 2016; Larsen-Freeman & Tedick, 2016). This is a tall order for several reasons. First, the field of FL education can be slow to change—witness the time it has taken for CLT to *take hold* and be substantiated by research. Despite evidence to the contrary, many FL practitioners persist in teaching *about* the language or offer L2 instruction in the students' first language (L1). Second, most teacher preparation programs are typically two years in length and may only include a FL methods course of one semester duration. It is little wonder with such a limited timeline and base that many pre-service teachers fall back on the *known* and resort to teaching how they were taught (Martel, 2017; Swanson & Hildebrandt, 2017). Nevertheless, successful CLT requires specific teacher candidate

preparation, focus, and a new approach to assessment of language learning, all of which must begin in pre-service teacher education programs.

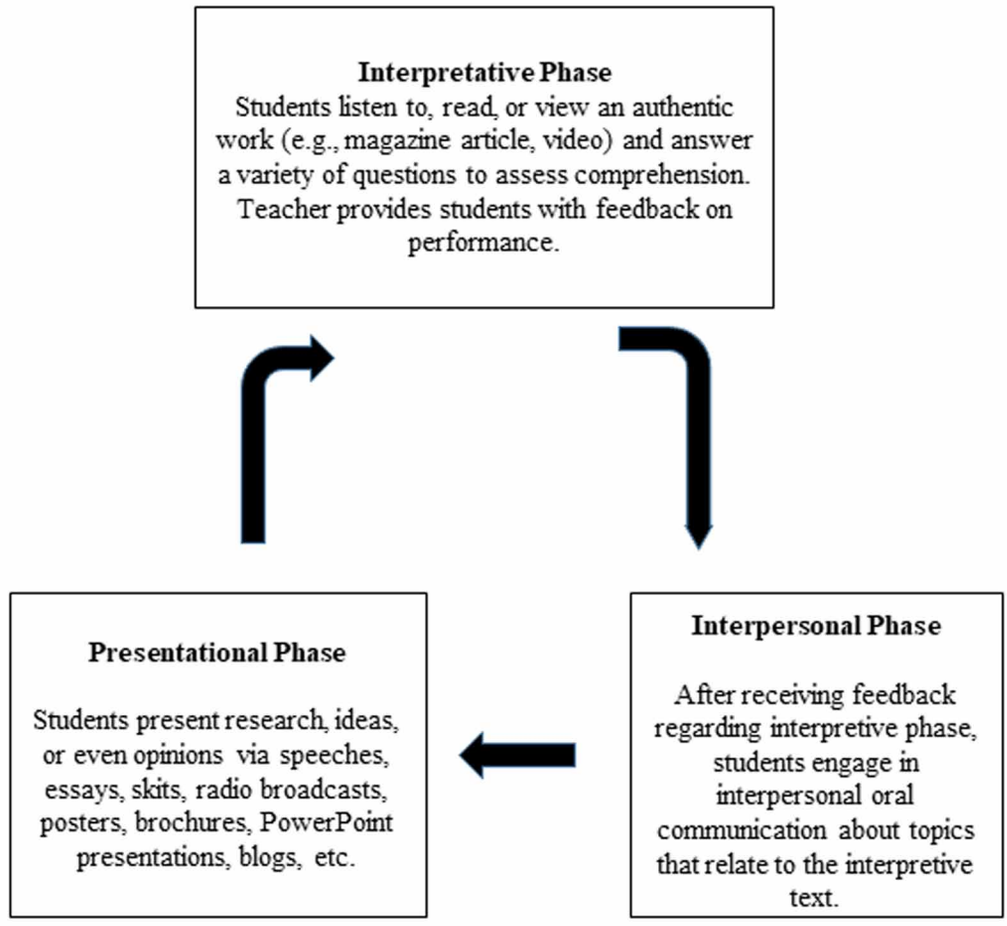
The implementation of CLT has engendered a focus on the three modes of communication: interpretive, interpersonal, and presentational (World-readiness Standards for Foreign Language Learning, 2015). In other words, language learners are asked to engage in TL communication in one or more of these modes on a regular basis. Concomitantly, along with the attention to communicative language activities, current best practices in language teaching for proficiency in the TL place an emphasis on developing and demonstrating this proficiency through performance-based assessments.

Student Proficiency Assessment in the Target Language

Performance-based assessments reflect the tasks and challenges language learners will face in real world scenarios. Through such assessments, students can work individually or collaboratively, use their collection of skills and knowledge to create a response to a prompt (complex questions or situations) or a product that can have more than one correct response (Liskin-Gasparro, 1996, 1997; Wiggins, 1998). The Integrated Performance Assessment (IPA) serves as an evaluation of student ability in the TL that is used as a cluster assessment featuring several activities (Adair-Hauck, Glisan, Koda, Swender, & Sandrock, 2006). The IPA was inspired by social constructivist theories of learning and conceived as a standards-based practical way to assess the success of L2 learners on performance-based tasks developed to measure the outcomes espoused by the World-Readiness Standards for Learning Languages (Adair-Hauck, & Troyan, 2013; Kissau & Adams, 2016; Zapata, 2016).

The IPA is a multi-task assessment conceptualized within a single thematic context. The assessment includes a series of assignments that mirror the three modes of communication and one or more other standards (e.g., cultures). These tasks may be carried out over several class periods (Cox, Malone, & Winke, 2018). For example, language learners first complete an interpretive task (e.g., reading or watching a video). Afterwards, they employ the information from an interpersonal task (e.g., conversation) before they summarize their learning with a presentational task. That is, language learners listen to, view, and/or read authentic texts in the TL, interact with learners in the TL in written and oral form, and then present orally and/or in written form to an audience. Feedback on each portion of the IPA can help students set new learning goals as well as directing teachers toward more proficiency-oriented instruction (Cox et al., 2018; Kissau & Adams, 2016; Martel & Bailey, 2016). The IPA is a well-established model of performance-based assessment of student language proficiency. Its adoption does represent a significant philosophical and pedagogical shift in instruction for language departments. Hence, it is incumbent upon pre-service teacher educators to incorporate knowledge, implementation of, and evaluation of IPA materials, purposes, tasks, rubrics, and their appraisal in the FL methods course (Kaplan, 2016; Okraski & Kissau, 2018). Furthermore, it has been shown that teacher candidates who implement an IPA as part of their WL edTPA portfolio score higher than those who choose to document traditional measures of learner assessment (Swanson & Goulette, 2018).

Figure 1.



USING VIDEO AND VIDEO CONSIDERATIONS

Teacher Candidate Skills Using Video

Today's teacher candidates who will be developing an edTPA portfolio typically have a broad skillset using technology. Some have even acquired specialized skills to integrate technology in the classroom. However, many have never used video as a self-reflective practice to watch themselves after they have taught a lesson (Goulette & Swanson, 2017). While it may make pre-service teachers anxious watching themselves teach, researchers find that video recording is a worthwhile pedagogical tool for self-reflection and growth as an educator (e.g., Baecher, McCormack, & Kung, 2014; Danielowich & McCarthy, 2013).

Throughout the US, teacher preparation program curricula vary to the degree and emphasis of technology integration. Some teacher preparation programs have a dedicated technology course (e.g., Georgia State University) and other programs embed technology throughout the program (e.g., Illinois

State University). Regardless of this, having the skills to successfully record oneself and gaining consent from parents / guardians for their children to be video recorded are necessary when creating an edTPA portfolio.

Securing Parental / Guardian Consent

As part of edTPA, teacher candidates must turn in a video of themselves working with learners in the classroom. Each teacher candidate selects a focal class on whom to focus their efforts and must receive parental / guardian permission to film in class even though their children may or may not appear in the video. If a parent / guardian refuses to grant permission, the student can still reside in the classroom for instruction but may not appear in the video unless his/her face is blacked out digitally. Thus, securing prior parental / guardian consent for recording in the focal class that has been selected is a prerequisite for edTPA. Teacher program coordinators need to make sure that school administrators and cooperating teachers will allow teacher candidates to film the focal class during class time. Otherwise, there is no need for a teacher candidate to be placed in a school with a teacher only to find out that video recording is not allowed. Researchers have advocated that once the focal class is identified, it is imperative that teacher candidates begin securing parental / guardian permission for their children to be video-recorded (Hildebrandt & Swanson, 2016). Given such a requirement, teacher preparation programs have created permission forms for teacher candidates to use for edTPA purposes. Interestingly, although some school districts require parents/guardians to sign a consent form for video recording at the start of each academic year, many times such a form may not include recording for edTPA purposes.

With respect to the recording, it is recommended that teacher candidates designate two distinct classroom sections temporarily: one section for the learners who can appear in the video and another section for those who lack parental / guardian permission, which is outside of the camera's view. In this scenario, a tripod can be a useful instrument to focus on one section while excluding the other section from the video. Using such an approach allows for the teacher candidate to engage all learners while the camera only focuses on those students whose parents / guardians have consented. It is recommended that the teacher candidate pilot test the placement of the camera not only so that the video area is correct, but also so that the audio can be heard from people furthest away from the camera in the classroom.

Minimizing Teacher Candidate Anxiety

As one might imagine, teacher candidates are typically most anxious during the recording phase of the edTPA. There are myriad reasons why the video recording process and submission can be anxiety-provoking for these novice teachers. These reasons range from potential technical problems to less than optimal TL proficiency concerns to insufficient pedagogical training and background in developing, executing, and evaluating student performance on the IPA tasks (Cox et al., 2018; Kissau & Adams, 2016; Tum, 2015). A pre-service teacher's personal insecurity about TL proficiency could certainly cause the candidate to experience anxiety when approaching the video recording task. Such anxiety could even affect the candidate's performance and even percentage of use of the TL during the lesson. Although much research has concentrated on learner anxiety, teacher FL anxiety is also a serious concern because it can have profound implications for what happens in the classroom. A pre-service teacher with self-doubts about TL proficiency may choose, consciously or unconsciously, to avoid TL use as much as possible, thus calling into question the quantity and/or quality of TL input the learners receive. This, in

turn, may have a domino effect on future learners who become language teachers themselves (Horwitz, 2010; Tum, 2015).

In terms of pre-service teacher preparation for developing, administering, and evaluating appropriate tasks for IPAs, several studies have revealed that teachers do struggle to prepare and execute IPAs that assess student proficiency in a balanced way across the communicative modes. Indeed, it seems that such preparation should be a necessity in teacher education programs, given that IPAs appear to be gaining in favor (Cox et al., 2018; Garcia et al., 2019; Kaplan, 2016; Kissau & Adams, 2016). The edTPA assessments require strong support from these preparatory programs. Perhaps a repository of sample IPAs could be developed to serve as professional resources for pre-service and in-service teachers alike (Martel & Bailey, 2016; Okraski & Kissau, 2018).

As a gauge of teacher candidate anxiety relating to technological problems, students in the Georgia State University FL education program who recently completed the edTPA reported the following concerns about the recording phase: technological issues, such as ensuring that the camera's batteries are sufficient to record the entire class period; students' sensitivity to the camera, for example, students misbehaving to *show off* for the camera; the pressure to produce the best quality video of excellent teaching that is highly engaging to students; and factors outside of their control that could come to bear on the video recording process, such as fire drills or other interruptions that could negatively affect the instruction. While these potential issues cannot be completely mitigated, university supervisors and cooperating teachers in the K-12 schools can collaboratively assist teacher candidates by offering suggestions based on past experiences working with video cameras in the classroom for edTPA. Again, early efforts in self-videotaping is a useful practice to help acclimatize pre-service teachers to the demands of video recording, its pitfalls and potentials.

Vital Considerations for Video Recording

The authors recognize that there are common technical issues that teacher candidates may deal with when building an edTPA portfolio. Thus, it is recommended that teacher candidates become familiar with the edTPA website, especially in terms of the recording process. As noted by Goulette and Swanson (2017), it is important that teacher candidates become familiar with video recording equipment well before beginning an edTPA portfolio. Such familiarity will most likely reduce teacher candidate anxiety and assist candidates in becoming more confident using the technology and even appearing in a video. The authors encourage teacher candidates to film themselves teaching as much as possible in order to be able to observe themselves critically. These videos can also be useful in monitoring general teaching behaviors such as inclusive presence (e.g., addressing all students the majority of the time), distracting mannerisms (e.g., playing with hair or a pen), and—arguably most important in a WL classroom—TL use.

When video recording for the edTPA portfolio, teacher candidates must turn in recordings of no more than 15 minutes in either one clip or two clips that must be less than 300 MB total in size. The target size is 200-300 MB or less (Pearson, 2014). Such a video size requirement means that teacher candidates should film in standard definition instead of high definition in order to keep file size smaller. Pearson recommends shooting video in the landscape aspect ratio and having resolution set to either 320 x 240 or 640 x 480. Additionally, edTPA only accepts video files in *.flv*, *.asf*, *.qt*, *.mov*, *.mpg*, *.mpeg*, *.avi*, *.wmv*, *.mp4*, and *.m4v* formats (Pearson, 2014). These are ubiquitous video file formats that can be opened by external reviewers who may use a variety of computers. Nevertheless, before submitting video files, the authors strongly recommend that teacher candidates try to open their video files on several different

computers to avoid a potential issue with the external reviewers not being able to open and view their videos. In the event that the video cannot be seen/heard, the teacher candidate does not receive a score on the rubrics. Rather, a condition code is given alerting the teacher candidate that there was an issue and that he/she needs to resubmit the video(s), which, in turn, means that the entire portfolio would not be scored, requiring a resubmission.

Teacher candidates must be aware that the video clips have to be "continuous and unedited, with no interruption in events" (Stanford Center for Assessment, Learning, & Equity, 2018, p. 19). Teacher candidates are prohibited from slicing or edited the video in any way. Additionally, titles and credits are not allowed (Stanford Center for Assessment, Learning, & Equity, 2018). Importantly, teacher candidates must include interactions between the teacher candidate and learners as well as learner-to-learner interactions.

Peer Review to Avoid Condition Codes

As eluded to earlier, creating a high-stakes assessment such as edTPA can be an anxiety-filled moment for teacher candidates, and perhaps even for program faculty members. Thus, it is important for all involved (e.g., university supervisors, cooperating teachers) to provide assistance to teacher candidates in order to avoid receiving any condition codes that would render the entire portfolio unable to be scored, requiring resubmission. Each time a portfolio has to be revised and resubmitted, either one task or all three, it costs an additional $100 per task, $300 if the entire portfolio must be resubmitted. The authors recommend having teacher candidates peer review the portfolios prior to submission by opening each file and making sure the videos play and that the commentaries can be read. edTPA rules stipulate that peer reviewers may only check for technical issues, such as a corrupt file or a file that is formatted incorrectly.

edTPA is a high-stakes assessment and receiving a condition code for even one video malfunction forces teacher candidates to resubmit one or more of the tasks at an additional cost. As noted by Hildebrandt and Swanson (2016), many academic semesters are based on a 14 or 15 week semester, and it is wise for teacher candidates to complete and submit the official edTPA portfolio by week 10 in order to have extra time if necessary to rework section(s) needing to be resubmitted for scoring in order to receive a passing score by the end of the semester. Official scoring often takes several weeks and can potentially create timing issues for program completion and teacher certification. The authors recommend viewing Pearson's (2019) schedule for submission to gauge an appropriate timeline for submission.

CONCLUSION

The passing and implementation of the ESEA legislation continues to impact American education. The law's focus on setting high standards for academic performance has changed the educational landscape in the US significantly. Coupled with the paradigm shift toward CLT with the concomitant emphases on TL use and real-world tasks in the WL classroom, evaluation of student progress in language learning and eventual development of TL proficiency have received renewed focus and attention. The ability of teachers to facilitate language learning in a CLT environment is based now on learner outcomes as demonstrated on student proficiency assessments, such as the IPA. In order to prove their professional competency and garner certification and/or licensure, teacher candidates are including use of IPAs as part of their edTPA portfolio to illustrate their students' progress toward TL proficiency. It is, therefore, ever-more important that teacher educators, school district officials, and teacher candidates become

knowledgeable about edTPA requirements and what constitutes a high-scoring edTPA portfolio in WLs. Research shows the criticality of creating and submitting quality videos as part of the edTPA portfolio (Goulette & Swanson, 2017) as well as using IPAs to document learner abilities in the TL (Swanson, & Goulette, 2018). With the widespread acceptance of edTPA in approximately 80% of the US, it is important that WL teacher educators guide pre-service teachers carefully in order to successfully create a quality and passing portfolio that indicates, at the very least, the professional capabilities sought after in a WL teacher candidate.

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KEY TERMS AND DEFINITIONS

Communicative Language Teaching Approaches: In a paradigm shift away from the four skills (i.e. reading, writing, listening, and speaking), the communicative approaches are based on the idea that learning language takes place successfully through communicating for the purpose of gaining real meaning.

edTPA: A nationally-available subject-specific performance-based assessment in 27 content areas that is now in place in more than 40 states and 900 teacher preparation programs in the U.S. as a method to measure teacher candidates' developing skills and knowledge via a portfolio.

Elementary and Secondary Education Act of 1965: A landmark federal law that funded primary and secondary education and stressed high standards and accountability. As mandated, funds are authorized for a variety of initiatives such as professional development, instructional materials, and resources to support educational programs. The government reauthorizes the act every five years sometimes under new titles such as No Child Left Behind and Race to the Top.

Integrated Performance Assessment (IPA): A standards-based and performance-based assessment that contains three tasks, aligned with a common central focus, that emphasizes each of the three modes of communication: interpersonal, interpretive, and presentational.

Modes of Communication: Based on ACTFL's notion that communication in a language takes place in three modes: interpersonal, interpretive, and presentational.

Teacher Candidates: Also known as pre-service teachers, this term is used to describe individuals who are enrolled in a teacher preparation program and working toward teacher certification. They complete state requirements for certification such as supervised field-based teaching experiences (a.k.a., student teaching).

Chapter 9
Implementation Imperilment and Imperatives of Integrated eIQA of HEI

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ABSTRACT

Teay expounded the eIQA as key backbone infrastructure for the HEI's quality and accreditation management for stakeholders at all levels in the institution. The eIQA links the PMS-IMS-QMS trilogy as integrated units of the HEIs' performance management. The eIQA implementation illustrates the case study university's QA management from 2016-2019. The poor 2009-2019 national accreditation performance shows the resistance/rejections mindsets/attitudes of the "complicated, costly ever-changing accreditation business case requirements" and not the eIQA platform per say. It demonstrates mainstream literature on eIQA implementation challenges to include the stakeholders' negative "resistance/rejection" mindsets as key obstacles. Better understanding of the "human" psychological-behavioral-beliefs-attitudinal, personified of self-power clique actions, skills/capacities/capabilities, and structural/managerial elements as key deterrents to eIQA implementation as essential research agenda.

INTRODUCTION

Regardless of what academics believe or like, with the depletion of public funding and increased competition, the reality is that Higher Education Institutions' (HEI) future is more business oriented potentially affecting educational quality (Haworth & Conrad, 1997, Bowden & Marton, 1998). This over-commercialization and internalization to achieve individual "economic" needs rather than meeting the public needs and concerns is an issue that affects strong and sustained academic performance excellence. Yin, *et al.* (2002) noted that education policy needs to include economic viewpoints that highlighted the needs for the institution to change the internal educational structures and systems to meet different educational purposes and aspirations. This is through identifying, procuring and allocating appropriate resources for

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inputs that enhances the efficiency of internal processes of the system and its sub-systems to meet the short-term and/or long-term education needs. Conti (2006) also emphasized the need of understanding the quality management from the systems perspective by extending the quality management concepts of economic transactions to social relations that ultimately creates value to the stakeholders.

All these leads to accountability in the form of accreditation as a "check and balance" to ensure the HEIs deliveries on its mission/objectives promise to the stakeholders of the students/parents/market needs/expectations. HEIs have a responsibility to the society to develop the future societal human capital through its educational value that they propose to the stakeholders through its internal value creation processes. The central issue is what and how these internal processes are aligned to create this educational value proposed to the stakeholders. There are three groups of stakeholders of "demand/supply" side of accreditation provider of the accreditation agency, the accreditation seeker that are the HEIs/Colleges/ Programs and the ultimate consumers of the students/parents/markets.

BACKGROUND OF STUDY

EQA (External Quality Assurance) as represented by any accreditation requirements has been prescribed voluntarily or mandated where all HEIs subscribe to or are mandatorily coerced into (Wells, 2014). While EQA hypes the protection of stakeholders' values in learning outcomes and competencies, the complementary IQA (Internal Quality Assurance) struggles to keep up with the pace of EQA progress and requirements (Kettunen, 2012) that evolves or are changed frequently. Systems and mechanisms in accomplishing and achievement EQA requirements falters or are sidetracked due to the mundane IQA requirements of documents, reports, statistics and evidences requirements of quality measures of processes and results underlying education value (Prikulis, Raugvargers, & Rusakova, 2011).

In attempting to resolve this issue, this chapter explores the implementation of the eIQA's (electronic-IQA) key components of quality-information-planning-performance underpinning education excellence to align the electronic integration of the 3 main IQA or eQMS (Quality Management System)'s core systems of QM (quality management), IM (information management) and PM (planning management) into the e-PMS (electronic Performance Management System). These encompass most aspects of the creation and delivery of the educational value of HEIs' PMS (performance management system). The integrated eIQA, which is the eQMS-PMS, as literally used in this chapter, is strategically and tactically aligned top-down and bottom-up where quality management is aligned with planning management via information management leading to informed decisions affecting quality management at all levels of the institution, administrative units, colleges and programs. To illustrate these QM-IM-PM linkages via its key integrated e-modules, a case study of CSU (Case Study University) a leading university in the Middle East demonstrates this strategic integrated eIQA system (Teay, 2018) and mapping its implementations from 2016-2019 over the decade 2010-2019 budding accreditation. The case study highlights implementation experiences of stakeholders' business case "deterrents" of a HEI's eIQA that is more "humanized-based cultural/structurally/shared-beliefs/skills/ psychological-behavioral-attitudinal personified-power actions" that impacts the IS implementation than "technical-systemic-based" obstacles.

FROM CONCEPTUALIZATION TO IMPLEMENTATION OF AN INTEGRATED eIQA

QMS-PMS (Quality-Performance Management System)

The ISO 8402 defines a QMS as "the organizational structure, processes, procedures and resources needed to implement quality management". This underscores the planning, monitoring and management of all educational performance measurement and management policies and procedures. These include faculty and personnel selection, motivation, development, engagement and retention; learner entry, guidance and student service & support systems; management information systems; student assessment; management of developing, delivering and evaluating learning programs and resources; availability and allocation of financial, administrative &physical resources; governance & administration. Goldberg and Cole (2002) identified three levels of educational quality management applications as: 1) the management processes of HEI; 2) teaching quality to students who are both customers and workers in the educational system; with 3) highest level of quality in learning to achieve the desired results. These meant that educators must question their core teaching and learning processes, teaching pedagogy & strategies, and assessment methods.

They contended that the traditional "institutionalized rationale" be replaced by a systemic quality approach as espoused by Deming's (1994) "a system is a network of interdependent components that work together to try to accomplish the aims of the system". The change to a systems perspective where the change is more systemic, the more the institution embodies changes in behaviors, culture, structure, strategies, philosophies, processes, people, systems and mechanisms, the more lasting the change will be which is in line with Deming's seventh principle resemblance of Senge's (2006) systems thinking. This would mean that comprehensive systems and mechanisms to enrich and enhance these quality environments, albeit an integrated one or hybrids (Marsh, 1995), are an imperative for improving education through quality management (Tribus, 1993) underscoring the PMS.

These systemic and systematic processes where activities interact to achieve defined goals resulting in the quality of the product and services, constituting the QMS-PMS, is defined by DTI (2015) as "A set of coordinated activities to direct and control an organization in order to continually improve the effectiveness and efficiency of its performance". This QMS-PMS enables an institution to provide consistency and coherence in the interactions and integrations of all education activities and processes of the institution's goals and objectives achievements of its policies and strategies. This begins with the identification of stakeholders' (students & parents, faculty & staff, regulatory bodies & society) requirements resulting with their satisfaction at every transaction interface. The QMS-PMS can be visualized as a "wedge" that both clasps the improvements, innovations and achievements along the quality journey, and prevents good practices from slipping back. Rouse & Putterill (2003) identified the QMS-PMS performance triplet as: performance measures, performance analysis and performance evaluation that corresponds to Altman's (1979) three component of evaluation, data analysis and performance measures underpinning the QMS-PMS architecture.

Bititci, et.al. (2004) observed that organizational culture and management styles have an impact on how PMS are implemented and used, thus affecting its success or failure. Nudurupati (2003) concluded that PMS, if appropriately designed, implemented and used would result in more dynamic and pro-active management styles leading to improvements in business performance. Bourne et al., (2002) and Franco & Bourne, (2003) noted that paternalistic culture, an organizational culture that does not punish people's errors and encourages discussion and analysis supports team-working, ownership and entrepreneurship

focused on continuous improvement and use of strategic PMS leading to a successful PMS implementation (Newman and Chaharbaghi, 1998). Coghlan et al. (2001) noted that the management should understand how and why their actions will bring about change in organizational work practices, behaviors of people, groups and organization through the e-PMS. Human issues lacking of senior management and users' drive and commitment leads to resistance (Bititci et al. 2002; Bourne and Neely, 2000; Hudson et al. 2001) playing key protagonists in e-PMS implementation.

Integrated Electronic QMS-PMS

An effective and efficient integrated QMS-PMS strategic directions and tactical implementations should meet stakeholders' requirements and expectations. This is effected through bringing about efficient and effective educational processes to create and deliver on educational value; reducing wastages and lower costs through activity based costing of the educational costs in education values deliveries; and ultimately increasing morale and motivations to strive for performance excellence and morals underpinning conscientious education benefiting the students. Hence, designing and building the integrated QMS-PMS includes the QMS-PMS infrastructure, the philosophies, plans, processes, procedures, people, practices and its deployment with performance measured and assessed bringing about continuous improvements and informed decision making paving the way towards performance excellence. The crux is the focus of improvement efforts in a holistic systemic and systematic approach to education QM-PM.

On the electronic dimension, the UN advocated the EMIS (Electronic Management Information System) that sought for the synergy and integration in terms of eight main dimensions: needs of producers and users; data; information handling; storage of data; retrieval of data; data analysis; computer and manual procedures; users networking. This includes the data warehouse, the data marts and BI (Business Intelligence) tools, and its mire of networks. Arbogast (2009) advocated that the "QMS-PMS be electronic, linked, or related so that the pieces can be analyzed; be dynamic, when change is required and capable of being analyzed and changed quickly; maintains history from a corrective action management perspective, and is a real-time managed system published electronically to the total organization that adds value and providing speed and agility on a long-term basis".

All these support Henderson and Venkatraman's (1992) definition of a three-dimensional IS strategy as a general or master plan for the build-out of the organization's information processing of: (1) ***information technology scope*** of the kinds and area of information systems and abilities that is unique to each business or organization (Chan et.al. 1998); (2) ***unique characteristics of information technology competencies*** of higher system reliability, interconnectivity, and flexibility that participate positively to the creation of new business strategies or support existing business strategy; and (3) ***information technology governance*** of structural mechanisms choices as long-term contracts to get the required information technology abilities. Earl (1987) and Hinton (2006)'s "Three-Pronged'' IS strategy formulation Model includes: (1) clarification of business needs (Rockart, 1988) and their ''top down'' translation into IS requirements; (2) evaluation of current ISS provision to evaluate the ''bottom up'' current ISS capabilities, and (3) identification of ''inside out'' innovative uses and opportunities of the IPOO (Inputs, Processes, Outputs and Outcomes) and eDRMS (electronic Document and Records Management System) (Queensland Government, 2010) afforded by IT/IS leading to a competitive advantage or create strategic options.

eQMS-PMS Implementation Challenges

Ho (1996) developed a model for a strategic alignment between operational units which in the HEIs are the academic and administrative departments and IT departments with multiple stages to overcome the difficulties associated with IT implementation in organizations. Both Ho (1996) and Salmela & Spil (2008) stressed the strategic change nature that the organization must understand to arrive at successful implementation. Key success factors underscoring the success of organizational IS strategy implementation, (Arvidsson et. al., 2014; Bansler and Havn, 2010; Wynn, 2008; Wilson, 1989; Yeh et.al., 2012) are:

1. Aligning of the organizational strategic purpose with the system capabilities,
2. Achieving the system implementation in the overall organization, and
3. Forming the system utilization, serving not only the applications but also the psychological pragmatic needs and expectations of the stakeholders and objectives alignment with the strategic purpose.

These mainstream literatures identified IS/IT implementation challenges (Almalki, et.al, 2017) as:

1. ***Weak Management*** compounded by weak communication channels, and lack of top management or leadership participation and enforcements
2. ***Human competencies and capabilities*** due to lack of resources to engage in user-education, inability in recruiting appropriate staff, experienced and suitable experts to develop, design and accomplish the information technology activities, and the basic human resistance to retain status quo
3. ***Technical hardware and software facets*** of the information technologies and systems infrastructures, migration from old to the new system or upgrading previous systems and
4. ***Internal and External Environmental stakeholders'*** organizational culture, change, behavior, inadequate capabilities, poor coordination and distribution of responsibilities. This includes competing for activities and unaligned organizational systems and resources, political conflicts, lacking a commitment to the strategy. In addition, middle and senior management's attitudes involving the interaction and direction of the organization's executive, misunderstanding or confusion of the strategies and doubts about benefits are imperatives to be managed (Wilson, 1989; Aaltonen and IkaÈvalko, 2002; Ossai and Degoke 2014; Roodsaz and Behrooz, 2013; Arvidsson, et. al., 2014).

Integration and Implementation Case Study of CSU-eIQA

The case study of CSU, a ranking university and leading university in the Middle East, is used as the main illustration of the integrated eIQA system which is the CSU-QMS.

To manage CSU's eIQA, a 3 staged CSU–QMS approach was designed (Figure 1) for the e-IQA system with its modules developed for the 3 stages (Figure 2) and as implmented for the Quality-Accreditation management (Figure 3) comprising of:

- **Stage 1 Self-Study, Program/Course Management:** The whole Self-Study process includes the tedious and mundane documentation required for QM and accreditation, which is the bane of equating quality to just documentations. The electonic part of the Course Specifications (CS) & Course Reports (CR) and Field Experience Specifications (FES) & Field Experience Report (FER) prepared on a semester basis culimnates in the annual Program Report (PR) based on the

Figure 1. Three Stages of CSU-QMS

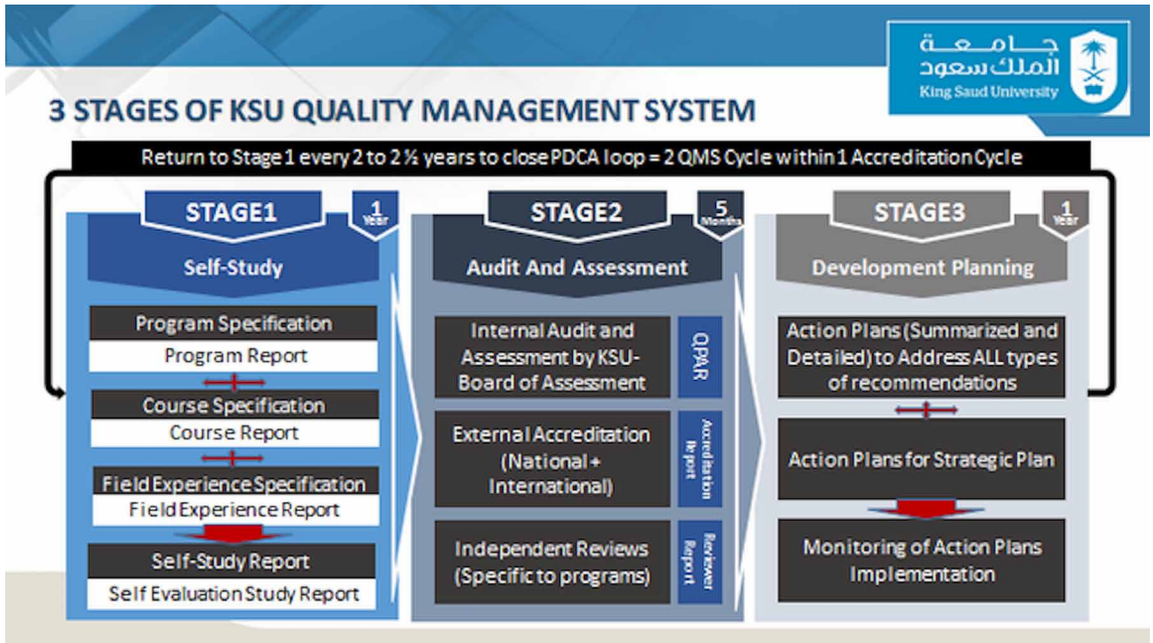


Figure 2. e-Modules of the CSU-QMS

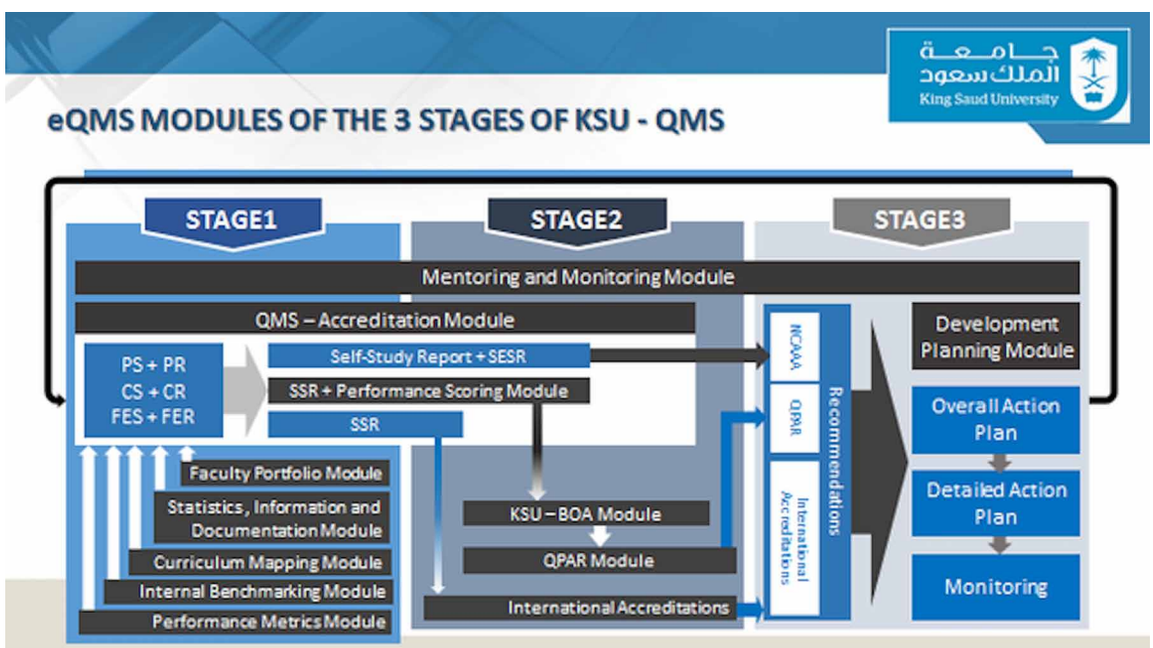
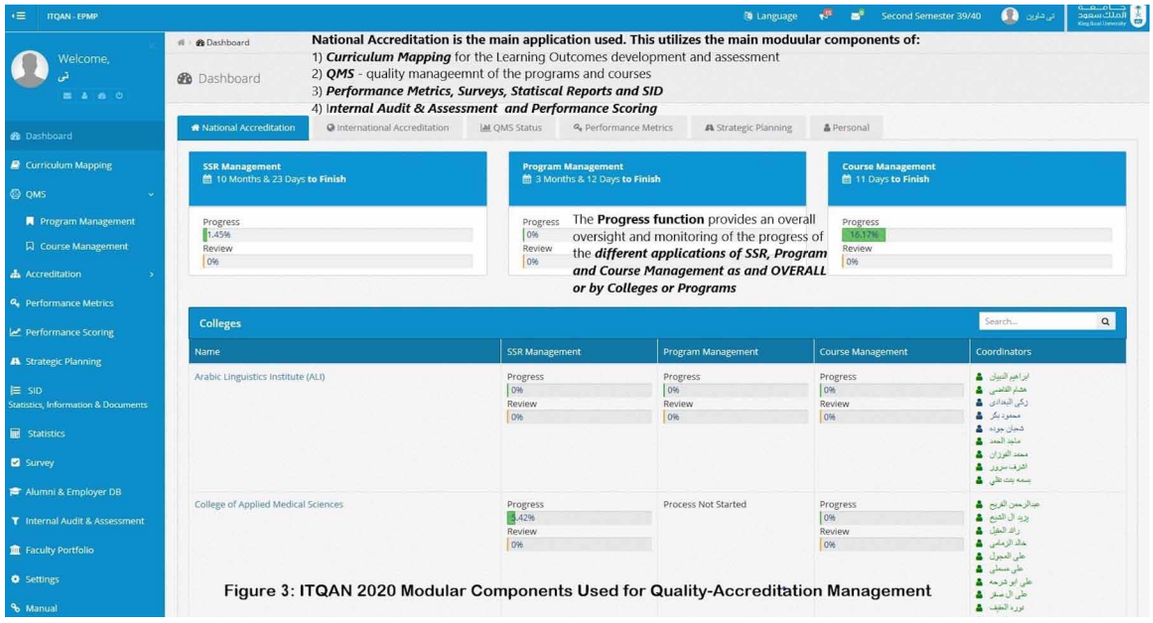


Figure 3. ITQAN 2020 Modular Components used in Quality-Accreditation Management



Program Specification (PS). All these supports the development of the program Self-Study Report (SSR) and Self-Evaluation Study Report (SESR) required for accreditation. Electronically they are the:

- **eQMS-Accreditation Module:** The core of the eQMS's is based on the multifarious accreditation forms and templates requirements to be uploaded online to the 2019 accreditation electronic submission system. In 2016 and 2017 respectively, CSU and 3 programs submitted their SSR/SESR and all statistical data and documentary evidence through the e-IQA to the accreditation agency. Supporting evidences includes the Curriculum Mapping Module that comprises the Student Learning Outcomes, the teaching methodologies and students' assessment mapping according to Program Objectives and Courses/Program Learning Outcomes (CLO/PLO) within the CLO/PLO Matrix. These include the key modules used by all the colleges, programs and faculty members to manage their CS/CR, PS/PR. FES/ FER and SSR/ SESR that are monitored for performance in key dashboards aggregated from the course levels up to the institution level.
- **eSurvey** and **ePerformance Metrics Modules:** These modules constitute the main statistical data from the 7 surveys of Course Satisfaction/Student Experience/Program Satisfaction/ Faculty & Staff Satisfaction/Alumni & Employment Market Satisfaction; the 56 NCAAA (National Center of Academic Accreditation and Evaluation) and institutional KPIs where internal/external benchmarking are compared. Since 2016-2019, all these statistical data are provided to all programs for their SSR/SESR, CS/CR & PS/PR performance management that minimizes human laborious computations & analytics.
- **eSID Module:** This is the main data mart for data, information statistics, documents of the eIQA of the different modules described above supported by the data marts for key applications utilization.

- **Stage 2 Internal Audit and Assessment (IAA):** The bi-annual IAA of the programs are audited and assessed by the independent internally appointed Board of Assessors (BOA). The aim is ensuring that the periods in between the accreditation cycle demonstrate continuous strengthened or sustained improvements. This is supported by the:
  - **eIAA and ePerformance Scoring Modules:** The computerization help lighten the loads of the BOA and all programs in the IAA exercises that requires substantial time and efforts of performance analysis, identifying strengths and areas for improvements, site visits issues based on the hefty evidence needed of the programs audit and assessment. The performance of the programs is based on the Performance scoring system with integration into the QPAR. By 2019, 22 programs' IAA have been completed on the eIAA.
- **Stage 3 Developmental Planning:** The aim of eIQA is to ensure continuous improvements with evidence substantiating these improvements meeting the vision, mission and goals as committed to the stakeholders and as planned in the strategic plans of the college or programs. These include developmental planning based on the recommendations of the accreditation and IAA exercises to avoid redundant planning and inconsistencies/incoherence across the quality-planning duo. But unfortunately, though the new templates were re-developed in 2018, the following modules were not implemented:
  - **ePlanning Module:** This is where the strategic plan of the university's vision, mission, goals, objectives are defined and cascaded to the academic & administrative units for alignment with the Balanced Scorecard (BSC) objectives.
  - **eFaculty & eStudent Portfolios Module**: The efaculty or eStudent portfolios have the key purpose of documentation/communicating formative and summative assessment of the student and his/her performance (Thompson & Cobb-Reiley, 2003; Barrett, 2004) for personal reflection and learning management. They have benefits of the tracking and documentation of teaching and learning experiences; encouraging the reconnection between learning process and outputs & outcomes; institutionalizing collaboration, reflection, and discussion. The aim is for each student to integrate his/her study, social and extra curricula and personal requirements to better customize his/her formative and summative academic, social and personal workspace and work life.

DISCUSSION OF ACCREDITATION AND PERFORMANCE MANAGEMENT – A STAKEHOLDERS' ANALYTICAL FRAMEWORK IMPLICATIONS

Academic institutions and academic programs or degrees do not exist in an organizational vacuum as they are part of the larger society (Rojas and Bernasconi, 2011; Pelikan, 1992). Arcaro (1995) noted "Quality as creating an environment where educators, parents, government entities, community and business communities work together to provide students with the resources they need to meet current and future academic, business and societal needs". This supports Bok (2013) central issue for external stakeholders like government or accreditors to assure at least minimum quality of institutions – how to handle institutions that are subpar through accreditation or transparency as supported by Chen and Haynes (2016): "transparency for whom?"

In the call for greater academic accountability, the accreditation's audit of compliance and assessment of academic performance according to the accreditation standards, the accreditation is "literally" the

performance management of the institution/college/program. In assessments of academic performance quality, the Deming's PDCA (Plan, Do Check and Act) is frequently used to "close the loop" of quality-performance management. The performance excellence use of the MBNQA (Malcolm Baldrige National Quality Award) evaluation framework of ADLI (Approach, Deployment, Learning and Integration) for process and LeTCI (Level, Trend, Comparison, Integration) for results performance converts the more subjective performance assessment to a more objective evidenced based PMS.

In any accreditation system, there are two main parties of the accreditation agency and the accreditation requesting party. These parties represent the demand and supply side of the accreditation transactions of (1) accreditation agency specifications of the standards' requirements, compliance, audit and assessment methodology and teams of auditors/assessors; (2) accreditation seeking parties of the institution/college/programs to demonstrate evidential compliance and progressive performance accomplishments. Both of these stakeholders' mutually inclusive interactions in the context and content of the standards, its performance metrics, methodology, academic requirements and performance assessment mechanisms is a pre-requisite for successful accreditation.

NCAAA Accreditation Analytics Progress 2010–2019

Accreditation in golden incentivized period of 2010–2015 and the 2016–2019 enforcement period by the NCAAA, the legal public entity overseeing all accreditation in Saudi Arabia, showed the following status for undergraduate programs (Table 1):

Table 1. Numbers of institutional and programmatic accreditation of NCAA

Table 1: Numbers of Institutional and Programmatic Accreditation of NCAAA

Types of Accreditation	2010 – 2019			
	Institutional (32)		Programmatic (103)	
	Governmental	Private	Governmental	Private
Full 7 years accreditation	11	11	38	22
Conditional 4 years	4	6	43	0
Total # accredited	**15**	**17**	**81**	**22**

Notes:

1. **Institution Accreditation:** 81% (26/32) were accredited in 2016 – 2019 period, with 6 (4 governmental and 2 private institutions) accredited 2010 – 2015 period, and CSU re-accredited in 2017.
2. **Programmatic Accreditation:**
   (a) Of the 103 accredited programs, 26% (27/103) were accredited during the period of 2010 – 2015 with the balance of 74% (76/103) being accredited in 2016 – 2019;
   (b) CSU, the leading university constitutes 42% (13 Full and 30 Conditional accreditation) of the 103 accredited programs 16% (7/43) programs having attained accreditation over the period of 2010 – 2015 and 84% (36/43) in 2016 – 2019;
   (c) Of the 43 CSU programs, only 12% (5/43) are Humanities programs with the rest of 88% (38/43) being Scientific programs

Source: NCAAA (2019), Accreditation Results, https://www.ncaaa.org.sa/enportal/accreditationresult/pages/orgsdirectory.aspx

1. **Institution Accreditation:** Of the total 57 governmental and private HEIs only 56% (32/57) had attained accreditation over 2010–2019 with 81% (26/32) in the later 2016-2019.
2. **Programmatic Accreditation:** Of numerous undergraduate programs in all 57 HEIs, only 103 were accredited by 2019 with 74% (76/103) in the later 2016-2019, and CSU accounting for 42% 43/103 undergraduate programs.

Table 2. Samples of accreditation status of scienticifc and humanities programs

Table 2: Samples of Accreditation Status of Scientific and Humanities Programs

Period when accreditation attained			2010 – 2015		2016 – 2019		Comments
	Programs	# of undergrad programs in College	National	International	National	International	
Scientific Colleges	Scientific C1	5	0	5	5	5	
	Scientific C2	12	0	9	2**	0 No budget	**3 in progress
	Scientific C3	11	0	11	11	11	
Humanities Colleges	Humanities H1	10	0	5	0**	0	**5 in progress
	Humanities H2	11	0	0	0**	0	**4 in progress

Note: International Vs National Accreditation: Sampled accredited programs show that programs attained more international than national accreditation. This is supported by the fact that of the 43 CSU programs, only 12% (5/43) are Humanities programs with the rest of 88% (38/43) being Scientific programs. The international accreditation strive dropped during the period of 2016 – 2019 is mainly due to national financial constraints from 2015 onwards and the enforcement of national accreditation over the decade.

Though CSU is leading the NCAAA accreditation, there are some discerning aspects over the 2010-2015 and 2016-2019 periods of:

1. **International Vs National Accreditation (Table 2):** In the golden incentivized 2010-2015, motivations for international accreditation was higher than national due to monetized incentives and the more mature requirements, less hassle and higher status of international accreditation. The national accreditation requirements documented 9 version changes of 2009; January 2012; July/December 2013; April/June 2014 February 2015 and the newest 2019 mostly to the Self-study (self-study and self-evaluation scale reports), program and course management templates (program/course/field experience specifications/reports) constituting the heavy evidences/reports requirements and the previously high cost of 1.3 million SAR (USD 350K/accreditation) but since reduced to 520K SAR (USD 130K) in 2018 as compared to international cost which is one-fifth of USD 52,000 for an ABET accreditation. These frequent changes and high cost provided an excuse to defer the implementation of quality-accreditation management not only in CSU but also in all institutions/colleges/programs (Table 1).
2. **National Accreditation Progress:** The 2010-2019 period covered only undergraduate programs, which means that CSU with a total 220 undergraduate and postgraduate programs has only 19.5% of all its programs accredited over the decade, as the postgraduate programs accreditation will start after 2019. A complete programmatic self-study process normally takes a two years period

to finalize and one year before being accredited, counting a whopping 3 years' excruciating, self-defeating exercise.

3. **NCAAA 2019 Version:** This constitutes a complete "ground zero" overhaul of the national accreditation system by reducing the standards (institution's 11 to 8; undergraduate's 11 to 6 and introducing postgraduate's 7 standards); modifying all the multifarious institutional/undergraduate/ post-graduate templates (self-study, program/ course management), volumes of statistical data and KPIs requirements (KSU, 2019) and the new online accreditation self-study submission system, all of which can potentially bring the whole accreditation system to being re-started.

Accreditation Stakeholders' Positional Pragmatic Performance Management

Using a simple "demand and supply" stakeholder analysis framework, the accreditation performance management is analyzed as:

1. **"Supply-Side" Accreditation Agency Provider's "Business-Case Complexity":** Items (1) to (3) above indicated that the national accreditation system is overly complex and complicated in its requirements of the self-study/ annual program and semester course-by-course sections' management templates, surveys/statistical/performance metrics, data requirements during self-study and from 2020 onwards to be submitted annually for the institution/program through the online system. The 2010-2019 accreditation statistics do not convey a positive nor successful performance accreditation system for all the 57 HEIs and their programs offers. The main reasons cited by the HEIs/Colleges/ Programs for not taking up the nationally mandated accreditation are mainly the complicated and multifarious requirements and the very frequent changes of the templates requirements that brought on a totally crippling quality fatigue. All of these are compounded by the overly high cost for national accreditation that is 10 times costlier than an internationally recognized accreditation system. Under the revamped system, the standards, the multifarious self-study/program/course management templates, volumes of surveys/statistical/performance metrics data requirements are mostly a "simplified and reduced but complicated accreditation" system that is compounded by the annual submission of the surveys/statistical/performance metrics data requirements. This inevitably will continue to affect the accreditation progress and performance from 2020 onwards.
2. **"Demand-Side" of Accreditation of Institutions/Colleges/Programs Seekers' Practices and Mindsets:** While inherently important through its purported alignment of the institutional/ collegial/ programmatic levels to ensure that all academic units move in the same strategic direction in its aim towards "academic excellence" under the performance excellence framework (NIST, 2019), its implementation and performance measurement/management success has been lack luster. The lack-luster performance of the frequently overlooked demand-side issues can be construed to be:
    a. **Stakeholder's Quality Mindset:** Though accreditation is nationally mandated of HEIs/ programs, there is an aversion to accreditation or performance management, as all academics claim that they are highly educated and professional academics who are delivering so-called quality and value added education to their students. This mindset inadvertently cause them to think that quality assurance or accreditation requirements "challenge" their holier than thou capacity and capabilities. In the studies of Kruger and Dunning (1999) and Ehrlinger and Dunning, (2003), both studies noted that people's perceptions of their performance, and potential errors in those perceptions, are chronic views people hold regarding their abilities or

incompetence. This potentially includes the ability to assess the quality of their performance as well as the performances of others (Maki, Jonas, & Kallod, 1994; Moreland, Miller, & Laucka, 1981; Shaughnessy, 1979; Sinkavich, 1995). These potentially holds true even in the academic environment when academics shy away from performance analytics or measures as assessments of ability has the tendency to be self-serving (Dunning, 1993).

b. **Shared Beliefs Quality Culture:** Another self-defeating mindset is the HEI's QA culture issue that is compounded by lack of clarity and vagueness about the concept of quality in higher education (Kahsay, 2012) while others claim QA in HEI to be "elusive" and "relative" (Harvey and Green, 1993; Vroeijenstijn, 1992; Westerheijden, 2007); not a static but a "dynamic" evolving concern nor it being a one dimensional but has "multidimensional" aspects and perspectives of interpretations, definitions, constructs and variables or just a philosophical concept that lacks a general theory in the literature"(Green, 1994; Westerheijden, 2007). Kottman, et al., (2016) also noted that "organizational culture that intends to enhance quality permanently is characterized by distinctive cultural/psychological elements of shared values, beliefs, expectations and commitment towards quality". A study by Kleijnen, et. al, (2011) showed that the management of quality cultures is critical to the QA's efficacy and its potential for the performance management in that "academic programs are more efficient when systematic quality assurance procedures were embedded in clear communication structures and open value systems allowing for quality learning rather than for quality control".

c. **Structural Governance and Silo-Centric Power:** Rojas and Bernasconi (2011) pointed out that structural intricacies are further complicated by the "relative weakness of hierarchical power structure and struggle", the "dense and diverse values system of different entities or cliques" and, importantly, the institutional dynamic interactions with its various external environments. All these separate subunits, levels, programs and functions, power struggles, silo-centricity must be organized together if the institution is to be effective and successful. The divide of the academic/administrative units' cooperation/collaboration towards the same HEI/Colleges strategic directional objectives is frequently undermined by the "power-control" and "information is power" mindsets by not providing potential HEIs/Colleges/Programmatic/Faculty/Administrative statistical data for performance metrics measurement/management. This is compounded by the fact that key positions like Vice-Rectors/Deans/Vice-Deans tenure of appointments of 3 and 2 years respectively does not contribute to smooth continuity of quality-information-planning policies/processes. The internal stakeholder's structural governance silo-centricity buttressed by the "power" cliques tussles undermine the QMS-PMS success.

d. **Skilled Informed Decision-Making Issues:** To improve on performance issues arriving at informed decision, data analytics objectivity can improve on informed decision making as to performance barring the QA, organizational cultural issue and the personification/political issues noted above. As noted by London's April 2019 McKinsey podcast, "bringing computing power and analytics capabilities together is critical to driving lasting and effective change" (Hancock, et.al, 2019). Unfortunately due to the complexity and changes frequency of the external stakeholder's accreditation system requirements, compounded by the "resistance/rejectionary mindsets" of the internal stakeholders of the faculty/programs/college/institution, these further undermine the development of the capacity and capabilities of quality-accreditation-performance management needed to manage the academic-technical

QMS-PMS. On the other hand, to manage the academic-technical system, the technical side should be well-versed in the academic requirements to successfully design/develop the integrated QMS-PMS and to service/support the academic users, who are loathing to "learn" due to "superiority complex" and ""resistance/rejectionary mindsets". Both of the skill-sets and informed decision data-analytics capabilities are part of the distressing performance of quality-information-planning-performance management accentuated accreditation.

In summary, in addition to the normal traditional challenges of eIQA implementation from the mainstream literature, as espoused in this paper, the stakeholders' analytical framework for the integrated electronic QMS-PMS which is the eIQA academic-technical System can enrich the better understanding of the "human" psychological-behavioral-attitudinal personified-power actions that impacts the eIQA implementation. These internal and external stakeholders' skilled-capacities/capabilities, behavior/attitudes, shared beliefs, systemic practices are both a structural/managerial element with defined but overcomplicated personification-of-self/shared beliefs/resistance-rejectionary mindsets/efforts processes that can impede or enhance quality (EUA, 2006).

While most literature looks at the changes as systemic eIQA obstacles, this case study demonstrates that the resistance/rejections can be caused by the "complexity/complicated and ever changing business case" and not the eIQA platform per say. On the other hand, the other key deterrent is the academic users themselves who profess "providing high quality educational value" who needs not be assessed nor be accountable. This leads to a negative "resistant/rejectionary" performance assessment attitude/mindset by the user which is normally blamed on the technicality of the eIQA system rather than the human's based stakeholders' psychotic/attitudinal/behavioral aspects.

IMPLICATIONS OF eIQA DEVELOPMENT AND IMPLEMENTATION

In the development/implementation of the integrated eIQA, it is considered a complete business process redesign that combine separate education processes into a singular core value process. This cuts across different internal/external stakeholders and domains as opposed to fragmented collections of individuals and small-scale systems with the output directed to the internal/external stakeholders' strategic needs and satisfactions (Ashworth, 1999; Childe *et al.,* 1994; Temporal, 1990).

As noted by Franco-Santos *et al.*, (2007), the two key characteristics of a strategic performance management system (SPMS) are "performance measures" and "supporting infrastructure" with 3 key processes of: "information provision", "measure design and selection" and "data capture". These were incorporated into the architectural design of the integrated eIQA linking the quality-information-planning dimensions (Teay, 2012). The integrated eIQA, part of a SPMS provides measures of performance, progress and opportunities to refine or improve on the "what, why and how" mechanisms.

On the implementation side, in addition to the mainstream literature on challenges/obstacles, as illustrated by the case study, one would need to delve into the more basic human factors of the internal/external stakeholders' equation. In this case, it illustrates the complicated/complex, heavy documents evidence-analyzed based and reporting requirements and costly accreditation requirements that contributes greatly to the resistance/rejectionary individual/organizational mindsets and faculty self-proclaimed efficacy as quality enforcers, self-professed quality educational value creators and delivers with high degree of responsibility and accountability. And, as such, these self-proclamations assertion is the necessity of

the essential performance assessment, and ultimately, their responsibility and accountability through the accreditation system. These fallouts potentially and inadvertently imperils the successful systemic implementation/acceptance for eIQA efficient/effective productive use by the stakeholders to create and deliver on education value through its electronic system. The eIQA is the "scapegoat" of being a highly complicated technical system used frequently as an excuse to avoid the institution/programmatic/faculty "conscientious" duty to society to attain and deliver on high quality educational value regardless of manual/electronic quality assurance platforms.

FUTURE RESEARCH DIRECTIONS

While this chapter discusses a basic integrated eIQA infrastructure that supports the QM-IM-PM in any HEI for quality-planning-information-performance management, there are vast potentials for more in-depth research of the internal/external stakeholders' "cultural/skills/structural/shared beliefs humanized factors" into enhancing the implementation of this electronic enabler in:

- **Supply Side Accreditation Provider"** To review/research into the "business-case" constitution/requirements of accreditation system's related complicated/documentation-focused necessities affecting quality fatigue with clearer focus on realistic "quality and accountability" systemic mechanisms.
- **Demand Side Accreditation Seeker:** To review/change/shift the user-academic's ego-centric/resistance-rejectionary mindset/shared beliefs, structural/political-powered governance/leadership systemic collaboration-cooperation/silo-centered perspectives/systems capacities-capabilities, all of which represents major humanized eIQA implementation deterrents.
- **eIQA:** To research into the applications of ICT in the complexity of the business cases requirements of academic performance management system and its eIQA design and development for manual-based academic QA workings and data analytics for student/faculty/institutional effectiveness.

CONCLUSION

This chapter and the illustrated case suggest that the fundamental "piece-meals" internal/external stakeholders' flaws that had always been obstacles in effective application of ICT for HEIs' educational aims and mission could be reconciled by:

- Bringing about an integrative approach of the strategic and education management with IS/IT as the enabler for QM-IM-PM integration that aligns the convergence of 3 very different and potentially unrelated disciplines into a PMS. This eIQA could be done through the expert knowledge of the champion or change agent who must have knowledge and skills of the strategic needs of the HEI, the operationalization of the technicalities of ICT and details of the tedious and overwhelming quality/accreditation requirements.
- Moving from the macro internal/external stakeholders' organizational strategic needs to the micro level operational/functional processes requirement of stakeholders' mind-sets calls on the capability-capacity of all individuals and organization, to move as "holistic one entity" in the same

strategic implementation direction for aligned accomplishments and achievements. The key factor is in the operationalization of the micro aspect of the macro overview that underlies the precarious internal academic processes and human capital re-engineering and re-discovery.

- Linking and integrating strategically and tactically the values addition teaching-learning-research processes of the QM-IM-PM trio with ICT into the eIQA as the supporting enablers through a set of strategic and operational plans that forms the integration and electronic triangularization of the quality-information-planning approach.

In conclusion, even-though this chapter emphasized on the strategic integration and implementation of the quality-information-planning trilogy through the eIQA, this does not mean that other concepts and frameworks are irrelevant. On the contrary, as noted by Andersen *et al.* (2006), the quality-information-planning-performance management, or for that matter, all aspects of the HEIs' commitment of educational value to society must be approached from a holistic perspective. These appropriate plethora of tools/techniques, systems/mechanisms depending on the situational and/or institutional requirements must go beyond humanized stakeholders' needs that are key deterrents/determinants of successful eIQA implementation.

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KEY TERMS AND DEFINITIONS

Electronic Internal Quality Assurance (eIQA): eIQA is an electronic quality assurance system that enables audit and assessment for quality/performance management achievements to meet value-added stakeholders' needs and expectations. It is a collation of educational inputs/processes/output/outcomes (IPOO) modules inter-linked through the data warehouse (DWH), its data marts using of Business Intelligence (BI) tools for data analytics in assuring educational quality and performance excellence.

Electronic Performance Management System (ePMS): ePMS is an electronic system designed with the goal to support management to determine, monitor, measure and manage performance through analysis for business processes efficiencies and results effectiveness through informed decision making.

IQMS (Integrated Quality Management System): An IQMS is an assurance system to meet stakeholders' needs which is: systems-based; people-based; process-based with emphasis and continuous improvements in all spheres to ensure and sustain educational quality and value efficiencies and effectiveness (FASSET, 2000). It is an integration system with 3 key education purposes of 1) Development Appraisal; 2) Performance Management; 3) School Evaluation (De Bruyn, et al., 2007; ELRC, 2003).

Chapter 10
Identifying and Evaluating Language-Learning Technology Tools

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ABSTRACT

Digitization and the globalization of English have made it possible to incorporate different forms of digital technology into the infrastructure of English language programs. However, there are no clear criteria in the existing literature to identify and evaluate appropriate language-learning technology tools. To fill the gap, this project proposed empirically supported guidelines in a rubric called the ULTIA Rubric to facilitate and accelerate the process of identifying and evaluating technology-supported language-learning tools. The ULTIA Rubric has its basis in the major components of the five concepts of universal design for learning (UDL), learning science (LS), technology acceptance model (TAM), intelligent tutoring system (ITS), and automatic speech recognition (ASR). The rubric can function as a practical solution for program administrators, instructors, and English language learners (ELLs) who are seeking a reliable roadmap to evaluate language-learning software.

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INTRODUCTION

All English language learners (ELL) who strive to access higher education opportunities in the United States need to be English proficient. A lack of English language proficiency not only impedes international students' academic achievements, but research also shows that it affects both their self-esteem (Terui, 2012) and their relationship with peers and professors (Wu, Garza, & Guzman, 2015). In addition to a lack of English language proficiency, many ELLs face other challenges. These often include time limits due to their visa status and the high costs of living and education in the US. Thus, they would benefit from a curriculum that not only facilitates their language proficiency but also accelerates it. Currently, many of these curricular enhancements incorporate technology. Digitization and the globalization of English have made it possible to incorporate different forms of digital technology into the infrastructure of English language programs. However, in the existing literature, there are not systematic, clear, and research-based criteria that could be applied by all users for identifying and evaluating appropriate language-learning technology tools.

To fill this gap, and considering the fact that there is a broad range of such tools with different purposes, this problem-oriented project has created a system that can be extremely beneficial to not only educators and administrators who wish to support ELLs' language-learning proficiency but also the ELLs themselves who intend to be autonomous learners. This system attempts to apply easy-to-understand, empirically-supported guidelines in a rubric called the ULTIA Rubric (Table 1) to facilitate and accelerate the process of identifying and evaluating appropriate technology-supported language-learning tools. The guidelines can help educators or individuals save their time and manage their budget by providing them with a systematic roadmap to follow so that they can select the most effective technology tools. The ULTIA Rubric which is registered by the researcher with the US Copyright Office (registration number: TXu 2-095-958) has its basis in 43 major components of the following five research-based concepts: Universal Design for Learning (UDL), Learning Science (LS), Technology Acceptance Model (TAM), Intelligent Tutoring System (ITS), and Automatic Speech Recognition (ASR). The ULTIA Rubric (each letter of the acronym standing for the first letter of the first word of the five concepts) supports the user to answer the degree to which a language-learning technology tool (a) is systematically structured based on the major components of Universal Design for Learning and Learning Science (b) can be personalized based on the needs of its users and their native language speech patterns, (c) is engaging and motivating, (d) can save learning time, (e) identifies and detects errors, (f) provides corrective, immediate feedback, and (g) can support the intended language skills.

BACKGROUND

Universal Design for Learning (UDL)

In education, UDL refers to "a set of principles for curriculum development" that provides "effective instruction to all learners" and gives them "equal opportunities to learn" (National Center on UDL, 2014). The purpose of UDL instruction is to create a motivating "learning environment that challenges and engages all students" (The IRIS Center, 2017).

UDL Principles

By applying different, engaging methods and techniques suggested by UDL, educators can involve all learners from diverse groups and assess their knowledge in a variety of ways. UDL suggests three major principles based on neuroscience research that educators can incorporate into their lesson plans: (a) *representation*, (b) *action and expression*, and (c) *engagement* (National Center on UDL, 2014; The IRIS Center, 2017). These principles can help educators remove the barriers that affect students' learning, and technology has the capability to make this happen. A technology-mediated learning environment can decrease the barriers that mostly exist in the traditional media by giving equal opportunities to all learners and engaging them in the learning process.

Based on the first principle of *representation*, information is presented in multiple methods and "modalities" so that different individuals can adjust the methods to their own learning preferences, abilities, and background (National Center on UDL, 2014). More simply, information should be perceptible so that learning can take place, and this happens when the new information is integrated "with prior knowledge, strategic categorization, and active memorization" (National Center on UDL, 2014). Effective learning also takes place when diverse learners are provided with "well-designed materials" which are "embedded with models, scaffolds, and feedback" until learners can generalize and independently apply what they have learned (National Center on UDL, 2014).

While the first principle of UDL focuses on "the what of learning," the second principle (*action and expression*), underscores "the how of learning" by giving learners the freedom to express themselves in multiple ways and to choose the learning preference they are more competent in, such as writing rather than speaking (National Center on UDL, 2014). By providing multiple means of action and expression, educators can help students set goals to solve their problems and remove barriers to achieve effective learning.

Providing "multiple means of engagement," as the third principle of UDL, aims at motivating and engaging all students to learn effectively in a variety of ways (National Center on UDL, 2014; The IRIS Center, 2017). This principle which is based on "the why of learning" asserts that there are some neurological, cultural, or personal explanations for specific learning behaviors (National Center on UDL, 2014). Being aware of one's individual differences can improve learners' self-determination, motivation, and engagement. In many cases, this can be achieved by providing resources for individuals to sustain their motivation and engagement (National Center on UDL, 2014).

Learning Science (LS)

It takes a significant amount of time and effort to master different aspects of the English language such as pronunciation, listening, speaking, structure, vocabulary, reading, and writing. The language-learning process can be facilitated and accelerated through effective methods that have a basis in learning science principles and that can enhance the metacognitive abilities of learners. The learning science strategies that are applied in the ULTIA Rubric are *retrieval practice, variable training,* and *the zone of proximal development.*

Retrieval practice or *repeated retrieval* helps the brain remember what it has already learned through practicing it over and over again, strengthening memory routes and making learning effective and robust (Brown, Roediger III, & McDaniel, 2014). *Retrieval practice* is applied in different forms such as *elaboration, reflection, testing effect, spacing out,* and *generation. Elaboration* refers to restating what

has been learned and applying it in different situations. *Reflection* means that a learner connects different ideas/concepts in a meaningful way and practices them over and over again until the new concept/idea becomes automatic and reflexive. *Testing* can be an effective *retrieval practice* if it is meaningful and effortful. This type of test is called *test of transfer* which reflects the depth of knowledge of the learner (Brown et al., 2014). *Spacing out* or *spaced practice,* as the fourth type of retrieval practice, is learning a new material/skill but practicing it at a later time, leaving some space between the two. By reviewing the new material or practicing the new skill after some time, instead of massed practice, and repeating it over and over again, the brain consolidates what it has learned. The last type of retrieval practice introduced in the ULTIA Rubric is *generation* or *generative learning* which means prior to learning a new concept, learners are encouraged to think about it, solve a problem related to it, or link it to their past experience. The main focus of *generative learning* is trial and error to strengthen memory and learning (Bransford, Brown, & Cocking, 2000; Brown et al., 2014).

The second learning strategy applied in the ULTIA Rubric is *variable training* or *varied practice* through which learners practice a new concept in different contexts, using different parts of the brain and moving from the factual knowledge to the conceptual knowledge. Another learning strategy related to *varied practice* is *interleaving* or *interleaved practice* by which a person learns different concepts/skills in parallel and at one time. Unlike *massed practice*, learning through *interleaved practice* is slower but deeper and more durable (Brown et al., 2014).

The third learning science theory introduced in the ULTIA Rubric is Vygotsky's *zone of proximal development* (*ZPD*). The *ZPD* is the level at which a learner can do a task through imitation and with the assistance of a more competent individual or a teacher (Chaiklin, 2003). In Vygotsky's *ZPD,* there should be the possibility of *developing* a skill, meaning that the learner should have prior knowledge or experience to understand a new concept and proceed to the new level. Additionally, there should be a more competent individual than the learner who demonstrates how a task is done and makes the interaction/collaboration between the two possible. Vygotsky also believes that the learner should be able to make connections between prior knowledge and the new concepts which sets the stage for *rigorous* learning (Jackson, 2010) and *transfer* (Bransford et al., 2000). *Rigorous* learning and *transfer* prepare learners to apply what they have learned in thinking independently and problem-solving without relying on others (Bransford et al., 2000; Chaiklin, 2003; Hedegaard, 1990; Jackson, 2010).

Technology

In addition to UDL and LS, the components of the Technology Acceptance Model (TAM), Intelligent Tutoring System (ITS), and Automatic Speech Recognition (ASR) are also included in the third section of the ULTIA Rubric, *Technology.* By introducing TAM, the objective is to show that an appropriate technology tool can develop and maintain the interest and positive attitude of its users towards learning the language and continuing to apply the tool. The purpose of including ITS in the rubric is to demonstrate how effectively intelligent tutoring systems in language-learning technology tools can detect errors and provide learners with immediate, corrective feedback and continuous scaffolded support. The last part of the *Technology* section of the rubric, ASR, focuses on efficacious spoken training technology tools that can comprehensively detect and correct errors made in the spoken language such as pronunciation, intonation, word stress, sentence stress, fluency, and grammar.

Technology Acceptance Model

The Technology Acceptance Model (TAM) is applied in information systems to predict the extent to which users think they can perform better in a system by using technology (Davis, 1989). Davis, who proposed the Technology Acceptance Model in 1986, believed that rejecting or accepting technology influences the way users apply it. He also considered *attitude* as a major factor determining users' behavior and their evaluation of a system/technology (Davis, 1989).

Among multiple factors, Davis indicates that the two most important elements in TAM that predict *attitude* and user behavior are *perceived usefulness* (*PU*) of technology and *perceived ease of use* (PEOU). The ULTIA Rubric can help users to determine both PU and PEOU. By *perceived usefulness*, Davis means the extent to which users think a system can help them improve their "performance," and he defines *perceived ease of use* as the extent of ease users think they can work with a system (1989, p. 319). The original idea of *perceived usefulness* was presented by Schultz and Slevin's 1975 research and later developed by Robey in 1979 (Davis, 1989). Davis's *PU* and *PEOU* were also influenced by Bandura's *self-efficacy mechanism.* To be more specific, Bandura states that "perceived self-efficacy" is related to the way people think they would react in different conditions, and their behavior is the result of "both self-efficacy and outcome beliefs" (Bandura, 1982, p. 140). Davis explains that "outcome beliefs" or "outcome judgments" are "concerned with the extent to which a behavior, once successfully executed, is believed to be linked to valued outcomes" (Davis, 1989, p. 321). Davis also asserts that *self-efficacy* determines what a person's expected behavior will be and analogizes *PEOU* to *self-efficacy* and *PU* to *outcome beliefs*. The ULTIA Rubric can act as an advanced organizer, a pre-assessment of a technology tool that can determine how useful (and easy to use) a particular tool is to both the learner and the instructor.

Intelligent Tutoring System

Compared to human tutors, empirical studies show that non-human tutors which provide appropriate, immediate feedback in the form of "explanatory," "short and directed error messages" (Anderson, Corbett, Koedinger, & Pelletier, 1995, pp. 190 & 167) influence student learning more effectively and positively. Infusion of non-human tutors into the curriculum does not necessarily mean the elimination of teachers but "as a part of the toolkit for teachers that would enhance their ability to do the things they can uniquely do" (Koedinger & Aleven, 2015, p. 20). The ULTIA Rubric was designed to assess the degree to which a technology tool included intelligent tutoring systems.

Non-human tutors which Anderson et al. call "cognitive tutors" (1995, p.168) are designed based on specific cognitive models and create their individualized instructions for each learner according to those models. This kind of modeling technique is called "model tracing" (Koedinger, Anderson, Hadley, & Mark, 1997, p. 32). Cognitive models also use "knowledge tracing" (Koedinger et al., 1997, p. 36) by identifying learners' problem areas through assessments and learners' responses. In language-learning technology tools, cognitive tutors or intelligent tutors focus on production skills that are learned through doing such as pronunciation and communication (speaking, reading, and writing). Thus, the instructional curriculum of intelligent tutoring in language-learning tools is designed based on displaying, monitoring, and giving "appropriate feedback" (Anderson et al., 1995, p. 171). In light of these factors, Anderson et al. have proposed eight principles for designing intelligent tutoring. Although these principles were originally meant for geometry and algebra, they can be applied to other subject areas as well. Based on

Principle 1, which focuses on "student competence as production set," (Anderson et al., 1995, p. 179) the intelligent tutor is accurately designed toward a specific skill and what learners are supposed to produce in that skill. This is done by "decomposing the components" of the desired skill and explicitly showing learners the goals to achieve mastery in that skill which is closely connected to Principle 2, communicating "the goal structure underlying the problem solving" (Anderson et al., 1995, p. 179). Principle 3 emphasizes providing "instruction in the problem-solving context" (Anderson et al., 1995, p. 180) which is usually done before a new section/skill is introduced. Intelligent tutors not only give instructions to students on each skill, based on Principle 4, they also "promote an abstract understanding of the problem-solving knowledge," (Anderson et al., 1995, p. 180); that is, they also teach students the general knowledge encompassing those specific pieces of information. Principle 5 states that "working memory load" (Anderson et al., 1995, p. 180) has to be minimized by focusing on only a few related points in a new skill. The purpose is to maximize effective learning by gradually building up skills and mastering them one at a time and not overloading students. Principle 6, as the most disputed tutoring principle in this set, is providing learners with "immediate feedback on errors" (Anderson et al., 1995, p. 181). The intelligent tutors which provide immediate feedback identify errors as soon as they are made and help students correct their mistakes. These intelligent tutors also provide learners with correct responses and explanations. Principle 7 argues that "the grain size of instruction" should be adjusted "with learning" (Anderson et al., 1995, p. 181), meaning that the intelligent tutor should match the target skills or the components of the target skills ("the grain size") with student learning. Specifically, more granular approaches are used with students who learn more slowly and require more detailed instruction and support to achieve success. Lastly, Principle 8, stresses that the "successive approximation to the target skill" (Anderson et al., 1995, p. 181) should be facilitated by the intelligent tutor. Very similar to the *zone of proximal development* (*ZPD*), Principle 8 shows that the intelligent tutor provides continuous scaffolded support and practice ("successive approximation") for students until they become independent learners. In other words, the Intelligent Tutoring System paves the way for self-directed learning (Koedinger & Aleven, 2015) and prepares students to be autonomous learners. The ULTIA Rubric helps learners and educators to determine the degree to which Intelligent Tutoring Systems are present in the various technology tools that can be chosen to support language learning.

Automatic Speech Recognition

Automatic Speech Recognition (ASR) is a technology that has the capability to "identify" (Kim, 2006, p. 322) and "decode" spoken words and transcribe them into text (Voicebox Technologies Corporation, 2017, para. 1). ASR applies various technologies such as Natural Language Processing (NLP), Natural Language Understanding (NLU), and Text-to-Speech (TTS) to respectively identify, understand, and process spoken and written human language. The ULTIA Rubric allows for the review of ASR technology.

ASR emerged in the early 1980s and flourished by the end of the 1990s (Eskenazi, 2009). One of the earliest studies that inspired the idea of ASR was conducted by Flege in 1988. He used "visual information specifying the tongue position" and provided "visual feedback" to train foreign language speakers to pronounce English vowels (Flege, 1988, pp. 367, 365). Providing *visual feedback* paved the way for devising different software which could do this automatically such as Massaro's Baldi, a "3-D computer animated talking head" (Massaro, Bosseler, & Light, 2003, p. 1) that shows how sounds are produced in the mouth of the talking head by displaying the position of lips, tongue, and teeth from different angles (Bosseler & Massaro, 2003). Baldi, which is specifically designed for teaching vocabulary, provides

customizable instructions and lessons for each learner through presenting visual images and sound of words (Bosseler & Massaro, 2003). The structure of these kinds of software is based on "an interactive" ASR system which combines four modules of (a) *instruction and modeling* by providing clear instruction and modeling for pronunciation lessons; (b) *monitoring* through *error detection;* (c*) evaluation* through *error analysis*, *error correction*, and *feedback*; and (d) *assessment* by continuously assessing learners' progress (Witt & Young, 1998, p. 9). *Error detection* which functions on special algorithms designed to detect pronunciation errors (Cucchiarini, Neri, & Strik, 2009) has a pivotal role in supporting learners to be aware of their spoken language errors. Research shows that having knowledge about sounds and how they are produced ("the metacognitive knowledge to understand the pronunciation feature"), as well as receiving corrective feedback "without relying on an instructor" can help students monitor and correct their mistakes and be autonomous language learners (McCrocklin, 2016, p. 26).

Providing feedback for language learners in ASR technology depends on how accurately the system can recognize speech and detect errors. Eskenazi believes speech error detection is carried out at two levels: (a) "individual error detection" which focuses on "specific errors" such as individual sounds or phonemes, and (b) "pronunciation assessment" which includes more general aspects of speech such as overall fluency (2009, pp. 834, 836). Empirical studies show that *individual error detection* can be more effective if (a) instruction is presented in various forms (*variable training)* such as illustrations, written messages, and sounds, and (b) if "phonetics and grapheme-phoneme relations" are explicitly taught to learners (Eskenazi, 2009, p. 835). It is, therefore, important to determine how well a specific technology tool can detect errors. The ULTIA rubric helps with that review.

FOCUS OF THE ARTICLE

This article focuses on the problem of evaluating language-learning technology tools in the digital era and attempts to fill the gap by incorporating the facets of learning science theory and research-based evidence as part of the assessment tool. This system intends to facilitate and accelerate the process of evaluation in a way that can be applied by not only educators but also learners. The current evaluations or frameworks in the research literature are mostly designed to be applied by educators or professionals and revolve around specific platforms such as Computer Assisted Language Learning (CALL), mobile assisted language learning (MALL), or websites. The empirically supported system proposed in this article, however, fills a gap by providing the user with a clear roadmap to evaluate a wide range of language-learning tools. This system which is presented in a rubric also supports learner's independence, autonomy, and confidence. It is designed in a rubric based on the five empirically-supported concepts of UDL, LS, TAM, ITS, and ASR. The criteria proposed in the rubric can help program administrators, educators, and students to determine the quality and capacity of language-learning digital tools. Using the rubric can support the selection and use of technology tools that can enhance student learning and improve instruction for ELLs.

During the process of selecting and evaluating language-learning software, it is important to consider different important factors such as its reliability, practicality, user-friendliness, and cost and time-effectiveness. However, in reality individuals or educators may find it very difficult to select the most efficient tool among an ever-increasing number of them in the digital era. The main reason is the lack of explicit, easy-to-understand, and research-based guidelines to help language learners, administrators, or educators navigate their search.

Although there has been important research conducted on evaluating language-learning software such as CALL or MALL, it is not easy to find the one which could be applied by all users to evaluate a wide range of language-learning digital tools. The following is a review of the most prominent studies on this topic.

One of the earliest attempts to evaluate different types of computer-based education (CBE) was made by Reeves (1994). Based on *learning theory*, he described 14 pedagogical dimensions of CBE (epistemology, pedagogical philosophy, underlying psychology, goal orientation, experiential value, teacher role, program flexibility, value of errors, motivation, accommodation of individual differences, learner control, user activity, cooperative learning; cultural sensitivity) and used them as criteria to analyze and evaluate CBE programs. The framework is based on research and learning theory, and evaluation has to be done by a professional or a researcher.

One of the most popular evaluations which was specifically designed for CALL was Chappelle's framework (2001, 2007) which expounded on CALL software, teacher-planned CALL activities, and learners' performance during CALL activities. The method of evaluation in this framework was judgmental and empirical. In line with this study, one of the most important CALL evaluation frameworks was proposed by Hubbard. Hubbard's most recent framework (2011) which focused on courseware and websites consisted of six steps: *technical preview, operational description, learner and teacher fit, appropriateness judgments*, and *implementation schemes*. Due to the limited purpose of this framework (courseware and websites), Kim and Kwon (2012) modified it and created a new one to evaluate MALL applications. The modified framework focused on three main categories: *content/design target*, *procedure and approach*, and *technical features*. Each category consisted of a number of components, and some components contained some other elements. For instance, *content /design target* consisted of *target learners*, *content*, *learning styles*, and *learning strategies; learning strategies,* in turn, covered *field-dependent/independent*, *deductive/inductive reasoning*, *collaborative*, *etc*. Compared to Hubbard's, this framework was more detailed and specific.

Interestingly, Samuels (2013) studied the selection of technology applications for CALL from a phenomenological approach. By interviewing 25 CALL directors, he concluded that among the four important areas reported by the directors, aligning pedagogical approaches of their programs to those of the language learning technology applications was the most important one. The other important factor was technical support. Cost and provider reputation were among less important areas of concern. Samuels also added some other elements to the list such as providing multilingual support and being customizable, interactive, and learner-centered. A more comprehensive framework for designing and conducting CALL evaluations was proposed by McMurry, et al. (2016). This framework considered the evaluand, type of evaluand, its purpose, the stakeholders, the criteria, and evaluation questions as the core of the framework.

To evaluate language-learning mobile applications for adult language learners, Chen (2016) proposed a seven-element rubric based on social interactionist theory (providing interactive guidance for the learners) and Krashen's affective filter hypothesis (lowering negative emotional factors such as anxiety and improving motivation and self-esteem). The seven elements in the rubric were aligned vertically under Category and included content quality, pedagogical coherence on language skills, feedback and self-correction, motivation, usability, customization, and sharing. After analyzing seven language-learning apps, three raters evaluated and rated the apps independently based on the rubric and categorized them as Least Suitable (1-3), Average (4-7), or Most Suitable (8-10). In concert with this research, Persson and Nouri (2018) focused on mobile assisted second language learning (MASLL) and identified its

positive effects on learning outcomes and improving the process of second language learning. Some of such outcomes included personalizing the material, motivating learners and encouraging them to learn collaboratively, improving learners' vocabulary knowledge as well as listening and reading skills, and increasing their satisfaction. The research also presented a systematic review of development of MASLL and the learning outcomes to support the positive effects of mobiles on language learning. In doing so, it applied the following categories: "educational form and level, study design, location, context, role of technology, pedagogical practice and learning impact" (p.188).

For evaluating language learning apps applicable to smartphones and tablets, Rosell-Aguilar (2017) presented a taxonomy or framework. This framework is based on four categories: language learning, user experience, pedagogy, and technology, and each category consists of a series of components. The process of evaluation is carried out by answering a question followed by each component. For instance, the components of the Language Learning section include Reading, Listening, Writing, Speaking, Vocabulary, Grammar, Pronunciation and intonation, Cultural information, Use of visual content, and Language varieties. For another instance, the Writing component is followed by a question asking if the app provides the learner with opportunities to write in the target language. The Pedagogy section also includes the nine components of Description, Teaching, Progress, Scaffolding, Feedback, Quality of content, Use of media, Differentiation, and Engagement. The components of the User Experience section are Interaction, Interactivity, Sharing, Badging, Price, Registration, and Advertising.

As can be seen, while most of these frameworks are research-based, some are not organized systematically and do not clearly guide users to evaluate a technology-supported language-learning tool. Additionally, all frameworks have been created for evaluating very specific purposes such as courseware, websites, CALL, MALL, or iPads; in other words, there is no one-size-fits-all solution. As a result, in this digital era, the need for clear, explicit, easy-to-use, easy-to-understand, and research-based guidelines which can be applied by all users (whether language learners or educators) for almost all types of platforms is more than ever. The rubric presented in the following section can fulfill the needs expressed above.

Solutions and Recommendations

The idea of utilizing technology-supported language-learning tools brought about the overarching research question of this project which is *What criteria should be considered in identifying and evaluating appropriate technology-assisted language-learning tools for English language learners?* However, as mentioned above, since there are not clear research-based guidelines in the existing literature that are comprehensible to all users to identify and evaluate appropriate technology tools, this project presented specific empirically-supported criteria in a rubric form called the ULTIA Rubric based on the 43 major components of five important concepts: (a) UDL, (b) LS, (c) TAM, (d) ITS, and (e) ASR. The rubric can function as a practical solution for those seeking a reliable roadmap to evaluate language-learning software. It is recommended that novice users familiarize themselves with the software or seek help from the software support system prior to applying the rubric.

The ULTIA Rubric

As illustrated in Table 1, the first column of the rubric contains five *inputs:* UDL, LS, TAM, ITS, and ASR; the second column shows all the components of these five concepts (UDL: items 1-9, LS: items 10-20, TAM: items 21-23, ITS: items 24-37, and ASR: items 38-43); the third major column, that is,

Table 1. The ULTIA Rubric with major components of universal design for learning, learning science, technology acceptance model, intelligent tutoring system, and automatic speech recognition used to identify and evaluate language-learning technology tools

Inputs	Components	Outcomes		Skills Supported			
		Name of the technology tool: _____ (Put a ✓ if it maps to components.)	How This Is Done	Listening	Speaking	Reading	Writing
DESIGN							
Universal Design for Learning (UDL)	1. Sets clear and measurable learning goals accessible to all students. (Based on UDL's 1st Curricular Component of *Goals*)						
	2. Gives learners equal opportunities by providing each learner with personalized options. (Based on UDL's 2nd Curricular Component of *Materials*)						
	3. Has well-designed and flexible instructional materials to meet the needs of all learners. (Based on UDL's 2nd Curricular Component of *Materials*)						
	4. Presents information in multiple ways (various instructional methods). (Based on UDL's 1st principle of *Representation*)						
	5. Provides learners with models, scaffolds, and individual feedback (such as progress charts). (Based on UDL's 1st principle of *Representation*)						
	6. Helps learners be aware of their development and monitor their own progress in order to be confident and independent learners. (Based on UDL's 3rd principle of *Engagement*)						
	7. Creates a motivating learning environment by providing *multiple means of engagement*. (Based on UDL's 3rd principle of *Engagement*)						
	8. Provides *multiple means of action and expression*/gives students the freedom to express themselves in multiple ways. (Based on UDL's 2nd principle of *Action & Expression*)						
	9. Uses multiple methods of assessment to evaluate what students have learned. (Based on UDL's 4th principle of *Assessment*)						
LEARNING							

continued on following page

Table 1. Continued

Inputs	Components	Outcomes		Skills Supported			
		Name of the technology tool: _____ (Put a ✓ if it maps to components.)	**How This Is Done**	**Listening**	**Speaking**	**Reading**	**Writing**
Learning Science (LS)	10. Relates what has been learned to a learner's prior knowledge. (Based on LS strategy of *elaboration).*						
	11. Presents a new idea in different contexts (Based on LS strategy of *reflection).*						
	12. Gives assessment in the form of pre-test, post-test, formative, & summative tests. (Based on LS strategy of *testing/test of transfer)*						
	13. Reviews the new material and leaves some space between teaching the new material and practicing it (Based on LS strategy of *spacing out).*						
	14. Links the new material to former knowledge. (Based on LS strategy of *generation).*						
	15. Presents the new concept in different contexts. (Based on LS strategy of *varied practice*)						
	16. Teaches different concepts in parallel. (Based on LS strategy of *interleaved practice)*						
	17. Provides models for learners to imitate. (Based on Vygotsky's *Zone of Proximal Development*)						
	18. There is the assistance of a more competent individual. (Based on Vygotsky's *Zone of Proximal Development*)						
	19. Provides the possibility of developing a skill. (Based on Vygotsky's *Zone of Proximal Development*)						
	20. Assesses that the learner has the potential to develop. (Based on Vygotsky's *Zone of Proximal Development*)						
TECHNOLOGY							
Technology Acceptance Model (TAM)	21. Users think the tool can help them improve their performance. (Based on Fred D. Davis's *perceived usefulness*)						
	22. Users think the tool is easy to work with (Based on Fred D. Davis's *perceived ease of use)*						
	23. Users' overall attitude towards the tool is positive. (Based on Fred D. Davis's *Attitude)*						

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Table 1. Continued

Inputs	Components	Outcomes		Skills Supported			
		Name of the technology tool: _____ (Put a ✓ if it maps to components.)	**How This Is Done**	**Listening**	**Speaking**	**Reading**	**Writing**
Intelligent Tutoring System (ITS)	24. Identifies learners' problem areas through assessments. (Based on *knowledge-tracing*)						
	25. Identifies learners' problem areas through their responses. (Based on *knowledge-tracing*)						
	26. Is engaging and motivating. (As a result of providing immediate feedback)						
	27. Reduces learning time. (According to Koedinger, Anderson, Hadley, & Mark)						
	28. Provides personalized instruction. (Based on *model-tracing*)						
	29. Corrects all mistakes. (Based on knowledge-tracing)						
	30. Decomposes the components of the desired skill. (Based on Anderson, Corbett, Koedinger, & Pelletier's 1st principle)						
	31. Shows learners the goals to achieve mastery in a skill. (Based on Anderson et al.'s 2nd principle)						
	32. Provides instructions for correcting mistakes. (Based on Anderson et al.'s 3rd principle)						
	33. Provides general knowledge/general rules on specific skills. (Based on Anderson et al.'s 4th principle)						
	34. Focuses only on a few related points at a time to maximize learning. (Based on Anderson et al.'s 5th principle)						
	35. Provides short, immediate, and timely feedback on errors (correct responses and explanations). (Based on Anderson et al.'s 6th principle)						
	36. Matches the components of the target skills with student learning. (Based on Anderson et al.'s 7th principle)						
	37. Provides continuous scaffolded support and practice. (Based on Anderson et al.'s 8th principle)						

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Table 1. Continued

Inputs	Components	Outcomes		Skills Supported			
		Name of the technology tool: _____ (Put a ✓ if it maps to components.)	How This Is Done	Listening	Speaking	Reading	Writing
Automatic Speech Recognition (ASR)	38. Provides clear instruction and modeling for pronunciation lessons. (Based on Witt & Young's 1st module)						
	39. Monitors learners through error detection. (Based on Witt & Young's 2nd module)						
	40. Evaluates learners through error analysis, error correction, and feedback. (Based on Witt & Young's 3rd module)						
	41. Continuously assesses learners' progress. (Based on Witt & Young's 4th module)						
	42. Detects general aspects of speech such as fluency. (Based on Eskenazi's *pronunciation assessment*)						
	43. Detects individual errors such as phonetics and prosodics (stress and intonation). (Based on Eskenazi's *individual error detection*)						

Note: The ULTIA Rubric is registered with the US Copyright Office (registration number: TXu 2-095-958)

Outcomes depicts whether or not the technology tool which is evaluated maps to the components, and if so, how this is done; and the last major column, *Skills Supported*, illustrates if the technology tool supports the four major language skills: listening, speaking, reading, and writing. Additionally, UDL and its components are presented in the *Design* section of the rubric, LS and its components are included in the *Learning* section, and the *Technology* section includes three major features: TAM, ITS, and ASR. The last section of the rubric, *Results,* is a holistic evaluation of the technology tool which is going to be evaluated and sums up the major goals of the five concepts through eight questions. The *Results* section attempts to answer if the language training technology tool (a) is systematically structured based on the components of Universal Design for Learning and Learning Science (items 1 and 2); (b) can be personalized based on the needs of its users and their native language speech patterns (item 3); (c) is engaging and motivating (item 4); (d) can save learning time (item 5); (e) identifies and detects errors through its Automatic Speech Recognition feature (item 6); (f) provides corrective, immediate feedback through its Intelligent Tutoring System (item 7); and (g) supports the intended language skills (item 8). The last part on the ULTIA Rubric is the *Overall Assessment* which determines by answering Yes/No if, in general, the technology tool maps to the 43 componenets.

Table 2. Results from table 1

Major Outcomes	Exemplary	Competent	Needs work
1. The technology tool is systematically structured based on the components of UDL.			
2. The technology tool is systematically designed based on the components of LS.			
3. The technology tool can be personalized based on the needs of its users and their native language speech patterns.			
4. The technology tool is engaging and motivating.			
5. The technology tool can save learning time.			
6. The technology tool identifies and detects errors.			
7. The technology tool provides corrective, immediate feedback.			
8. The technology tool can support the intended language skills.			
OVERALL ASSESSMENT	**Does the technology tool _____map to the components? Yes/No**		

Note: The ULTIA Rubric is registered with the US Copyright Office (registration number: TXu 2-095-958)

FUTURE RESEARCH DIRECTIONS

The rubric introduced above can systematically analyze how language-learning software tools function. Language-learning technology tools come in a variety of forms and might focus on only one, many, or all aspects of a language such as pronunciation, structure, vocabulary, listening, speaking, reading, and writing. The rubric has the potential to help learners and educators to assess various technology tools and determine which tool fits the need. While the ULTIA Rubric is self-explanatory, the best result can be achieved if users familiarize themselves with the target software prior to the application of the rubric. Future research may provide a more convenient way such as an app to facilitate the evaluation process for all users without the need to learn about the technology tool. However, for now the ULTIA Rubric is a stand-alone product that can apply to a wide range of technology tools.

CONCLUSION

This project demonstrated an effective and practical way by using a rubric to facilitate and accelerate the process of identifying and evaluating digital language-learning tools for ELLs. Taking into account the major characteristics and needs of the current population of ELLs in the US in the 21st century, and considering the tremendous impact of digitization on pedagogical approaches, it can be concluded that digital technology which is developing exponentially has the potential to facilitate and expedite ELLs' language-learning process. To that end, it was reasoned that research-based criteria could guide English language programs as well as individuals to identify and evaluate appropriate language-learning technology tools. However, since such criteria are missing, this project proposed explicit, easy-to-understand, and empirically-supported guidelines in a rubric called the ULTIA Rubric to fill the gap. The rubric, which can function as a roadmap for students and a GPS for educators, has the potential to pave the

way for further research so that everyone can easily and independently identify and evaluate the most practical technology-supported language-learning tools.

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KEY TERMS AND DEFINITIONS

ASR: Automatic speech recognition (ASR) is a technology that identifies and decodes spoken words and transcribes them into text.

CALL: Computer-assisted language learning refers to applications of the computer in teaching languages.

ELL: English language learners (ELLs) are students who attend English language programs in order to acquire English language proficiency. Either school-based or postsecondary ELLs have to meet all the standards and requirements that other students in schools and colleges are expected to meet.

ITS: In language-learning technology tools, intelligent tutoring system (ITS) is designed to detect errors and provide learners with immediate, corrective feedback as well as continuous scaffolded support.

LS: Learning science (LS) theories are valid and empirically supported theories that are the instructional foundations applied for all kinds of learners.

MALL: Mobile-assisted language learning refers to applications of smartphones in teaching languages.

TAM: Technology acceptance model (TAM) is applied in information systems to predict the extent to which users think they can perform better in a system by using technology.

UDL: Unlike traditional, one-size-fits-all instruction, universal design for learning (UDL) is a systematic and flexible framework which creates a motivating learning environment to challenge and engage all learners.

ULTIA: The ULTIA Rubric which is exclusively applied in this project and is registered with the US Copyright Office (registration number: TXu 2-095-958) refers to the five concepts of Universal Design for Learning (UDL), Learning Science (LS), Technology Acceptance Model (TAM), Intelligent Tutoring System (ITS), and Automatic Speech Recognition (ASR). The ULTIA Rubric has been used to systematically and scientifically identify and evaluate language-learning technology tools. Each letter of the acronym ULTIA refers to the first of the first word letter of the five concepts of UDL, LS, TAM, ITS, and ASR respectively.

Section 2

Educational and Assistive Technologies

Chapter 11
Educational Games as Software Through the Lens of Designing Process

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ABSTRACT

Educational games (EG) as learning software have become more dominant in the educational industry and have gained immense popularity. However, a constant battle between designing an EG that combines fun and educational content in delivering learning objective is a prominent challenge through the designing phase for various stakeholders involved, especially game designers. This chapter discusses three major contributions to game design fundamentals and principles and unpacks their concepts on designing EG. Moreover, an in-depth discussion of game design models/frameworks is understood. This analysis highlights issues and problems raised through the gaps existing between models/frameworks against them. This chapter proposes a combined prototyping process adopted from the discussion and emphasizes aspects required in documenting game design. With the process documented and aligned, game designers will be able to reflect a better understanding of a game design process in the industry.

INTRODUCTION

Over the past decade, educational games (EG) as learning software and the usage of game-based learning (GBL) has become more commonly used for educational deliverance, as opposed to pure entertainment, has gained immense popularity. With that, reports discussing both positive and negative impacts on usage of GBL in education and variety of ways in which the learning outcomes have been achieved. A constant battle between designing an EG that is a combination of fun and educational in delivering learning objective is a prominent challenge through an implementation phase for designers (Azadegan et al., 2014; Romero, 2015; Serrano-Laguna, Manero, Freire, & Fernández-Manjón, 2018). Games-based learning (GBL) is a pedagogical approach that utilizes EGs to support learning (Prensky, 2003). As explained,

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GBL utilizes an appropriate set of game mechanics (the rules of EG), provides freedom for learners to recreate scenarios without having a fear of adverse reactions, and provides a problem-oriented learning process to allow learners achieve learning goals in the EG (Poulsen, 2011).

The guidelines for designing an educational computer program including (games) and make learning with computers exciting and motivating have proven to be captivating (Malone, 1983). Malone (1983) provides a checklist for designing enjoyable educational programs that include: (1) challenge (goal, uncertain outcome) (2)fantasy, (3) Curiosity (sensory curiosity and cognitive curiosity). Despite the consideration of multiple challenges discussed in this work, Malone (1983) does conclude that the capabilities of computers in making learning exciting and engaging, but designing those learning tools (games) is undoubtedly tricky when programming is considered. This shows one of the very first groundbreaking guidelines provided in educational games creating as a checklist and the consideration of programming, which leads to its relevance with game designers and designing EG. As Malone (1983) mentioned the importance of constructive feedback provided to the players, a later study painted a flow of transformation of the computer from a "work" tool to directly linking towards children, learning, and play (Ito, 2009). Ito (2009) described three main genres with descript towards academic achievements, software designed to support school content, allow children to be a part of the designed software, and lastly, engaged and explore the construction and instruction of the possibilities of using digital media. The third genre draws upon 'construction' where an emphasis on empowering kids in creating their artifacts through interactivity with the software and technology, but the work is limited to 5thD:' a system where children play a diverse range of educational software in an informal afterschool setting.' Noticeably, it doesn't focus on how to achieve the negotiation between designers, children, industries, media, or education; however, it is useful for current 21st-century digital media and the impact it has on children's learning.

Despite the research has managed to accomplish a large range of EGs that has delivered its function successfully, there have been many EGs that have reported to be a failure or unsuccessful. It is definite that game designers do not create replicas of the games that are well-recognized. With that, recent articles published has addressed the rising tension between stakeholders of the game designing process, i.e. game designers, teachers, developers, learners, students, players. Designers are required to enhance the educational tools by integrating game elements and core concepts to maximize the tools' effectiveness, to increase the possibilities of achieving learning outcomes, levels of engagement and motivation (Kalmpourtzis, 2018; Schell, 2008). Not only that, designing EG required multiple consideration of multiple stakeholders such as game designers, developers, educators, teachers, and software engineers.

Understanding the game design is a complex job. As defined: "*Design is a process by which a designer creates a context to be encountered by a participant, and from which meaning emerges"*(Zimmerman & Salen, 2004, p. 41). With game design (GD) defined a variety of game design elements and learning theories that establish and define an EG. Table 1 for examples of game design elements that are crucial (Shi & Shih, 2015). Similarly, GD is equipped with learning characteristic that adds the value of providing a good learning experience to learners. Some of the characteristics are learning outcomes, usability, user's experience, motivation, engagement, game design, user satisfaction, usefulness, understandability, performance, playability, pedagogical aspects, efficacy, social impact, cognitive behavior, enjoyment, acceptance and user interface (de Aguiar, Winn, Cezarotto, Battaiola, & Gomes, 2018; Lameras et al., 2017; Wouters & van Oostendorp, 2017). The innovative learning approach derived from EG possesses educational values or even different kinds of software applications that compile into knowledgeable aspects such as teaching enhancement, assessments, and evaluation of learner (Tang & Hanneghan, 2010).

Table 1. Game design elements and their definitions

Elements	Description
Game goals	Game designer provides what type of experience for players pursue game goals
Game mechanism	Refers to the methods prompting players to achieve the designer goals and enables smooth functioning of the virtual worlds
Interaction	Player operations that trigger the computer to generate related responses, including the interactions and conflicts between players and computers.
Freedom	An open game system that allows for player autonomy, including individual services such as the avatar.
Game fantasy	Refers to the environmental context that provides virtual world imagery
Narrative	Describes what occurs in the virtual worlds
Sensation	Multimedia presentation of the virtual worlds
Game value	Promotes players to increase their game motivation
Challenges	Refers to player efforts towards the game or personal goals
Sociality	The interaction between people through the game system including communication, cooperation, competition, and conflict
Mystery	Refers to providing a novel experience for players, including curiosity and exploration.

Source: (Shi & Shih, 2015)

Game-based learning (GBL) has been defined by identifying its principles and mechanisms (Perrotta, Featherstone, Aston, & Houghton, 2013). The principles target intrinsic motivation, learning through ''fun,'' authenticity (i.e., contextualized learning), self-reliance/autonomy, and experiential learning. Mechanisms include rules, clear but challenging goals, fantasy, progressive levels of difficulty, interactivity, player control, uncertainty, feedback, and a social element. This study focuses on the definition of GBL defined by Perrotta (2013) as it involves game mechanics that related to game design aspects. As mentioned by Perrotta (2013), studies on GBL usually focus on secondary school. This may be because of the fact that there is a little consensus between researchers and among teachers as to how games could be used for educational purposes. GBL is specifically designed to teach specific concepts or to strengthen competencies. There exist a broad scope of games including digital and non-digital ones (All, Castellar, & Van Looy, 2016; Connolly, Stansfield, & Hainey, 2009; Dondlinger, 2007; Selwyn, 2014). Digital games are developed for use in smartphones, computers, tablets, etc., whereas non-digital games exploring the use of resources such as boards, cards, pencils and papers (Connolly et al., 2009).

For GBL designing process to be effective and reliable, it is vital to provide emphasis on involving theoretical foundations with game rules, and fun with authentic learning for learners, thus, providing a precise base for learners to gain knowledge (Hays, 2005; Kebritchi & Hirumi, 2008; Schell, 2008). Hence, researchers propose theoretical frameworks for designing EG for insights between theoretical and designer's perspective. This can also be enhanced through understanding the software designer's perspective in software engineering through the established life-cycle method following strict instructions to ensure product satisfactorily. According to the prominent contributors (Kalmpourtzis, 2018; Schell, 2008; Zimmerman & Salen, 2004) in discussing educational games design, game designers reflect on a variety of concepts throughout their designing phase. When the game designers initiate the designing of EG, challenges occur in terms of planning from gathered requirements, verifying or prototyping, and cross-checking the initially designed requirements to ensure consistency and reliability. This is due to a

mixture of pedagogical aspects, educational principles, motivational elements as well as game designer's own experience that influences the designing process. Combining the software designing procedures, along with educational game designing fundamental and the pedagogical concepts have challenges and issues due to its large interdisciplinary conflicts.

The objective of this chapter is to comprehend and compare a series of game design models/frameworks for designing EGs and reflect their practicality to game design fundamentals and principles established in prominent books by leading game designers/scholars: (1) *The art of Game design (Schell, 2008)*, (2) *Rules of Play: Game Design Fundamentals (Zimmerman & Salen, 2004)*, and (3) *Educational Game design Fundamentals* by Kalmpourtzis (2018). With that, the discussion on how software engineers focus on the design process of software and documentation requirements to track the crucial steps will also be compared in terms of educational game design. Therefore, this chapter attempts to provide a holistic idea based on how theoretical frameworks/models consume game design fundamentals established and how the collaboration between the designing process of EG and software design can provide a promising impression. Lastly, future direction and recommendations provide an understanding of the current approach in research for game designers, teachers, educators and software engineers.

BACKGROUND

This section mainly attempts to highlight the fundamentals/principles of educational game design through the lens of three established books on game design fundamentals (please note that due to page limitations, the author was unable to include more research). Then, a series of published models and frameworks (from 2015 to 2018) for designing EG are studied.

Observation by leading game designers, the essence of a "game" is a problem-solving or a puzzle-solving with which competence is developed through a trial-and-error and exploration learning practice (Koster, 2013; Schell, 2008). Players choose from the choices they experience in real-world and learn from those actions and feedback provided by the game, leading to an interactive learning experience. EG's remarkable motivational power includes challenges that thrills and excites players, teaches and master achievements, "It is the act of solving puzzles that makes games fun. In other words, with games, learning is the drug" (Koster, 2013, p. 40). A recent study where GBL approaches were used to enhance learning through a cross-disciplinary integrative approach; however, the key challenge is producing an effective educational game design which allows an equal balance between game playability and fun, along with the learning outcomes of the assessment of GBL (de Freitas, 2018). To find the balance between game playability and fun, and having a solid game design that is aligned with the learning outcomes of the assessment or course content, is also a challenge.

Educational Game Design Fundamentals

B.U.G designer Salen and Eric Zimmerman (CEO of the game-design studio gameLab) in *Rules of Play: Game Design Fundamentals (2004).* "Meaningful Play" is the most crucial concept that combines actions (descriptive) and outcomes(evaluative) within a magic circle to add the emotional experience of playing games through a game system (Zimmerman & Salen, 2004, p. 27). The book evolves the discussion of game design through three major schemas in which the knowledge is organized and frames: **rules** (formal game design essential for logical and structures of game), **play** (experiential, social and repre-

sentational that foregrounds the player's participation with the game and others), and **culture** (contextual design engaging larger contexts in which the games are designed and player). Consequently, proceeds on explaining the schemas in the form of a system where the elaboration on an organized system, human experience, and engagement within the context of the system was discussed in depth.

Games as a "system" contain elements such as objects, attributes, internal relationships and environment; that can be easily framed according to any game. The key concept of how the system is constructed and designed to create meaning that can engage players into a thrill and motivational feeling is always a challenge and goal. The concept of interactivity through the design of EG and its interrelation to concepts of design, systems and meaningful play discussed throughout the book to provide ease in understanding the complexity of the game design. The overall discussion of how game designers are interested in the concepts of meaning because they are involved in the creation of systems of interaction is discussed in depth. With respect to the establishment of the concepts, the book opens the door for probabilities that game designers may take in terms of social interaction, storytelling systems, cultural resistance and how each game design is visualized differently before beginning.

Lastly, the book openly challenges game designers to take into considerations of the vast potential of cultural and ethical values whilst discussing the "the play-centric" of games. Nevertheless, the critique of the book is intentionally condensed and no engagement with the interactive entertainment industry conversed. The book is a testimony to the variety of fields that game designing (game processing through iterative design approach) and game studies can potentially appeal from.

Game Design Process Through "Lens"

The art of game design (Schell, 2008), experienced in professor and game designing, discusses two major trajectories: the game design process and own advice through "the lens". The lens describes the concepts through which the design decisions are approached in terms of skill levels, mechanics, aesthetics, story and also the technological composition in industry. With the 100 lenses unfolding the designing process for designers, the discussion of each chapter unfolds from designer to experience through the game and the player and the effort of embedding each lens into a mind-map throughout the book has provided an in-depth understanding to basics of the designing process. For example, *Lens#32* The Meaning Choices (p.181), understanding the choices provided to the player are sufficient or making the player feel in charge? Or *Lens#47* The Balance (p.205) as a recommendation to apply with any occurring design problem, however, the decisions to fix the concepts and implement occurs only by the decision of programmers. Not only those, *Lens#89* The Team (p.380), *Lens#90* the Documentation (p.387), *Lens#91* The Playtesting (p.401) all fall under a very relevant yet thoughtful concepts of game designers working communicating and working respectfully, documenting the necessary concepts and testing the play of the game through player's perception.

This means putting game designer's thought out of the testing and covering essentials for game designers and engage the content for video games creatively through the design process. The mind-map includes thirty bubbles to represent new element emerging from each chapter and one hundred lenses provided can be very overwhelming information for the game designing team, who needs an urgent answer to the problem-solving or iterative approach. Despite the content list provided, it is noticeable to be confused with some identifications of the Lens names. To conclude, a creative involvement of game systems and the player working along to endorse the experience, whilst addressing crucial organizational perspective in relevance to software development methods such as spiral model, rapid prototyping and play-testing.

Game Design Principles and Cores

Educational Game Design fundamentals by an educator, game designer, founder, director and board member of several European design studios; presents a comprehensive how-to-guide on design and building world-class educational experiences (Kalmpourtzis, 2018). It combines the evolvement, pushing through concepts and learning throughout the process by providing the stand on for the reader "Games are principles and not rules" (p.7). Although rules are elaborated on their own entirety (pp. 169- 180). "Rules" are illustrating that games present rules in operational constitutive and implicit way, rules present goals and rules define ways of punishment and rewards. Kalmpourtzis highlights that game designers have the magical power to deal with challenging tasks during the educational game design process. Hence, referring to his magical triangle (p.54): players, game and learning aspects to structure basic elements and their relationships to create games evolves through the chapters.

The emphasis on the designer's struggle to ensure that the balance is maintained in the system between the realistic and imaginative context of design is rather fruitful. Explaining that games consisted of objects and placing the objects as elements to be implemented in the game lead to the betterment of gameplay (p.181). "Game Core" being the most interesting establishment, it discusses the concrete basis of any game design based on the axis of the magical triangle and providing three approaches to designing a game (p.119): the unbreakable core, the flexible core, and the hybrid core. In the same context, the perspective discussed that prototyping is a key element of game design and evaluating what has been completed theoretically as well as practically. Nevertheless, Kalmpourtzis highlights that interdisciplinary game design is always the most challenging aspects, i.e. engineer working with a game designer will differ in terms of the application of the methodology to be used in building the game.

Coexisting is nearly impossible in many cases yet there is always a way to try and provide a common language as a "tool". In relation to structuring and prototyping (the fastest and easiest way), there is an evaluation of games strategies discussed which were rather general and have been published in the previous article as well (Ahmad, 2018). Evaluating games using usability, playtesting and quality assurance approaches can highly coexist with software engineering approaches. Lastly, the documentation chapter (p.325) had a new and interesting projection of how game design document shape through the designing phase, despite mentioning the difficulties faced by designers in communicating their voice formally and that the structure of the document is never the same. Listing three types of documentation: the classic document (one or more documents), the wiki (online with indexed searches) and the forum (participatory process) (p.327).

To conclude the discussion of game design fundamentals, "lens" of game design and educational game design fundamentals and cores, Table 2 summarizes the key movement from 2004, 2008 and 2018. This shows how the published work from game designers and theorists in the field. One prominent movement can be seen that 2004 presents no interest in documenting the designing process, whilst 2008 reports a non-existing template for game designers to 2018 where a formal structure has been proposed by Kalmpourtzis (2018).

Educational Game Design Frameworks and Models

In order to provide specific models and frameworks reflecting on the criteria of game design, design process, evaluation techniques used during the game design. This section discusses the highly relevant work to show the movements of research from 2015 to 2018.

Table 2. Demonstrates the similarities, differences and concerns noticed in the studies

Books	Salen & Zimmerman (2004)	Jesse Schell (2008)	George Kalmpourtzis (2018)
Uniqueness	Three (3) major concepts: 1. Rule – formal, structured 2. Play – experiential, social, representational 3. Culture – contextual design to engage players. Key Concepts: 1. Engage Players – motivational, thrill, challenges & goals. 2. Interactivity – design, system, play.	Design aspects: 1. Mechanics 2. Aesthetic 3. Story 4. Technology in industry Lens # 100 – mind map for designers to unfold the design process.	Educational games design specific and design principles. Magical Triangle: 1. Players 2. Game 3. Learning Aspects Game Cores (3 of the designing process): 1. Unbreakable 2. Flexible 3. Hybrid Common language "tool" required. Evaluating games: · Usability · Playtesting · Quality assurance approaches Key Considerations of designing & evaluating process: · Prototyping Discusses Pedagogy with games through major learning theories.
Difference	Revolves around the three major concepts throughout.	Discusses: · Designer's thoughts (lens) · Essential game components · Engage player through experience	Discusses Schell's Design aspects and adds: · Pedagogy Documentation for Designing Games: Formally structured
Concerns/ absence	· Very niche industrial related discussion. · Very niche educational games discussion. · More on cultural context, play, and rules. · Discussion of Documentation of Games is not mentioned.	· The Mind map has 30 different points to understand which is confusing for designer's iterative work rules. · Lens names are partly confusing and could be organized better. · Documentation template does not exist.	Author Highlights: · Coexisting and interdisciplinary designing is nearly impossible. · Common language "tool" required.

1. A recent study implements a six-phase methodology, HEXA-GBL, for designing and evaluating GBL activities from a learner-centered perspective (Romero, 2015). The phases are: 1) game design activity, 2) learning objectives definition, 3) the learner-centered need analysis, and the definition of the game modalities, 4) mechanics and rules, 5) the play activity evaluation from the learning outcomes, assessment and feedback, and 6) learners' gaming and learning experience during the GBL activity. While overcoming the barriers of GBL costs and focusing on game mechanics, HEXA-GBL also prioritized the educators to operationalize with adapting processes.
2. Game-Based Learning Design Model (Shi & Shih, 2015) highlighted specific game genres making them difficult to use when the target game genre is different from default game genres applied in research. Consequently, presenting macro-level design concepts comprising of 11 key factors to provide a thinking process for assisting EG designers to integrate them into their game designing (game goals, fantasy, mechanism, game value, narrative, interaction, challenges, freedom, sociality, sensation, and mystery). With evaluation, the authors verified the usability of the model with the

performance of the factors and concluded that it can assist EG designers in developing motivational games (Shi & Shih, 2015).

3. Mechanics-Game Mechanics (LM-GM) model provides a graphical representation of game flow to establish relationships among components which translates pedagogical learning mechanics into game mechanics (Arnab, Lim, Carvalho, Bellotti, De Freitas, et al., 2015). Although it identifies abstract patterns and predefined elements to be replicated across EG, it does not expose the connection with the educational objectives to allow sustainable mechanics.
4. Recently, a framework is proposed for a blended learning environment to enhance learning outcomes and to provide a valuable strategy to facilitate both lecturers and students to obtain better educational knowledge (Jing, Yue, & Murugesan, 2015). Although it has proven a positive learning outcome, there is a need for more research work that can validate the learning-driven game design strategy.
5. In contrast, an Activity model takes accounts for the distinction between designer and instructor explicitly, therefore, the clarification of the role of the teacher/instructor in the game is needed. The game sequence representation follows the unified modeling language (UML) activity diagrams notation, which uses the shapes connected by arrows to represent the flow of the activities (Kühn, 2015).
6. MEEGA+ model (Petri, von Wangenheim, & Borgatto, 2016) was proposed to address the limitations of its predecessor regarding the lack of understanding of measurement instrument items and in terms of its validity and reliability. The MEEGA+ model has been systematically developed by decomposing evaluation goals into measures and defining a measurement instrument to evaluate the perceived quality of educational games in terms of player experience and perceived learning. The MEEGA+ model provides game creators, instructors and researchers with a measurement instrument in order to evaluate the quality of educational games and, thus, contribute to their improvement and effective and efficient adoption in practice. MEEGA+ evaluates the quality of learner assessment, thus, EG as a software, development or EG design was not included in this study.
7. A Hybrid theoretical framework that analyses a few existing design models, the learning theories embedded in them and the user experience component (de Aguiar et al., 2018). The hybrid framework is content specialist (puts developers and designer's perspectives), contains educational goals and technological aspects required around designing a game. Provides an iterative design process throughout the stages to ensure pre-production, production, and post-production are polished and enhanced. Not only that, the model includes a pedagogical approach and learning theories. Despite an immense study conducted, it is still a work in progress and the model needs to be verified or validated through the designer's and developers; to ensure its practicality, and also, the genre of games is serious games, hence, the confusion on understanding educational games and serious games is still ambiguous.
8. Another recently published work on proposing an architecture of serious game design and assessing the technology establishes through emphasizing the engaging and motivating needs of game design through knowledge of learning domain (Mestadi, Nafil, Touahni, & Messoussi, 2018). Along with that, pedagogy and game design components and their collaboration between domain content, pedagogical and playful experts lead the architecture to propose a taxonomy, representing a functional architecture for supporting the conceptual design of the game. With the help of the architecture designed, the paper reports that modification of decisions of the educational robot with affecting

a game, and responding to new updates to improve games or even reusability of the educational robot with the newly designed game is beneficial through the domain content where playful experts share the design requirements. A concern to be highlighted reducing and encapsulating experts intellectual may seem quite interesting but allowing domain experts to focus on their definitions and knowledge and not worrying on the playful aspects of letting game designers amend aspects without having them to acquire deep knowledge of domain content seems ambiguous and requires more testing to prove the authenticity of how a game design might be retrieved.

MAIN FOCUS OF THE CHAPTER

Issues, Controversies, Problems

The gap between game design and educational game design has become evident that to optimize the learning from serious games, pedagogical experts should be actively involved in the development process (Arnab, Lim, Carvalho, Bellotti, Freitas, et al., 2015; Tahir & Wang, 2018). A systematically reviewed article discussing how EGs are evaluated by including 112 relevant articles and evaluated their relevancy based on analysis factors, research design, evaluation models/methods, and the kind of instruments that are used in the research (Petri & von Wangenheim, 2017). This concludes that the majority of published articles are based on qualitative research methods, hence, they do not use a well-defined evaluation model or method. Furthermore, it highlighted that there is a need for more rigorous evaluations as well as methodological support in order to assist game creators and instructors to improve such games as well as to systematically support decisions on when or how to include them within instructional units.

The crucial experts involved in the designing process is highlighted many times. It is a challenge and substantial to ensure that collaboration between game-based learning experts, theoretical experts, game designers teachers, learners, developers, and non-technical domain experts to occur. Yet research still mentions the challenges of collaborating the experts with different intellects in one room (Kalmpourtzis, 2018). The sophistication of popularity and budget of creating EG by scratch demands a high level of the production process is also challenging to researchers and game developers. This gap was also recently highlighted in a comparative analysis study and reported two major issues in perspectives of designing EGs and models: lack of independent evaluation of EG and the need to focus on the practical application of the design models to be presentable in EG industry (Tahir & Wang, 2018). Due to lack of infrastructure capabilities including hardware and software requirements, theoretical aspects in terms of pedagogical and instructional aspects are also very crucial in designing and development process. The game industry needs to ensure that integrating an instructor in an EG can provide useful feedback to users at a run-time significance (Sinkewicz, 2015). This way bringing out the fundamentals and principles published in (Kalmpourtzis, 2018; Schell, 2008; Zimmerman & Salen, 2004) could enhance the game design process.

Designing an effective EG needs to have a clear understanding of what the desired learning outcomes are and to establish a transparent mapping amongst (Hainey, Connolly, Stansfield, & Boyle, 2011). To understand that, research methods and statistics are broad-ranging, complex, and interconnected with logical and scientific reasoning, understanding different representations of data, data analysis, interpretation of results and evaluation skills (Boyle et al., 2014). It is barely the case where domains such as gameplay, game environment, subject-matter, and learning theories interaction have been discussed in order to provide a holistic view of a particular game element. Mostly, the literature uses vaguely spread

game elements that cover a large number of relationships and domains. Defining domains, playful experts, domain content in the interdisciplinary context still seems to be vaguely established (Mestadi et al., 2018).

The GBL and its diverse dimensions and characteristics make it difficult to evaluate and model. However, evaluation remains the only way to verify if the educational targets are being achieved and to detect any functional vulnerability inside the learning game. If the gaps between EG community and industry, and between academia and industry is bridged, the game development efforts could benefit all communities, including industry (Arnab, Lim, Carvalho, Bellotti, Freitas, et al., 2015; Azadegan et al., 2014). Although evaluation process can be costly, there should be a pre-modeling strategy, which can allow developer or designer to model out the elements and related elements, as well as domains that should be involved in EG actively. The collaboration between pedagogy, structural elements, dynamics and also theories in a game remains a tough task, although the research strives to provide theoretical models achieving as much as possible, yet testing their application and evaluating the proposed models is still under construction (All et al., 2016; de Aguiar et al., 2018).

Besides that, only two models cited Schell's work on "the art of game design", which is alarming as the work published in the books sets basics and establish definitions that can be adopted to ensure consistency and defined terms (2008). With respect to much work published, the questions remain untangled on what are the core values, core principles or the fundamentals; one must follow to obtain a satisfactory game design. The process of evaluating game design process using prototyping was highly discussed and seems to be promising; and it was confirmed by (Kalmpourtzis, 2018) that prototyping is the key element of designing an educational game. In terms of design, only a few models represent the idea of prototyping, however, the evaluation of EG discusses prototyping but this is still noticeably niche and needs a deeper understanding in terms of software engineering prototyping.

SOLUTIONS AND RECOMMENDATIONS

Below are a few suggestions that are carefully analyzed through the analysis of models and frameworks; to the issues mentioned above.

There is a need for researcher proposing theoretical models and frameworks to provide a legitimate ground of using definitions, game design fundamentals, structural elements of game design, or the principles of game design from the established books. This is due to the fact that every researcher understands and interprets the definitions from different articles that are written under different scenarios. Steps of software engineering prototyping and the steps to be undertaken for the game design process. This does not imply that their work is at fault, but the application of consistent terms used throughout the research will provide more engaging content to a larger group of experts. Else, the question then rises to why the mind-map to designing a game with 100 lenses of designer's experience (Schell, 2008), game rules and design fundamentals(Zimmerman & Salen, 2004) and Fundamentals of game design (Kalmpourtzis, 2018) are not being employed as they should. The in-depth procedures provide a concise yet detailed step in various aspects to visualize the position of not only game designers, but also developers, educators, new game designers, software testing teams, etc. Hence, providing a common ground and looking at the similarities of articles published and books provided game designing fundamental can assist a clarity towards designing models for game designing process.

Understanding the prototyping leads to the betterment of the game design process, there is a need to unpack how the procedure of prototyping in designing EG can be enhanced. The understanding of

game designing prototyping steps through Kalmpourtzis' s fundamentals and the lens of Schell's design provides an understanding of the basic steps required for prototyping. The discussion provides a comparison and understands similarities of the prototyping steps undertaken for software engineering and the prototyping steps discussed for designing games. With the overview, the steps from software engineering prototyping can be used in the designing process of EG to clarify the requirements to ensure learning objectives and entertainment remains the equally present.

Figure 1 shows the prototyping steps discussed through the game design process in (Kalmpourtzis, 2018; Schell, 2008; Zimmerman & Salen, 2004). A commonly used and recommended (Wenzler, 2009) development method is iterative design. This is also described as a play-based design process (Zimmerman & Salen, 2004). A prototype is played, evaluated, adjusted and played again, allowing the designer or design team to base decisions on the successive iterations or versions of the game. Iterative design is a cyclic process that alternates between prototyping, play-testing, evaluation, and refinement (p. 11).

Figure 1. Proposing Combined Prototyping steps adopted for the game designing process
Source: (Kalmpourtzis, 2018; Schell, 2008; Zimmerman & Salen, 2004)

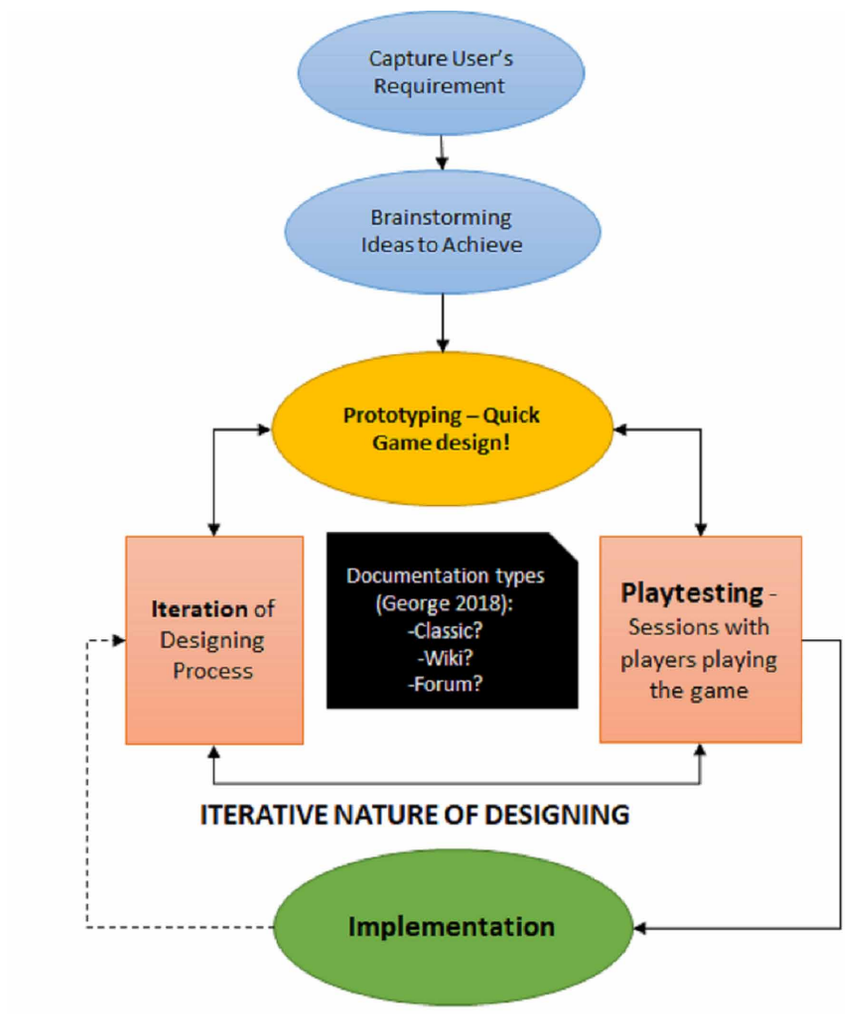
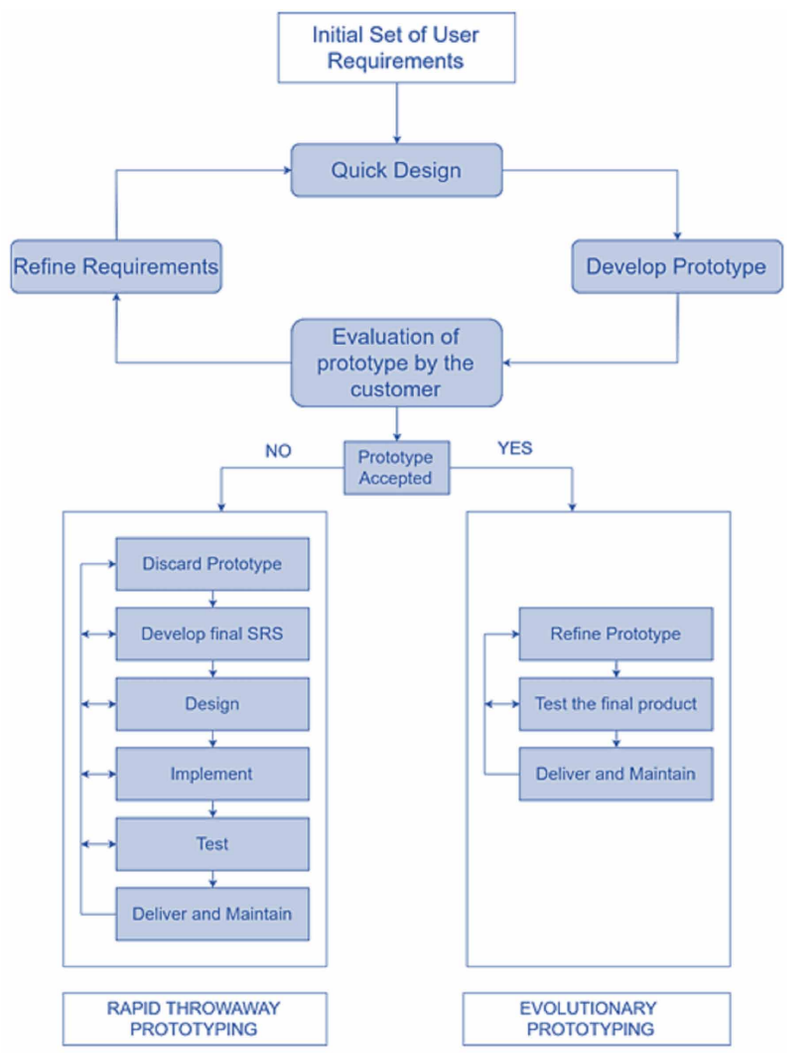


Figure 2 shows the steps undertaken in software prototyping through two different approaches: Evolutionary and Rapid throwback. Evolutionary prototyping is an incrementally refined process on the basis of customer's (players) feedback until it finally gets accepted. It saves time and effort as developing a prototype from scratch for every iteration of the process can sometimes be very frustrating for the developers. Rapid throwback is a method of exploring ideas and getting customer feedback for each prototype. A developed prototype need not necessarily be a part of the ultimately accepted prototype. Customer (players) feedback helps in preventing unnecessary design faults and hence, the final prototype developed is of better quality. These processes can be easily adopted in the game designing process as the emphasis on iterative game designing has been highly discussing in the published research. Although this requires testing on designing games, it projects a promising iterative designing approach.

Figure 2. Prototyping model of software engineering combining evolutionary and throwback prototyping
Source: (Gowtham et al., 2017; Padda, Arora, Gupta, & Sharma, 2014; UsingAPA)



Another crucial aspect to highlight is the documentation of game designing. Schell's stated that "The magic template does not exist!" (Schell, 2008, pp. 382-383). There are only two exact purposes of game documents: (1) Memory document which records decision and amendments taken place throughout the development period and, (2) Communication document, where all the stakeholders tend to communicate. Kalmpourtzis (2018) emphasized the idea of creating a document that helps individuals rather than creating problems, and stated: "game design documents are not about formalities, they are about actions!" (p. 326). Consequently, an efficient game design document contains a list of attributes: (1) never the same structure, (2) simple structure, (3) clarity of design process, and (4) Descriptive (imagery, music, videos).

Table 3 presents the most common aspects that are likely to occur in a game design document. From a software designer perspective, this can be categorized as poor management for software development, as software requirement analysis documents are required to ensure all software diagrams, content, requirements, analysis, and also the end product is quality attested (Georgiadou, 2003).

Table 3. Common aspects encountered in educational game design documents

No.	List of Aspects for an Educational Game Design Document
1.	Learning aims & Objectives
2.	Learning Methodologies
3.	Learning Theories used and their Impacts
4.	Evaluation of the Game
5.	Presentation of the game (introducing to players)
6.	Audience
7.	Audience Needs and Preferences
8.	Learning Context
9.	Game Mechanics
10.	Narrative Elements
11.	Game Characters and Abilities
12.	Connection and impact between game elements (mechanics and story of technology and mechanics)
13.	Technology Features (Related to any categories stated above)

Source: (Kalmpourtzis, 2018)

FUTURE RESEARCH DIRECTIONS

To unpack the game design process, there is a need to ensure the fundamentals, core values and the state of the art of game design is taken into consideration. This chapter attempts to comprehend the concepts, fundamentals of game design and designing process involving various experts in the field and a few recommendations to providing similarities and differences between software design and game design were discussed. Prototyping has proven to provide a good grasp on designing game and have iterative nature to test the requirements and the play of the game (Serrano-Laguna et al., 2018). Researchers have

proposed prototyping tools for designing games using the iterative rapid prototyping methods (Volkovas, Fairbank, Woodward, & Lucas, 2019).

With respect to discussed literature and proposed solution, this could be further enhanced into a variety of areas in the field that could be beneficial for game designers, academicians, and researchers. The following

- Practicing on applying the fundamentals of game design to propose an educational game designing model EG.
- Defining terms in each model/framework proposed is a crucial necessity as there is a noticeable inconsistency.
- A template of a document is provided in Kalmpourtzis (2018, p.327) that covers common aspects every EG encounters. Perhaps, that could be easily adapted to document the design process and provides an ease of communication with other experts.
- Using the Prototyping steps clearly to achieve a more quality product.
- Testing and feedback procedures in EG could also be weighed in perspective of software engineering tools and techniques, as not all techniques could work but not all fail during application.

CONCLUSION

This chapter has discussed three prominent games designing fundamentalist alongside with various types of existing theoretical frameworks and design models which aid in designing EGs. Due to an overwhelming requirement on unpacking the complexity of the game design, this chapter discusses the models and frameworks in parallax with established fundamentals through the prominent fundamentals of game design. EG design phase also requires prototyping that has proven to be useful in iterative nature, hence, this chapter provides an overview conceptual model that game designers can adopt during the designing phase (Figure 1). The proposed conceptual model combining prototyping in game design can be similarly contrasted with software engineering prototyping (Figure 2) where throwback and evolutionary approaches can enhance the designing process of an EG. Finally, this chapter provides a further recommendation on how the software designing processes can be adopted for designing an EG and documentation of an EG thoroughly to provide a communication ground for other experts in designing process.

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KEY TERMS AND DEFINITIONS

Evolutionary Prototyping: Incrementally refined on the basis of customer feedback till it finally gets accepted, saves time and effort as developing a prototype from scratch for every iteration of the process can sometimes be very frustrating for the developers.

Fidelity: In the context of serious games, the concept of fidelity referees to the extent to which game emulates the real world. Mostly refers to the game environment, visual effects and response to an action from players.

Game Design Schema: A way of understanding games, a conceptual lens that can be applied to the analysis or creation of the game.

Game Environment: A dimension which collaborates game rules, objectives, subject, and theoretical aspects together as a whole to provide an interactive flow of activity.

Gameplay: This is where the rules and regulations of EG.

Model-Driven Engineering: A software development approach, focusing on the creation of models that represents the system-under-study (SUS) and subsequent generation of fully-working software artifacts from these models.

"Play-Centric Account" of Games: The formal and experiential approach to game design.

Rapid Throwaway Prototyping: A method of exploring ideas and getting customer feedback for each prototype. A developed prototype need not necessarily be a part of the ultimately accepted prototype. Customer feedback helps in preventing unnecessary design faults and hence, the final prototype developed is of a better quality

Schema: A way of framing and organizing knowledge.

Chapter 12
Usability Analysis of a Mobile Learning Application

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ABSTRACT

With the advances in mobile technology, mobile learning has gained importance and has spread widely especially among young people. In this study, a research model is developed to determine the factors affecting the usability of a mobile learning application belonging to one of the most popular MOOCs (massive open online courses) providers. The constructs—aesthetic graphics, color, control obviousness, entry point, fingertip-size controls, font, gestalt, hierarchy, subtle animation, and transition—adapted from the study of Hoehle et al. are included to reveal their effects on usability perception. Furthermore, the operating systems—iOS or Android—used in the mobile devices affect the usability of the mobile application is explored. A questionnaire is developed, and 223 surveys are collected from the users of the application. The results of the study show that gestalt, control obviousness, subtle animation, and aesthetic graphics are significant factors on the usability perception of the users.

INTRODUCTION

With the advancements in technology, mobile phone usage has increased in the last decade. According to statistics, there are currently more than 4.93 billion mobile phones around the world while the world population is 7.6 billion ("Number of mobile phone users", 2018; "Current world population", 2018). With the increase in mobile device ownership and usage, mobile devices have become part of our daily lives. People start to use these devices not only for daily mobile phone activities but also for

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sophisticated ones such as banking transactions, buying plane tickets, booking a hotel room and getting an online education. Getting online education by using mobile devices is called "mobile learning". In the literature, mobile learning is defined as "the delivery of learning to students anytime and anywhere through the use of wireless Internet and mobile devices, including mobile phones, personal digital assistants (PDAs), smartphones and digital audio players (Wang et al., 2009).

Mobile learning has advantages such as interactivity between students and teachers, portability of the mobile devices, collaboration between the students in an online education class, engagement of young users (Hashemi et al., 2011; Özdamli & Çavuş, 2011). Students could access learning contents anywhere and anytime with the help of their mobile devices. However, these advantages do not conclude that mobile learning is perfect and it takes the place of the traditional education in the near future. There are some disadvantages of mobile learning caused by the specifics of mobile devices such as small screen size, mobile context, connectivity, different display resolutions, limited processing capability and power, restrictive data entry methods etc. Furthermore, the design characteristics of the mobile applications such as complexity may cause usability problems that affect the user's intention to use negatively. As the system becomes sophisticated, people start to feel hesitation or anxiety while using the system. At this point usability of any system becomes essential for the acceptance and success. Usability may be defined simply as the ease of use. However, it includes other concepts like learnability, memorability, error-free or error prevention. Because of this, in this study, factors affecting the usability of a mobile learning application are examined.

In this study, the mobile application of one of the favourite MOOCs (Massive Open Online Courses) providers is examined. It is a mobile learning application published on the Apple's App Store on iOS platform and Google's Play Store on Android platform. It is currently one of the world's biggest online education platforms, and the platform currently has more than 80,000 different courses available online. These courses have a wide range of topics like programming, design, music or even sports in 10 different languages. In the platform, instructors prepare their lessons about the subjects they expertise with the help of the tools provided by the system and publish them.

In this study, a research model is developed in order to determine the factors affecting the usability of the mobile learning application. The constructs- aesthetic graphics, color, control obviousness, entry point, fingertip-size controls, font, gestalt, hierarchy, subtle animation and transition adapted from the study of Hoehle et al. (2016) are included to reveal their effects on usability perception. Furthermore, the operating systems- iOS or Android used in the mobile devices affect the usability of the mobile application is explored. A questionnaire is developed, and 223 surveys are collected from the users of the application. A three-step approach is used in the analysis: In the first step, the reliability analysis of each construct is checked. In the second step, significant factors affecting the usability of the mobile application is determined by using the technique-regression analysis and separately iOS and Android applications, the significant factors are also determined. In the third step, the t-test is applied to examine whether there is a difference between iOS and Android applications regarding usability constructs, and in addition, an item based analysis is done.

The remainder of this study is organized as follows: The second section provides background information about mobile learning, the usability of mobile applications and usability of mobile learning applications. In the third section, research methodology and the analysis results of this study are presented. In the fourth section, solutions and recommendations are discussed. Finally, future research directions and conclusions of the study are presented.

BACKGROUND

Mobile application usability is defined as "the degree to which a mobile application can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use." by adopting from the definition of usability of International Standards Organization (ISO) (Hoehle et al., 2016). The features of mobile devices such as such as small screen size, mobile context, connectivity, different display resolutions, limited processing capability and power, restrictive data entry methods etc. influence usability of mobile applications (Jacko, 2011; Zhang & Adipat, 2005). In addition, the operating system of mobile devices may affect the usability of mobile applications (Kortum & Sorber, 2015). Therefore, usability guidelines developed for other systems such as computers, websites etc. may not determine the usability problems specific to mobile applications.

In the literature, there are several studies attempted to develop usability guidelines and define usability metrics specific to mobile applications. Hussain & Kutar (2009) identified a set of questions and metrics specific to the mobile application based on the primary measures, effectiveness, efficiency and satisfaction, which are used to define usability. Hoehle & Venkatesh (2015) developed a measure for mobile application usability based on Apple's guidelines. Their instrument has 19 first-order constructs such as instant start, effort minimisation, concise language etc. and 6 second-order constructs such as application design, user interface graphics etc. They validate their conceptualisation by applying survey to U.S. consumer using social media applications. The results of the study show that application design, application utility, and user interface graphics are the more important predictors of mobile application loyalty and continued intention to use. Hoehle et al. (2016) analyzed Microsoft's mobile usability guidelines, and they developed a measure including ten constructs: Aesthetic graphics, color, control obviousness, entry point, fingertip-size controls, font, gestalt, hierarchy, subtle animation and transition. They validate their constructs by applying a survey to German consumers using social media applications. The results of the study show that gestalt, fingertip-size controls and subtle animation are the most significant factors of continued intention to use and gestalt, fingertip-size controls and control obviousness are essential factors of brand loyalty.

Mobile learning applications are mobile applications designed for educational purposes, and they provide users to reach learning materials anytime anywhere. Mobile learning applications have gained importance with the advances in mobile technologies and usage of mobile learning applications are highly increased especially among young people. In the literature, there are several studies about mobile learning investigating the impact of mobile learning and factors affecting the adoption of mobile learning. Arain et al. (2018) examined the influence of a mobile learning application on the learning outcomes of university students by conducting user testings, and the result of the study shows that the mobile application has a positive effect on the learning outcomes of the students. Hamidi & Chavoshi (2018) studied the adoption of using mobile learning in higher education regarding the factors as; ease of use, trust, characters and personal qualities, context, perceived usefulness, culture and behavioural intention. The results show that the context of the mobile applications has a positive effect on the ease of use and usefulness. Also trust and culture of using have a positive impact on behavioural intention to use. Wang et al. (2009) determined performance expectancy, effort expectancy, social influence, perceived playfulness, and self-management of learning are significant factors on behavioural intention to use mobile learning based on the unified theory of acceptance and use of technology (UTAUT). Al-Hunaiyyan et al. (2016) investigated the perception of instructors and stıdents toward the use of mobile learning and they also discussed the challenges related to the adoption of mobile learning as design challenges,

technical challenges, management challenges, social and cultural challenges, evaluation challenges. For example of these challenges, high investment costs, rapidly changing mobile technologies, resistance to change, need of fast internet connection, privacy issues, lack of efficient evaluation methods to assess learning outcomes, etc.

Mobile learning applications have three design aspects as instructional design, interface design and screen design (Al-Hunaiyyan et al., 2016). Two of these three design aspects as interface and screen design is directly related to usability. Usability is an important quality attribute to increase the satisfaction of the users and their intention to use the systems in the future. On the other hand, in the literature, there is a limited number of studies about usability compared to the number studies investigating mobile learning in the aspects of pedagogy and TAM (Parsazadeh et al., 2018). Furthermore, Crompton & Burke (2018) grouped the studies according to their research purposes in their literature review study including 74 articles. The results of the study show that 31% of the studies investigated the impact of the mobile learning on student achievement, 29% of the studies focus on the students' perceptions, 20% of the studies examined the pedagogy involved in mobile learning, 15% of the studies investigated the factors influencing mobile learning, and just 5% of the studies investigated the evaluation of specific applications and systems. The results of the review of Crompton & Burke (2018) show that there is a gap in the evaluation of the mobile learning applications.

As mentioned in the previous section, there is a limited number of studies about usability evaluation of mobile learning applications. Ali et al. (2015) used heuristic evaluation method and applied user testing with 96 students to compare the two interface designs for mobile learning applications in terms of ease of use, user satisfaction, attractiveness and learnability. Masood & Thigambaram (2015) conducted a usability study and applied user testing to evaluate the UI of a mobile learning application designed for the children aged 4-5 years by using eye tracking glasses. Parsazadeh et al. (2018-1) developed a usability questionnaire specific to mobile learning applications by using Delphi method and applied user testing and survey method a mobile learning application: The Cooperative and Interactive Mobile Learning Application (CIMLA) designed by themselves. Their questionnaire includes the constructs such as effectiveness, efficiency, timeliness, satisfaction, learnability, memorability, error and cognitive load. Parsazadeh et al. (2018-2) applied the usability questionnaire developed by Parsazadeh et al. (2018-1) to compare the traditional learning methods with CIMLA which is a mobile learning application designed by themselves. The results show that proposed mobile learning application design has a better performance than the traditional methods.

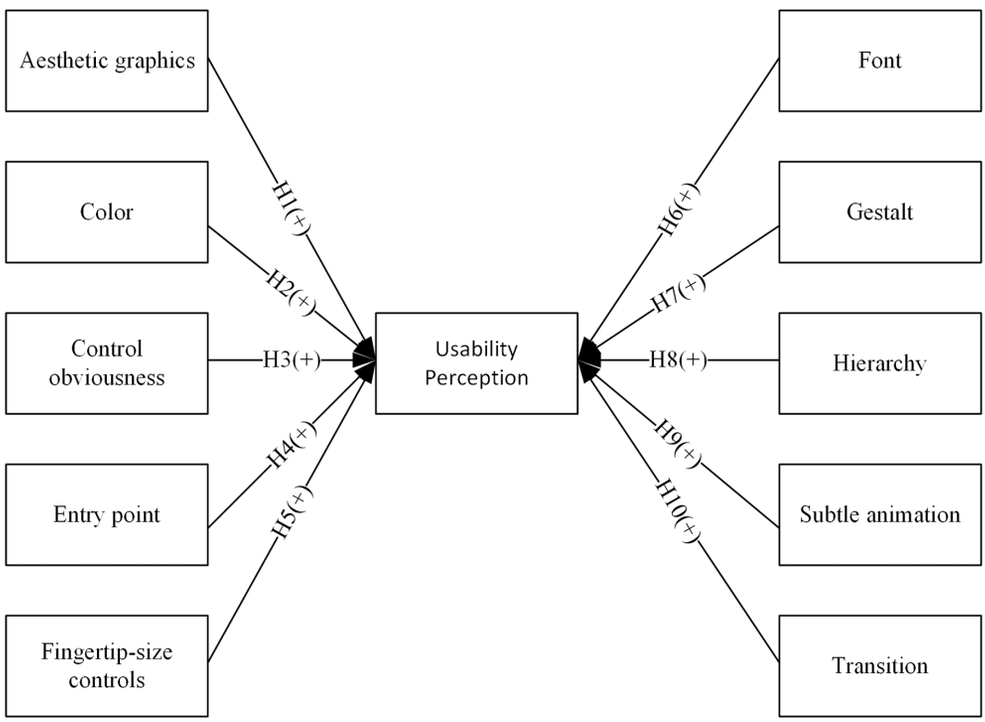
Parsazadeh et al. (2018-1) developed a questionnaire specific to mobile learning applications, but they mostly concentrate on the learning side of the system, and the proposed survey may not help to determine the usability problems caused by the specifics of the mobile devices. On the other hand, the scale developed by Hoehle et al. (2016) is a usability guideline specific to mobile applications, and this scale may be more helpful to increase the usability level of the mobile applications. As far as our knowledge, this will be the first study applying the scale of Hoehle et al. (2016) to evaluate the usability of a mobile learning application. Usability is an important quality attribute for the success of the mobile applications, and mobile learning will be an essential part of the education system for the next generations. For this reason, this study focuses on the usability of a mobile learning application to determine the significant factor affecting the usability of the system. Furthermore, as seen in the literature review, there is a limited number of studies about the usability evaluation of the mobile learning applications, this study will contribute to filling this gap.

RESEARCH METHODOLOGY

Research Model

In order to determine the factors affecting the usability of the mobile learning application, a research model is constructed as in Figure 1.

Figure 1. Research model of mobile learning application



The hypothesis of the research model is presented as follows:

H1: Aesthetic graphics has a positive effect on usability perception of the users.
H2: Color has a positive effect on usability perception of the users.
H3: Control obviousness has a positive effect on usability perception of the users.
H4: Entry point has a positive effect on usability perception of the users.
H5: Fingertip-size controls have a positive effect on usability perception of the users.
H6: Font has a positive effect on usability perception of the users.
H7: Gestalt has a positive effect on usability perception of the users.
H8: Hierarchy has a positive effect on usability perception of the users.
H9: Subtle animation has a positive effect on usability perception of the users.

H10: Transition has a positive effect on usability perception of the users.

All measurement items in the model are adapted from the study of Hoehle et al. (2016). 5-point Likert scales are used in order to measure the items (1 means strongly disagree, and five means strongly agree). In the survey, there are ten categories and 40 questions in total (4 questions for each category).

Table 1. Measurement items and questions of the survey (Hoehle et al., 2016)

Construct	Definition	Measurement Items
Aesthetic graphics	"the extent to which a user perceives that the mobile application makes use of aesthetic graphics."	"AEST1: The mobile application uses beautiful artwork." "AEST2: The mobile application uses rich, beautiful, and engaging graphics that draw you into the application." "AEST3: The mobile application uses stunning graphics." "AEST4: The mobile application benefits from beautiful and engaging graphics."
Color	"the degree to which a user perceives that the mobile application uses colors effectively."	"COL1: The mobile application uses appropriate colors." "COL2: The mobile application makes use of appropriate colors." "COL3: The mobile application has great colors." "COL4: The mobile application does not misuse colors."
Control obviousness	"the degree to which a user perceives that the mobile application deploys controls that are immediately obvious."	"COOB1: The mobile application makes the main function of the application immediately apparent." "COOB2: The mobile application uses intuitive commands." "COOB3: The mobile application uses controls that are immediately obvious." "COOB4: The mobile application employs controls that are intuitive."
Entry point	"the degree to which a user perceives that the mobile application can be accessed through alternative entry points."	"ENPO1: The mobile application can be accessed using two different ways." "ENPO2: The mobile application can be accessed via two different menus." "ENPO3: The mobile application can be started either through an icon or menu." "ENPO4: The mobile application is accessible using different icons or menu access points."
Fingertip-size controls	"the degree to which a user perceives that the mobile application deploys fingertip-size controls."	"FISC1: The mobile application uses fingertip-size controls." "FISC2: The mobile application makes use of fingertip-size buttons." "FISC3: The mobile application uses large-size controls." "FISC4: The mobile application uses small controls that require you to aim carefully before you tap it."
Font	"the degree to which a user perceives that the mobile application uses font effectively."	"FON1: The mobile application makes use of a good font." "FON2: The mobile application has a good font." "FON3: The mobile application uses a good font size." "FON4: The mobile application uses a font that I find appealing."
Gestalt	"the degree to which a user perceives that the mobile application uses gestalt principles effectively."	"GEPR1: The mobile application uses similar shapes for elements that are identical." "GEPR2: The mobile application groups elements together that are similar." "GEPR3: The mobile application groups things that belong together." "GEPR4: The mobile application makes use of similar shapes for elements that are identical."
Hierarchy	"the degree to which a user perceives that the mobile application has a hierarchical structure."	"HIER1: The mobile application has a well-defined hierarchical structure." "HIER2: The mobile application uses a clear hierarchy." "HIER3: The mobile application makes use of headings to develop a hierarchy on the screen." "HIER4: The mobile application employs headings to establish a hierarchy."
Subtle animation	"the degree to which a user perceives that the mobile application uses subtle animations effectively."	"SANM1: The mobile application uses animations effectively to communicate content." "SANM2: The mobile application uses animations appropriately." "SANM3: The mobile application does not overuse animations." "SANM4: The mobile application uses subtle animation to communicate content."
Transition	"the degree to which a user perceives that the mobile application transitions from one page to another."	"TRAN1: The mobile application informs you when it transits from one screen to another." "TRAN2: The mobile application tells the user when switching from one screen to another." "TRAN3: The mobile application moves from one screen to another without any problems." "TRAN4: The mobile application switches from one screen to the next smoothly."

The questions which are given below are asked to measure the usability perception of the users:

- **USAP1:** "I would find the mobile application easy to use" (Luarn & Lin, 2005)
- **USAP2:** "I like to use the mobile application to learn" (Liaw & Huang, 2003)
- **USAP3:** "I would find the mobile application useful in learning" (Luarn & Lin, 2005).
- **USAP4:** "I intend to increase my use of the mobile application in the future" (Luarn & Lin, 2005).

Data Analysis

223 participants who have experience in using the mobile application responded to the questionnaire. However, there were 25 incomplete questionnaires. After deletion of incomplete questionnaires from the sample, in total, 198 questionnaires were collected. From the participants, %47.5 of them have mobile devices which have an Android operating system and remaining participants % 52.5 use mobile devices which have an iOS operating system. First, reliability analysis is done, and Cronbach Alpha values of each construct are calculated as shown in Table 2. According to the results, the internal consistency of all the constructs is higher than the threshold value of 0.60 (Sekaran 1992).

Table 2. Cronbach alpha of each construct

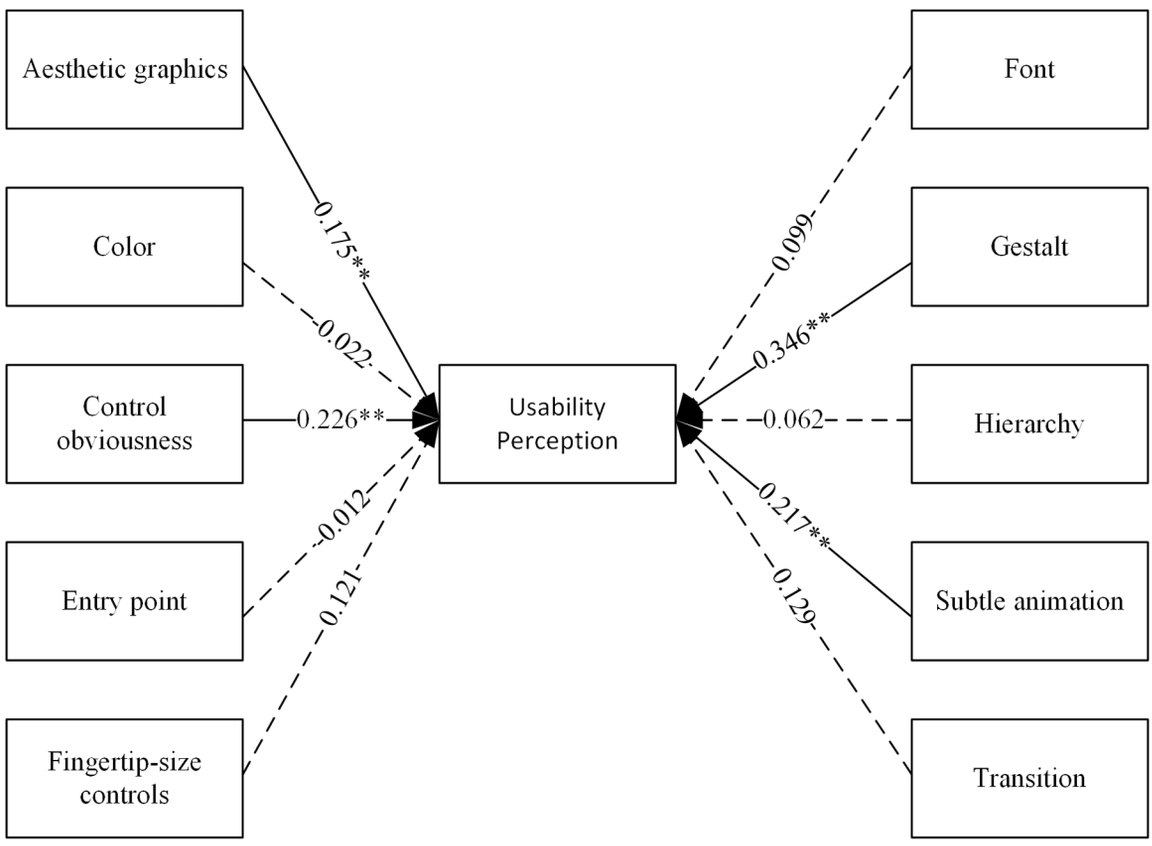
Constructs	Cronbach Alpha Values
Aesthetic graphics	0.905
Color	0.907
Control obviousness	0.936
Entry point	0.931
Fingertip-size controls	0.859
Font	0.740
Gestalt	0.940
Hierarchy	0.935
Subtle animation	0.728
Transition	0.917
Usability Perception	0.934

Average scores of each construct are also calculated, and the results show that all average scores are close to each other and greater than three. In order to determine the significant constructs have a positive effect on usability perception of the users, stepwise regression analysis is done by using SPSS V20, and the results of the regression analysis are shown in Table 3. According to the results of the regression, variables of the models explain the 61.5% (R^2= 61.5%, adjusted R^2=60.7%) of the variance on usability perception of the users. Four of the ten hypotheses are supported. The results of the research model are shown in Figure 2. The results indicate that the key factors affecting usability perception are gestalt (β=0.346), control obviousness (β=0.226), subtle animation (β=0.217) and aesthetic graphics (β=0.175).

Table 3. Regression analysis results of the research model

	Sum of squares	df	Mean square	F	Sig.
Regression	159.023	4	39.756	76.988	0.000
Residual	99.664	193	0.516		
Total	258.687	197			
Predictors	**Beta**	**Std. error**	**Adjusted R^2**	**F**	**Sig.**
Intercept	0.241	0.226			
Gestalt	0.346	0.082	0.542	233.780	0.000
Control Obviousness	0.226	0.070	0.587	22.442	0.002
Subtle Animation	0.217	0.102	0.600	7.349	0.035
Aesthetic graphics	0.175	0.083	0.607	4.400	0.037

*Figure 2. Results of the research model (** p < 0.05)*



Additional to this general regression analysis, to determine which factors are significant for iOS and Android systems, separately regression analyses are made. For the Android application, the results of the regression analysis are shown in Table 4. Significant factors explain the 47.9% variance of the variance on usability perception of the users. The results indicate that the key factors affecting usability perception are font (β=0.580), and subtle animation (β=0.436).

Table 4. Regression analysis results of the Android mobile application

	Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Regression	54.759	2	27.379	41.906	0.000
Residual	59.455	91	0.653		
Total	114.213	93			
Predictors	**Beta**	**Std. error**	**Adjusted R^2**	**F**	**Sig.**
Intercept	0.012	0.416			
Font	0.580	0.116	0.434	72.167	0.000
Subtle Animation	0.436	0.165	0.468	6.966	0.010

The regression analysis results for the iOS mobile application are shown in Table 5. The results show that the significant factors explain 78.2% of the variance in usability perception of the users. The results indicate that the key factors affecting usability perception are gestalt (β=0.335), control obviousness (β=0.236), hierarchy (β=0.225) and aesthetic graphics (β=0.191).

Table 5. The regression results of iOS mobile application

	Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Regression	109.354	4	27.338	88.788	0.000
Residual	30.483	99	0.308		
Total	139.837	103			
Predictors	**Beta**	**Std. error**	**Adjusted R^2**	**F**	**Sig.**
Intercept	0.248	0.189			
Gestalt	0.335	0.074	0.646	188.652	0.000
Control Obviousness	0.236	0.069	0.728	138.663	0.001
Hierarchy	0.225	0.079	0.765	112.487	0.005
Aesthetic graphics	0.191	0.087	0.773	88.788	0.031

Average scores of each construct for the operating systems are calculated as shown in Table 6. As seen in Table 6, scores are close to each other. In order to determine if there is any significant difference, the t-test is applied with Levene's test for homogeneity. Results of the Levene's test and t-test are shown in Table 7. According to the results of the Levene's test, all significance values are above 0.05, so homogeneity assumption is validated. Therefore, t-test results under equal variance assumption are

Table 6. Mean values of constructs based on the operating system

Constructs	Android (I)	iOS (J)
Aesthetic graphics	3.426	3.409
Color	3.372	3.248
Control obviousness	3.492	3.490
Entry point	3.332	3.488
Fingertip-size controls	3.253	3.433
Font	3.316	3.404
Gestalt	3.340	3.450
Hierarchy	3.309	3.399
Subtle animation	3.215	3.221
Transition	3.274	3.478
Overall Score	3.333	3.402
Usability perception	3.338	3.644

Table 7. Results of the t-test and Levene's test

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference (I-J)	Std. Error Difference
Aesthetic graphics	0.086	0.769	0.108	196	0.914	0.01688	0.15690
Color	0.083	0.773	0.771	196	0.442	0.12474	0.16190
Control obviousness	0.065	0.798	0.010	196	0.992	0.00164	0.16270
Entry point	1.581	0.210	-0.941	196	0.348	-0.15553	0.16528
Fingertip-size controls	0.066	0.797	-1.204	196	0.230	-0.18003	0.14952
Font	0.178	0.673	-0.671	196	0.503	-0.08736	0.13011
Gestalt	0.665	0.416	-0.675	196	0.500	-0.10909	0.16154
Hierarchy	0.231	0.631	-0.562	196	0.575	-0.09053	0.16101
Subtle animation	2.820	0.095	-0.053	196	0.958	-0.00573	0.10871
Transition	0.991	0.321	-1.251	196	0.212	-0.20443	0.16341
Usability perception	0.666	0.415	-1.891	196	0.060	-0.30646	0.16203

applied, and the results of the t-test show that there is no significant difference between iOS and Android applications regarding the constructs by taking into consideration the average scores of each construct (all $p \geq 0.05$). Furthermore, another t-test analysis in order to investigate the differences between Android and iOS applications regarding items of constructs is conducted. Except for the items FTSC4 (p=0.049), USAP3 (p=0.046) and USAP4 (p=0.07), all items have significant values greater than 0.05, and there is no significant difference between Android and iOS applications.

SOLUTIONS AND RECOMMENDATIONS

In this study, a research model is proposed to reveal the affecting factors on usability perception of a mobile learning application. According to the results, four of the ten hypotheses are supported, and the key factors affecting usability perception are found as gestalt (β=0.346), control obviousness (β=0.226), subtle animation (β=0.217) and aesthetic graphics (β=0.175). Gestalt is the most crucial factor affecting usability perception. Gestalt laws are used to create appealing and effective visuals by grouping the individual elements (Chang et al., 2002; Möller et al., 2012). Microsoft guideline which Hoehle et al. (2016) used to develop the mobile application guideline applied the two gestalt laws, proximity and similarity. However, there are more principles related to Gestalt theory; for example, the law of simplicity and law of unity/harmony (Chang et al., 2002). These laws may help designers to create visuals that are simple and more effective. The second important factor is control obviousness, controls of the applications should be clear and understandable to provide users easy navigation especially while using mobile devices having small screen sizes. The third one is subtle animation, which has the lowest average score comparing to other constructs. Using high-quality animation should be an effectıve communication tool. However, increasing number of animations or using highly complex animations may distract the users. The results of the study show that application overuses the animations. Therefore, the number of the animations should be decreased. The last construct is aesthetic graphics, visuals used in the application should be beautiful and appealing to take attention of the users, on the other hand, overusing of the visuals should be avoided not to distract the users. For Android applications, the results indicate font (β=0.580), and subtle animation (β=0.436) are the significant factors. Users of both Android and iOS application did not find the font appealing. Designers should think to change the font by taking into consideration the advice of the users. For iOS applications, the key factors affecting usability perception are gestalt (β=0.335), control obviousness (β=0.236), hierarchy (β=0.225) and aesthetic graphics (β=0.191). Hierarchy is an important design factor related to the structure and organisation of the application, and it increases the navigational capability and ease of use of the mobile application. Mobile application designers should work to develop a clear and well-defined hierarchy.

According to the results of a t-test based on average scores of the constructs, there is no difference between iOS and Android applications. On the other hand, the item-based analysis shows that for the item "FTSC4: The mobile application uses small controls that require you to aim carefully before you tap it.", iOS is better than Android. Furthermore, for the items "USAP3: I would find the mobile application useful in learning." and "USAP4 I intend to increase my use of the mobile application in the future." iOS has higher scores than Android. In other words, users of the mobile application run on iOS operating system found the application more useful and their intention to use the application in the future is higher than the users having Android devices. On the other hand, only for three items from 44 items, iOS has a higher performance than Android and higher scores of the iOS application users in usability and intention to use may be due to other factors such as the context of the lectures, price etc. that are not included to the research model. As a general conclusion, there is not any difference between

FUTURE RESEARCH DIRECTIONS

The significant constructs gestalt, control obviousness, subtle animation and aesthetic graphics explain the 61.5% variance on general thoughts of the users. Furthermore, font and subtle animation explain the

47.9% variance for Android systems and gestalt, control obviousness, hierarchy and aesthetic graphics explain 78.2% of the variance for iOS systems. However, there is still unexplained variance on the general thoughts of the users; additional study should be conducted with including new constructs context of the courses, culture, price, expertise of the lecturers etc. to explain the remaining variance on usability perception.

Furthermore, this study is conducted in Turkey with Turkish users, similar studies in the other countries should provide a general understanding of the usability of mobile learning applications. In this study, the usability guideline developed by Hoehle et al. (2016) is used, this guideline is specific to mobile applications, and in general, it is useful to detect many usability problems. On the other hand, mobile learning has its specifics differently from the other mobile applications. As future research, using a usability guideline specific to mobile learning applications may help to determine other constructs affecting usability perception of users and determine more usability problems.

CONCLUSION

Mobile learning has gained importance with the advances in the mobile devices. This study investigated the factors affecting the usability of one of the popular mobile learning application. The results of the study show that gestalt, control obviousness, subtle animation and aesthetic graphics are significant factors on usability perception of the users. Furthermore, the operating systems-iOS or Android affect the usability of the mobile application is investigated, and the results show that there is no effect of the operating systems by taking into consideration the average scores of the constructs. However, according to the item based analysis, there is the difference in the usability perception between iOS and Android in just 3 of the 44 items. Users of the mobile application who have mobile devices run on iOS operating system found the application more useful and their intention to use the application in the future is higher than the users having Android devices.

Furthermore, this study revealed the significant factors affecting usability perception of the mobile applications used different operating systems. Fonts and subtle animation are found as the significant factors on usability perception of Android mobile applications, on the other hand, gestalt, control obviousness, hierarchy and aesthetic graphics are found to be significant factors on usability perception of iOS mobile applications. These findings may help mobile application designers to solve usability problems related to significant factors to increase the usability level of the mobile application.

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KEY TERMS AND DEFINITIONS

Heuristic Evaluation: A usability inspection method is used to determine usability problems of user interfaces by taking into account the general usability principles called as "heuristics."

Mobile Application: A software program developed to run on mobile devices.

Mobile Learning: An educational system allows students to learn anytime and anywhere by using mobile devices such as mobile phones, smartphones, tablets and PDAs, etc.

MOOC (Massive Open Online Courses): An online course that has open access and enables unlimited and interactive participation using the web.

Technology Acceptance Model (TAM): One of the most frequently used information systems theory which models how users adopt and use technology by taking into consideration perceived ease of use and perceived usefulness of the technology.

Usability: A quality attribute that measures the degree of ease of use, effectiveness, efficiency and satisfaction of a product or software during the execution specific tasks.

Usability Testing: Tests are designed to evaluate the usability level of products.

Chapter 13
Main Features and Types of Educational Use of Wiki Technology

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ABSTRACT

Wiki technology has become very popular during the last years and is used in many fields. It enables the collaborative creation and management of content retaining the history of changes. There is abundant wiki-based content on the web covering a large number of subjects. A significant contribution of wikis involves education. Under certain conditions, technology may enhance the learning process due to the unique features it encompasses. In this context, wikis may prove very helpful as they provide the infrastructure for collaborative learning approaches and the development of online learning communities. This chapter discusses main features of wikis, wiki features specifically required in education, and typical uses of wikis in education. Representative examples of successful wikis are presented. Future research directions are also outlined.

INTRODUCTION

Technology has been integrated in non-formal and informal education (Kálmán, Molnár, & Szűts, 2018; Latchem, 2018) and in all levels of formal education from early childhood to higher education (Lytras, Papadopoulou, Marouli, & Misseyanni, 2018; Prentzas, 2013; Voogt, Knezek, Christensen, & Lai, 2018). The Web plays an important role in technology-enhanced learning. There is a variety and abundance of educational resources available anytime and anywhere. Synchronous and asynchronous communication tools facilitate interaction. Various Web-based customized systems are used to support

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learning such as Learning Management Systems (Antonis, Lampsas, & Prentzas, 2008) and user-adapted systems (Hatzilygeroudis & Prentzas, 2006; Prentzas, Hatzilygeroudis, & Koutsojannis, 2001). Blended and distance learning approaches may be supported. The aforementioned are merely indicative benefits that the Web may provide to education.

The Web 2.0 is considered an evolution of the initial Web as it enhances participation, social interaction and collaboration. It provides richer experiences to users and enables them to interact much more with applications and among themselves (O'Reilly, 2009). Users may create and update content and provide comments. Applications benefit from user participation. Applications based on social interaction such as blogs, wikis, multimedia sharing, podcasting and social networks are considered representatives of Web 2.0 (Mhouti, Nasseh, Erradi, & Vasquèz, 2017). Many researchers have attempted to integrate Web 2.0 tools in education (Bugawa & Mirzal, 2018; Mhouti, Nasseh, Erradi, & Vasquèz, 2017; Zarei, Mohd-Yusof, Daud, & Azizi, 2017).

Wikis are among the Web 2.0 tools that are exploited in education. Wiki technology enables the collaborative creation and management of content retaining the history of changes. The available wiki-based content covers a large number of subjects. In education, wikis may prove helpful as they provide the infrastructure for collaborative learning and the development of online learning communities.

This article outlines main technical and educational aspects concerning wiki technology. It is organized as follows. First, background information is provided covering the main features of wiki technology. Next, general aspects regarding use of wikis in education are discussed. The following section discusses solutions and recommendations including representative examples of wikis. Further on, future research directions regarding wiki technology are outlined. Finally, the article concludes.

BACKGROUND

A wiki is a website whose content is created and updated through asynchronous collaboration among users. The first wiki was WikiWikiWeb and was implemented by Cunningham (Leuf & Cunningham, 2001). It became available in 1995. During the following years, the participatory philosophy of wikis was widely accepted.

Roque (2013) discerns four main types of wikis, that is, enterprise wikis, educational wikis, public wikis and personal wikis. Personal wikis are the simplest ones and are used as personal Web pages. Enterprise wikis are discerned into three categories: single-user wikis whose creator shares the content with other company employees, project-group wikis involving collaboration of a group of users in a specific project and enterprise-wide wikis concerning the whole company. Educational wikis are discerned into three categories: course wikis involving a specific course of educational institutions, knowledge wikis used by teachers to share knowledge and subject wikis that include content about a specific subject. Public wikis may be accessed and updated by anyone and are discerned into two categories: general-purpose public wikis including information about various subjects (e.g., Wikipedia) and specific-purpose public wikis concerning a specific subject.

The most well-known wiki in the world is probably Wikipedia. Wikipedia is only one of the many wiki applications available on the Web. The flexibility of wiki technology enables it to be used in different ways and to handle all types of content. Indicative application fields for wikis are the business sector (Bolisani & Scarso, 2016), crowdsourcing (Al Helal & Mokhtar, 2018; See et al, 2015), decision support for emergency management (Rauner et al, 2016), education, government services (Al Helal &

Mokhtar, 2018), health (Swart et al, 2017), journalism (Tan, Ranaivo-Malançon, & Kulathuramaiyer, 2015) and politics (Margolin, Goodman, Keegan, Lin, & Lazer, 2016).

Wiki services may operate within a corporate or institutional Intranet. However, the benefits of the specific technology are increased when wiki functionality is available through the Web and the created content is stored on a server. The Web-based nature of wikis provides flexibility because it enables users to work anytime and anywhere (Al Helal & Mokhtar, 2018). This facilitates access to wiki functions and interaction among users. Storage of content on a Web server facilitates the collaborative creation of content. The server retains a single copy of the content. In case the content was stored locally in each computer of the collaborating users, there would have been multiple copies of the content and with differences among them (O' Bannon, Lubke, & Britt, 2013). This would have made difficult the management of content.

Wiki functionality is available through a (common) Web browser (Leuf & Cunningham, 2001). This enables users to perform all operations using a tool they are accustomed to without having to install and learn a specialized tool (Shih, Tseng, & Yang, 2008). Users find this very convenient.

A main feature of wiki functionality is the simplicity of its use. Wiki functionality is generally user-friendly requiring minor technical knowledge (Shih et al., 2008). Content is created and edited using an environment that is similar to a text editor. Other relevant functions (e.g., asynchronous discussion, commenting and file uploading) do not require particular technical knowledge. Simplicity also involves the names given to the created pages. More specifically, page names are easily understood without requiring interpretation and are also precise avoiding name clashes (Cunningham, 2014). According to various theories of technology acceptance (Marangunić & Granić, 2015), the user-friendliness of a technological tool is a factor that affects positively user acceptance.

Wiki philosophy focuses on collaboration and collaborative content creation aiming on groups and communities of contributors. However, individual schemes may be also implemented. As already mentioned, personal wikis constitute a type of wikis functioning as personal Web pages. In the case of education, tutors may give students individual assignments that may be implemented using wikis. Wikis may be used to combine both aspects. More specifically, a wiki may function as a personal Web page but may be also open to collaboration (Duffy & Bruns, 2006).

Wiki content is gradually created and enriched through collaboration. The gradual creation of content is facilitated by the ability to insert hyperlinks to wiki pages that have not been created yet (Cunningham, 2014). Wiki tools enable users to easily define the structure of content. The structure is cohesive through insertion of hyperlinks that enable navigation in the created content and other related content. The collaboration among contributors and the simplicity of wiki functionality enables the fast creation of content as demonstrated by the abundance of available wiki content on the Web.

Wiki environments provide the option of open or restricted access to their functionality. Both options provide advantages. Open access enables any user to update the available content or provide comments (He, Xia, Jin, Zhang, & Tian, 2016). This facilitates knowledge sharing. However, restricted access is considered necessary in certain cases. A user name and password are required to gain access to wiki content. Access privileges are assigned to each user defining the tasks that may be performed. In this way, the number of persons that may access the wiki content and the freedom of their actions are restricted and the content is protected from malicious actions (He et al., 2016; Schwartz, Clark, Cossarin, & Rudolph, 2004).

The history of changes in wiki content is retained. Furthermore, in many implementations notifications are provided when the content changes (Hadar, Levy, Ben-Chaim, & Farchi, 2016). This enables

the restoration of a previous version of the content which is useful in cases of erroneous or inaccurate contributions and in cases of vandalisms (Shih et al., 2008). Furthermore, the history of changes provides a view to the content creation process (Duffy & Bruns, 2006). The contribution of each user in the created content is also stored and this is frequently exploited by tutors to assess students.

The Web-based creation of content requires the interaction among contributors. This assists in clarifying ambiguities in the text, providing missing details and generally handling different views of contributors regarding the content. For this purpose, wiki environments provide asynchronous media of interaction among users. Discussion pages constitute a main medium of asynchronous communication in wiki environments. They enable users to exchange opinions, make suggestions for required changes in content and explain changes made in content (Alghasab & Handley, 2017). Therefore, the interaction among contributors ultimately assists in enriching the content and improving its quality. The stored interaction may also be used to assess the communication among contributors and the coherence of the group.

Various implementations of wikis enable users to create their own wiki essentially at no cost. In case an institution or organization decides to install a wiki platform on its own server, open source wikis (e.g., MediaWiki) may be exploited saving money. Obviously, there are companies that charge users in order to provide access to their wiki platforms. The existence of alternative options enables users to choose the scheme they regard as most preferable (Esichaikul, Myint Aung, Bechter, & Rehman, 2013).

The different implementations of wikis that are available have variations in their specific characteristics and offered functionality. Wikis may also function independently or may be integrated in other tools such as Learning Management Systems (He et al., 2016; Page & Reynolds, 2015). The alternative options may cover different needs of users interested in employing wiki functionality.

Table 1 outlines the main features of wiki technology.

It should be mentioned that Cunningham (2014) discusses main principles that govern wiki technology. As he was the creator of the first wiki it is interesting to outline his corresponding views. These principles are associated with the technical features and the overall philosophy of wiki technology. Due to the fact that the features of wiki technology have already been covered, the principles concerning wiki philosophy will be briefly mentioned.

Tolerance is a main issue in wiki-based work. Wikis promote a negotiation process that is based on the tolerance and exchange of different opinions. The convergence of different opinions will define the produced content.

Another principle is trust among wiki users. Each contributor needs to trust and depend on the other contributors. Trust involves the work each contributor produces and the opinions he/she expresses.

Table 1. Main features of wiki technology

1. Functionality available through the Web and created content is stored on a server
2. Functionality available through a Web browser without requiring a specialized tool
3. Simple and user-friendly interface requiring minor technical knowledge
4. Group-based and individual schemes of wiki use
5. Gradual creation and enrichment of content through collaboration
6. Option of open or restricted access to functionality
7. History of changes is retained and ability to restore a previous version of content
8. Asynchronous interaction and commenting through discussion pages
9. Wiki implementations at no cost
10. Variations in wiki characteristics and offered functionality

Cunningham specifically mentions that a contributor may assume that the others have good intentions. However, he also notes that there are limitations to this assumption.

A further principle is that wiki-based work needs to be amusing. This means that users enjoy providing their contributions and collaborating with others. Finally, Cunningham maintains that wiki philosophy is based on the notion of sharing knowledge, ideas, experiences and opinions.

WIKI TECHNOLOGY IN EDUCATION: GENERAL ASPECTS

This section discusses general aspects about the use of wiki technology in education. The following main aspects are discussed: (a) the specific wiki features required for educational use and (b) typical educational uses of wikis.

Wiki Features Required for Educational Use

The aforementioned features of wiki technology make it a useful environment especially in the case of collaborative authoring. This is verified by research concerning collaborative authoring. In this context, Noël and Robert (2004) outline the main features required by a technological environment in order to support collaborative authoring. More specifically, the required features are the following:

- Direct access to content to all group members,
- Access to previous versions of the content,
- Easy way of communication,
- Content distinguished from contents involving it,
- Easy track of changes done in the content,
- Support to the design and organization of the implementation stages of an assignment,
- Easy way of submitting personal opinions and commenting on the opinions of other group members,
- Provision of notifications in case of changes in the content,
- Synchronous communication facilities.

Wiki environments encompass all these required features with the exception of synchronous communication facilities. Therefore, wiki technology seems to provide a useful infrastructure for collaborative authoring and may be exploited in educational settings to support collaborative learning approaches.

However, there are significant differences among the different implementations of wikis. For this reason, tutors need to carefully examine the specifications of each platform. Schwartz et al. (2004) discuss the main aspects that need to be considered in the selection of a wiki environment that will be used in an educational setting. These aspects are outlined in the following.

The cost of wiki services is one of the first aspects to be considered. As already mentioned, there are free wiki platforms available on the Web. Others charge users according to different schemes of use and the provided services. Institutions that install wiki services on their own servers need to cover the cost of supporting these services with the corresponding personnel.

Wiki environments are not complex. Nevertheless, online support is useful. This includes, among others, online technical support, existence of documentation for the provided functionality and the existence of an active community providing feedback to questions posed by the users of the wiki platform.

Control support functionality plays an important role in the work of tutors and administrators. A user-friendly interface is necessary. Indicative control support features that are required concern the ability to view the list of connected users, the ability to create user accounts and assign corresponding access privileges, the ability to easily restore a previous version of content and provision of e-mail notifications in case of changes in content.

Clarity is always a significant aspect in a technological resource used in education because it assists tutors and learners in understanding how to work with the resource. In the case of wiki environments, clarity concerns aspects such as the hierarchy and structure of the wiki, the organization of content into files and the recording of the history of changes for each wiki page.

Specific technical features are deemed important as they facilitate wiki-based work. For example, such features involve the functionality provided to contributors and the operation status of the wiki platform. The former concern aspects such as the ability to edit content using either a WYSIWYG editor or HTML, the ability to insert and format any type of digital items, the ability to use tables and lists, facilities in the interconnection of wiki pages using hyperlinks, existence of spelling and hyphenation tools, design tools, search facilities, voting facilities and a calendar service. The latter concerns the ability of a wiki platform to operate in the Internet and within an Intranet. This last aspect is useful in cases of organizations interested in operating the wiki platform along with other services within their own Intranet.

Typical Educational Uses of Wikis

Various researchers have attempted to create a list of the main educational uses of wikis (Bower, Woo, Roberts & Watters, 2006; Duffy & Bruns, 2006; Hadjerrouit, 2013; Page & Reynolds, 2015; University of Delaware, 2008; Zorko, 2009). Obviously, wikis may be used to satisfy the corresponding needs of students, tutors and institutions.

Very often wikis are used to fulfill group assignments which usually require from students to do some research. Indicatively, certain types of group assignments may concern the summarization of bibliography in a specific subject, the creation of stories, the preparation of books or manuals, the creation of glossaries, problem solving and interdisciplinary or intercultural collaboration on a subject (Bower et al., 2006; Duffy & Bruns, 2006; Hadjerrouit, 2013; Page & Reynolds, 2015; University of Delaware, 2008).

Wikis may be used to support distance and blended learning approaches possibly in combination with other Web-based tools. On the one hand, wikis may facilitate learners in acquainting and communicating with peers and tutors. Learners may also use wikis to implement learning activities, to provide comments and submit proposals to tutors. On the other hand, tutors may use wikis to upload references to learning sources, educational content, instructions and the program of studies (Duffy & Bruns, 2006; Hadjerrouit, 2013; University of Delaware, 2008).

Wiki activities are connected to brainstorming. The gradual creation of content is achieved through continuous submission of ideas and opinions. In this sense, the wiki firstly functions as a tool that supports brainstorming (Page & Reynolds, 2015). Secondly, it functions as a tool supporting social interaction in which different viewpoints are discussed and the ones that will be developed further are chosen.

The experience gained by tutors while implementing Web-based activities is valuable. It would be very useful to record this experience. The content involving the recorded experience could be exploited

by other tutors especially novice ones and also could be enhanced through collaboration of different tutors. Wikis may assist towards this direction. More specifically, wikis may be used to accumulate the experience of tutors and make it available to the educational community. To achieve this goal, tutors may use the wiki to gradually record teaching techniques, views about teaching and learning, key aspects that had to be considered, important decisions affecting the teaching process and the handling of various problems and difficulties that arise in the corresponding educational setting. Other tutors may gain access to this content and the benefits could be multifold. They may exploit it to improve their own teaching, they may enhance it in collaboration with other tutors and they may provide useful comments (Duffy & Bruns, 2006; University of Delaware, 2008).

Assessment plays an important role in education. Both tutors and learners are involved in assessment. More specifically, tutors assess individual learners, groups of learners and the overall educational process. Learners assess themselves, their colleagues and the overall educational process as well. Wikis may be used as a tool of official or unofficial assessment. The created content and the asynchronous discussion reflect the contribution of each learner and the contribution of each group as a whole. The corresponding data may be used by tutors and learners to assess the progress and contribution of individuals and groups. Asynchronous discussion enables learners and tutors to provide constructive feedback improving group work and the produced output. Wikis may be also used for the assessment of the educational process. More specifically, learners may provide feedback and assess the courses they take contributing to the enhancement of the curriculum and the teaching methods (Duffy & Bruns, 2006; Hadjerrouit, 2013; Page & Reynolds, 2015; University of Delaware, 2008; Zorko, 2009).

Meetings, workshops, conferences and other events are often organized in all levels of education. Participants may use a wiki to gradually prepare the schedule of an arranged event. Preparation of a schedule requires the collaboration of all participants and wikis may facilitate this process. During and after the event, the wiki may be used to upload relevant information about the event and the drawn conclusions (University of Delaware, 2008).

E-portfolios are frequently used in educational settings by tutors, learners and educational institutions (Yang, Tai, & Lim, 2016). Wikis may be used to create e-portfolios. Portfolios may be discerned to group, individual or institutional portfolios. Group portfolios involve groups of students or tutors whereas individual portfolios involve specific individuals (Chaudhuri & Cabau, 2017). Institutional portfolios may be used by an institution to advertise its identity, goals and achievements (University of Delaware, 2008).

Wikis may be used by teaching staff members to prepare collective documents involving their academic work. In this context, academic staff members may collaboratively prepare documents about the research they conduct (i.e., recording of ideas for research directions, papers, technical reports, project deliverables and project proposals). Dissertation committee members may collectively prepare their comments about the manuscript of the dissertation and the needed changes. Other types of documents may concern collective letters, statements or positions. Wikis provide the necessary infrastructure in order to create a consensus on the final content (University of Delaware, 2008). Depending on the nature of the aforementioned types of documents, their preparation may concern either groups with a few members or larger groups and access to content may be restricted to the specific members or open to the public. Wiki platforms support all types of groups and access privileges.

Generally speaking, wikis may be used to create content that will be useful to tutors and students in any context. Indicative such content concerns collections of hyperlinks to educational resources, reference lists, lists of questions and answers and glossaries of terms. Furthermore, tutors and students may

prepare educational content that will be publicly available (Bower et al., 2006; Hadjerrouit, 2013; Page & Reynolds, 2015; University of Delaware, 2008; Zorko, 2009).

Table 2 outlines typical educational uses of wikis.

Table 2. Typical educational uses of wikis

1. Implementation of group assignments by students
2. Support of distance and blended learning approaches
3. Accumulation of tutors' experience and availability to the educational community
4. Tools of official or unofficial assessment
5. Support of meetings
6. Building of portfolios
7. Preparation of collective documents involving academic work of teaching staff
8. Creation and management of content that will be useful to tutors and students in any context

SOLUTIONS AND RECOMMENDATIONS

This section briefly presents representative examples of successful wikis to demonstrate their usefulness. More specifically, examples of wikis used in education and in various other fields are presented.

Representative Examples of Wikis in General

In this section, representative examples of wikis involving different application fields are briefly outlined. The presentation intends to highlight the use of wikis in various sectors of modern life.

Wikipedia is an encyclopedia whose content is the result of the work of thousand volunteers worldwide (Arazy, Ortega, Nov, Yeo, & Balila, 2015). It is a public wiki that promotes the notion of open resources. The available articles cover many fields. Advantages of Wikipedia compared to traditional encyclopedias are the continuous updating of content and its availability in several languages. These aspects promote its popularity and usefulness.

Health is a field that may benefit from wikis. For example, before and after surgical operations, patients need to receive medical care from specialized personnel. Communication and sharing of information among caregivers is necessary to adhere to surgical protocols. Usual types of communication among caregivers concern e-mail messages, hardcopy documents and verbal handoffs (Swart et al., 2017). Effective communication may assist in avoiding errors, inconsistencies, unnecessary testing and deviations in patient care. Wikis may be used for this purpose. Swart et al. (2017) present such an approach that concerns anthroplasty patients and adherence to post-operative protocols. The wiki is accessible by all caregivers and its content is collaboratively created. A software package from Wikispaces was installed on a server of the institution. The approach was evaluated using groups of patients before and after implementation of the wiki. Adherence to protocols improved after implementation of the wiki.

Tan et al. (2015) discuss an approach that may be used by historians and journalists. It involves a repository of historical documents and integrates a timeline and a wiki. The specific tools used (i.e., SIMILE Timeline and JSPWiki) are free. The timeline is used to visualize the events regarding the contents of documents. The timeline is generated automatically. Search and highlight facilities are offered to users. The approach has been applied using digitized versions of a popular newspaper. The authors

mention that the specific implementation is available only for internal research due to copyright issues. The feedback from three historians that used the system was positive.

Wikis may be used to implement crowdsourcing and co-design approaches regarding services provided by authorities to citizens (Al Hetal & Mokhtar, 2018). In corresponding crowdsourcing approaches, citizens provide data and feedback to authorities regarding the provided services that may be used to improve them. In co-design approaches, citizens participate in the design and development of services. The purpose is to increase the engagement of citizens to public affairs and enhance decision making, transparency and accountability of the authorities. Al Hetal and Mokhtar (2018) present a wiki approach combining crowdsourcing and co-design that concerns the city of Riyadh. The free tool Wikia was used to implement the public wiki.

Representative Examples of Wikis in Education

In this section, representative examples of integration of wikis in education are briefly outlined. They involve higher education, school education and education in a business environment and provide results of improved learning performance.

Page and Reynolds (2015) discuss a collaborative writing approach concerning 58 postgraduate students in marketing research. The duration was eight weeks. The researchers explored how past wiki experience and Web familiarity of students affect their participation in wiki activities and how student performance is affected after their participation in wiki activities. Data were collected from student surveys pre and post the activities, wiki log files and performance in exams (i.e., a quiz at the end of the last class and an essay exam two weeks after the last class). Students worked in small groups and each student could access only the work of his/her group. The wiki was integrated in a Learning Management System. Students had past experience in accessing wiki content but the large majority of them did not have past experience in creating/editing wiki content. The results showed that Web familiarity affect students' participation but this was not the case for past wiki experience. Furthermore, the more students participated in the activities, the better they performed in both types of examination.

A multicultural approach concerning the Japanese language was implemented by Jung and Suzuki (2015) in a Japanese university. It involved non-Japanese students from various countries that were experienced in Japanese language. The study concerned three ten-week terms. Each term comprised 13 to 27 students. Students were asked to co-create wiki content about a specific topic regarding Japan and ultimately provide written group reports that would be orally presented. Students worked in small groups. In the first two terms, the wiki was integrated in a Learning Management System. Wikispaces was used in the third term. Three scaffolding strategies were employed (i.e., working examples, grouping, assessment and feedback). In the first term, the tutor organized students into homogeneous groups by nationality whereas in the next two terms, students organized themselves into heterogeneous groups. Data were collected from the wiki, surveys at the end of terms, interviews, assessment of written reports and oral presentations by five tutors and tutor's observations. The findings showed that participation was better in the case of heterogeneous groups. Students' learning performance improved compared to previous years. More specifically, the quality of the wiki-based group reports was better compared to the quality of reports prepared individually in previous years.

Science instruction generally benefits from interaction and collaboration among students as they assist in knowledge acquisition and comprehension. In this context, DeWitt, Alias, Siraj and Spector (2017) studied the use of wikis for collaborative problem solving in secondary school Science. 31 students whose

previous achievements in Science varied participated in the study. They were organized into groups. The specific Science module concerned nutrition. Pre-tests and post-tests were used to determine the learning outcomes. The results showed a significant difference between pre-test and post-test scores. This demonstrates that use of wikis for collaborative problem solving may assist Science instruction. Students did not have previous experience in wiki activities but this did not affect the results.

Wikis may be used effectively for learning in settings besides formal education. For instance, Huang et al. (2015) present an approach using a semantic-based visualized wiki for learning product design aspects in a ship-building company. The approach enables knowledge accumulation and reuse by engineers. This is very useful because most parts of the product design process require reuse of gained knowledge (e.g., learned lessons). Conventional wiki systems may be used for accumulating product design knowledge but search and reuse is not as effective as in semantic-based systems. In conventional wiki systems, mere full-text search with keywords is feasible without the ability to combine knowledge from multiple articles. The core semantic module is a topic knowledge map which is automatically generated. Knowledge reuse performance was evaluated. Participants in the evaluation were 84 assistant engineers organized into an experimental and a control group. Experimental group members learned using the semantic-based system and control group members learned using a conventional keyword search mechanism. Test sheets including items across all resources and post-test questionnaires were used to evaluate learning. Testing scores and learning satisfaction were higher for experimental group members.

FUTURE RESEARCH DIRECTIONS

In the context of this article, future research directions in wiki technology may be discerned into two main categories. The former concerns technical aspects and the latter concerns aspects regarding the use of the specific technology in education. Indicative technical aspects concern semantic wikis and knowledge extraction from wiki environments. Large scale implementations of approaches integrating wikis in education are other indicative future directions.

The Semantic Web is regarded as an evolution of the current Web. The basic notion is to enable computing devices to process more easily the Web content and provide services based on the semantics of content (Antoniou, Groth, van Harmelen, & Hoekstra, 2012). This will be achieved by using effective approaches to represent content. For instance, HTML is not appropriate for this purpose because the corresponding content is not easily processed by computing devices. Main advantages of the Semantic Web are more efficient search, retrieval, sharing, reuse and integration of information. In this context, semantic wikis may be developed (Di Iorio & Rossi, 2018; Huang et al., 2015).

There is abundance in educational data due to the existence of several types of e-systems used in education. Knowledge extraction from available educational data could provide benefits to various actors in education such as tutors, students, academics, policy markers and administrators (Romero & Ventura, 2010). For this purpose, educational data mining and learning analytics approaches are often used (Romero & Ventura, 2010; Baker & Inventado, 2014). The different types of educational settings, actors and data sources obviously create different needs for the knowledge extraction process. As wiki environments are used in educational settings, useful knowledge could be extracted from the content, data concerning user habits and interaction among users.

A purpose of education is to teach students how to handle problems and issues in their daily life and how to interact with others. Collaborative learning is a necessity in educational settings since many issues

in daily life are handled through collaboration. Furthermore, it teaches students to work with, depend on and respect others. This assists in improving interpersonal relations. Wikis may assist in these aspects as they constitute a tool based on which collaboration may be developed. Nevertheless, the successful integration of wikis in education requires the preparation of teachers. In this sense, a future research direction concerns the education of teachers in promoting collaborative learning using wikis. Several research studies discuss this topic. What is needed is to design and implement a large scale approach for the education of teachers in the aforementioned issues. A first step in this direction is to record the positive and negative aspects of previous research studies and take them into consideration. The improvement of teachers' skills may entail an improvement of the education provided to students.

A next direction concerns a large scale implementation of wiki-based learning in all levels of education. This effort needs to follow the previous effort concerning the education of teachers. It needs to involve all or most of the teaching subjects. Many research studies have been carried out that involve integration of wikis in education. However, none involves a large scale implementation of teaching with wikis such as the aforementioned that will follow a previous large scale education of teachers in the corresponding issues.

CONCLUSION

The integration of wikis in education has attracted the interest of the research community. The specific features of the wiki technology may give an added value to education. The user-friendliness of the environment, flexibility, security, negligible cost and availability anywhere and anytime are certain of the advantages of the specific technology. However, the most important is that wiki technology focuses on the collaborative creation of knowledge. In this way, the requirements of socio-cognitive learning theories that regard learning as a result of social interaction are satisfied.

The aforementioned features of wikis promote the goals of education by gradually constructing knowledge bases with the contribution of many persons. Certain of these goals concern the submission and processing of ideas and opinions, the development of interaction and reflection, the assessment of the educational process, groups and group members and the support of distance and blended learning. The encouraging results that have been derived from various research studies urge the research community to continue this effort and explore new aspects.

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KEY TERMS AND DEFINITIONS

Blended Learning: A type of learning that combines traditional classroom instruction with learning based on Internet technologies.

Collaborative Content Creation: Creation of content in which the final product is the result of multiple collaborating contributors.

Collaborative Learning: A type of learning in which learners learn by collaborating with each other. Knowledge is created through active interaction among learners and their participation in shared activities.

Distance Learning: A type of learning in which learners and tutors are in geographically dispersed locations. Often Internet technologies are employed to support learning and teaching.

Educational Data Mining: The application of data mining approaches in educational data.

Learning Analytics: It involves the analysis of educational data in order to enhance learning and learning environments.

Learning Management System: A system incorporating a suite of e-learning functionalities addressed to learners, tutors and system administrators. It supports blended and distance learning approaches.

Online Learning Community: A type of learning community whose members employ Internet technologies to interact and collaborate. The community members have the same learning goals and closely interact and collaborate to achieve them.

Semantic Web: An evolution of the web that will employ more advanced representations of content in order to enable effective services based on the meaning of content.

Wiki: An environment enabling collaborative content creation using a web browser. The history of actions is retained enabling restoration of previous content versions and recording of users' contributions.

Semantic Web: An evolution of the Web that will employ more advanced representations of content in order to enable effective services based on the meaning of content.

Chapter 14
A Survey of Recent Approaches Integrating Blogs in School Education

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ABSTRACT

Web 2.0 tools are frequently integrated in education. The main goal of this integration is to provide enhanced learning experiences to students. Among other Web 2.0 tools, blogs are often used. Many approaches have been presented that successfully exploited blogs in all levels of education. An aspect of interest is to outline main directions of the corresponding research work that will provide insight to researchers, teachers, students, developers, and policymakers. This chapter provides a brief survey of approaches integrating blogs in primary and secondary education. Initially, main concepts regarding blogs as Web 2.0 tools and educational blogs are briefly discussed. Then, 16 approaches concerning the use of blogs in primary and secondary education are surveyed. The results derived from these approaches are analyzed. The analysis shows that the results are positive, and blogs turn out to be useful tools for school education. It is likely that more such approaches will be presented in the future. The chapter also outlines future research directions.

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INTRODUCTION

A trend in education is to use Web 2.0 tools because they place emphasis on sharing, participation, interaction and collaborative authoring of content (Conole & Alevizou, 2010) and these features may be exploited by learners and teachers. Among several types of Web 2.0 tools available for educational purposes are blogs. Researchers have studied the integration of blogs in education and the results have shown that they provide advantages. Blogs may be used in different teaching subjects as they involve reading, writing, thinking, interaction and collaboration.

There are many studies involving the use of blogs in higher education but an interesting topic is to study their use in primary and secondary education. There are specific reasons for doing this. During the last years, emphasis is placed on use of ICT in early childhood, primary and secondary education as indicated by the goals of the corresponding curricula, the available technological infrastructure in educational settings and the education of teachers. Students at a young age need to realize the role of ICT for educational and productive purposes and acquire digital literacy skills required in the digital world. To perform their tasks, school students may use applications that adults also use (e.g., Office, multimedia and Web applications) and educational applications specifically addressed to them. For example, visual programming tools addressed to young learners and their teachers have become popular as they combine programming with the implementation of 2D and 3D multimedia applications (i.e., digital stories and games) (Prentzas, 2016). In general, educational applications and content are available for all teaching subjects. Devices besides computers may be used such as robots assembled and programmed by children and (semi-)autonomous robots (Prentzas, 2013).

Web-based tools are exploited in school education because several and diverse tools are available. Blogs may prove useful in school education because they are one of the earliest types of Web-based applications focusing on user-created content and social interaction (Andersson & Räisänen, 2014). The purpose of this chapter is to survey briefly recent research approaches on the integration of blogs in school education and highlight the main results that have been obtained.

This chapter is organized as follows. The following section provides background regarding blogs as tools of Web 2.0 in general and educational blogs, then followed by recent research studies concerning the integration of educational blogs in primary and secondary education. Future research directions are then presented. Finally, the chapter concludes.

BACKGROUND

Blogs are Web-based applications. According to Blood (2002), the term *weblog* was first used by Barger (1997), and the term *blog*, a truncation of weblog and was accredited to Merholz (2002). The first blog was created by Berners-Lee (1992) and considered a website that provided information and updates on new websites (Williams & Jacobs, 2004). Blood (2002) claimed that blogs looked like journals or diaries and reflected their creators' personalities. In general, blogs are used for publishing posts and for discussing these posts (Andersson and Räisänen, 2014). Blog users may read, write and comment (Andersson and Räisänen, 2014). Blog posts are displayed in reverse chronological order which means the most recent posts appear first, followed by less recent ones (Duarte, 2017) with the original post appearing last. The main types of blogs are journalist blogs, product sales blogs, personal blogs and educational blogs (Duarte, 2017).

Campbell (2003) focused on the need to create educational blogs to support students who were studying English as a foreign language, which marked the beginning of the creation of educational blogs. He distinguished educational blogs in three categories: (a) teacher blogs, (b) student blogs, and (c) classroom blogs. As the term suggests, teacher blogs are managed by teachers and typically include subjects related to the curriculum, issues related to everyday needs and practices within classroom, links to other Web-based resources, and comments provided by others (e.g., students). Student blogs are created by students and intended for other students; topics concern personalized teaching or groups of collaborating students. Classroom blogs enable all classroom students to interact by exchanging messages and to work collectively.

In one of her posts, Nguyen (2006) classified educational blogs into *classroom blogs*, *collaborative blogs*, *discussion blogs*, and *student portfolio blogs*. Classroom blogs do not differ from Campbell's (2003) classroom blogs because they offer opportunities for questions and answers on educational process issues, everyday educational practices, and assignments. Collaboration blogs are used for collaboration among students who may share homework that is evaluated by classmates. Collaboration blogs may include teachers who assist with the implementation of exercises and tasks, thus providing mentoring to students. Discussion blogs do not just concern academic or educational issues because students can discuss topics, ideas, and opinions that are not necessarily related to their assignments or classes. Finally, student portfolio blogs archive student work and identify tasks that need to be fulfilled, which enables teachers to monitor each student's progress. It is probably the most important type of educational blogs because it stimulates students to improve themselves as their work is available online.

Several benefits of educational blogs are reported in literature. For example, blogging easily involves students in the learning processes (Cakir, 2013; Liu, 2016; Yang & Chang, 2012). Communication and collaboration are facilitated (Angelaina & Jimoyiannis, 2012; Poling, 2005) as a result of the individual and collective creativity (Conole & Alevizou, 2010) and in combination with other communication tools (Grippa & Secundo, 2009; Kim, Hong, Bonk, & Lim, 2011). Online learning communities may be supported by blogs. The content is multimodal, thus often addressing the needs of students with different learning styles (Asadi, 2016; Mutmainna, 2016; Sawmiller, 2010). Students may learn anytime and anywhere (Albaugh, 2013, Richardson, 2006; Sawmiller, 2010).

Additionally through blogging students' reading and writing skills are improved, and critical thinking and reflection are developed (Conole & Alevizou, 2010). Constructive learning is supported because the content of blogs is part of the available Web-based content, the motivation for learning increases and learners rely on previous knowledge acquired from the Internet to construct new knowledge (Albaugh, 2013; Kochoska & Petrovski, 2017; Noel, 2015). Blogging contributes to better learning outcomes (Blau, Mor, & Neuthal, 2013, Boyd, 2013; Dos & Demir, 2013; Hungerford-Kresser, Wiggins, & Amaro-Jimenez, 2014; Liu, 2016; Novakovich & Long, 2013). Bartlett-Bragg (2003) further notes that educational blogs provide an opportunity for their visitors to deepen their knowledge. Students who learn through blogs acquire metacognitive skills (Deng & Yuen, 2011; Huang, 2016; Kochoska & Petrovski, 2017; Li, Bado, Smith, & Moore, 2013; Meinecke, Smith, & Lehmann-Willenbrock, 2013).

The content of posts is made available to wider online communities rather than only to their creators (McGrail & Davis, 2011). This increases the usefulness of the created content and brings into contact persons of different backgrounds. In this context, Meinecke et al. (2013) and Richardson (2006) further assert that the exchange of comments and messages in blogs develops intercultural understanding. Finally, blogs enable teachers to monitor students' progress through their tasks, guide them, and provide them feedback and advice (Kochoska & Petrovski, 2017).

Educational blogs may support distance and blended learning approaches. Generally speaking, in school education, blended learning approaches are more usual.

Tools for creation and customization of blogs are available. According to Poznanska, Romaniukha and Sorokina (2017), the most popular blogging platforms of 2017 were the following: WordPress.org, Constant Contact Website Builder, Gator, WordPress.com, Blogger, Tumblr, Medium, Squarespace, Wix, Ghost and Joomla. According to Byrne (2017), the best educational blogging tools of 2017 were the following: Blogger, Edublogs, Weebly for Education, SeeSaw.me, WordPress.org, Kidblog, WordPress.com. Learning Management Systems used in schools may also offer blogging functionality. Teachers need to examine the available blogging tools and choose the most suitable ones.

Access to educational blogs may not be restricted to persons that are part of the actual learning setting. In this case, an interesting aspect is the role of blog visitors. Visitors of educational blogs may be:

- Teachers who teach students of the same grade in other schools and are interested in obtaining useful information for their own class (Watkins, 2016).
- Teachers intending to use educational blogs and wanting to get ideas from other blogs (Watkins, 2016).
- Students of the same grade in the same school or in different schools of the same country (Simon, 2016; Yuen & Cheung, 2013).
- Students of the same grade in other countries that intend to communicate with students in other countries and develop intercultural understanding (Meinecke et al., 2013; Richardson, 2006).
- Pre-service teachers who desire to get ideas they could use as future teachers (Countinho, 2007).
- Parents who want to get a picture of their children's learning activities (Morris, 2018).
- Researchers who aim to study and evaluate educational blogs (Dragnic-Cindric & Anderson, 2017).

SOLUTIONS AND RECOMMENDATIONS

A careful search using Google Scholar was carried out. The search involved research approaches on the integration of educational blogs in primary and secondary education in the current decade. Sixteen surveys were identified, eight in primary and eight in secondary education.

Recent Approaches in Primary Education

Bakan (2017) explored the ways in which 20 fourth-grade students of a primary school in the United States were encouraged to write texts on a blog and read texts written by their classmates on the blog. He also tried to identify the ways in which they responded to posts, the ways of engaging them in text writing on a blog, and the feelings they felt about using the blog. After creating an educational blog for the class, the researcher gave an iPad to each student to access it. He gathered qualitative data and the resulting analyses showed that students responded to the challenge of writing texts on the blog, which had grammatical and editorial errors. Students read their classmates' texts with great pleasure, and their posts about classmates' texts were positive. The students were excited about the use of the blog, since with this choice they had another attractive and pleasant way of writing.

Al-Qallaf and Al-Mutairi (2016) presented a study involving 23 primary school students who were taught English as a foreign language in their school in Kuwait. The researchers focused their interests on the impact of blogs on vocabulary, spelling, grammar, and learning English. They also explored students' moods and perceptions about the use of blogs in their learning. The researchers showed students how to create a blog with WordPress and how to make posts. Students' posts were related to activities within the English language program that included, writing letters to their friends, descriptions of texts related to their travel experiences, and narratives about the story of a video they watched on the blog. The survey results revealed that at the end of the semester there was progress in student learning evidenced through students writing longer texts evidencing improved spelling and grammar. Additionally, blogging motivated students to improve their learning based on their positive attitudes to blogs.

Monaghan (2016) studied the sense of team spirit, reading motivation and reading comprehension of 33 primary school students in a school in the United States. The researcher used a sequential mixed strategy that produced quantitative and qualitative data. He divided students into two groups; one read literary texts through an educational blog while the other read in the traditional way. Before the research, questionnaires were provided to students of both groups to explore the motives for reading and the sense of team spirit. At the end of the experiment, questionnaires were again given to collect data on the sense of team spirit, reading motivation, and students' reading comprehension. The questionnaires were followed by interviews between the students of both groups. Results of quantitative data analysis revealed no significant differences with respect to the three aforementioned parameters. However, the interviews revealed that the blogging group outmatched the other group in terms of a created sense of team spirit. It also appeared that the critical thinking skills of blogging group members improved, with some students evidencing enthusiasm due to blogging.

Young and Stover (2015) investigated the contribution of blogging to the production of high-quality writing and to the improvement of writing, editing and correction skills regarding English language texts. The study involved 19 students in a school in the United States. The researchers taught students how to write summaries, narratives, or reports as well as how to study and correct text, and how to create and edit posts. The students then browsed the blog and read the posts of others. Next, they learned details about how a blog works. At the beginning of the research, they prepared the texts that they would post and then posted them. Subsequently, classmates provided comments about the posts, and the authors of the texts made corrections. When the corrections were completed, six teachers printed the revised posts and corrected them by observing the editing and spelling rules applicable to primary school. The results of the statistical analysis showed students' improvement in the production of written discourse. Their skills related to processing and correction of texts also improved.

Eteokleous-Grigoriou and Photiou (2014) assessed the effectiveness and the role of blogs in achieving specific learning objectives and the development of a blended learning setting. They also explored the roles assumed by teacher and students in blended learning and the way in which a research group emerges in blended learning environments. Their sample consisted of 20 fifth-grade students of a primary school in Finland, and the intervention concerned the learning subject of language. The first concern of the researchers was to familiarize students with the blog in the school's computer lab, which was created by the researchers using Blogger. According to the results of the study, the blog helped to achieve the learning objectives set and motivated students. Additionally, it appeared that the blog contributed to the design of a blended learning environment and its fostering. It also assisted in promoting a student research group in a blended learning environment.

Yuen and Cheung (2013) identified two main goals in their research: What worked well when students browsed existing educational blogs and what challenges did they encounter. The research participants included two classes of 69 fourth-grade students from two different schools in Singapore. The results were similar for both classes of students. First, most students did not consider the use of blogs challenging. Students in both classes liked the blogs because they were interested in them and considered them entertaining. Further, students in both classes interacted through comments with other users and displayed polite behavior when engaging with others through blogs.

In another study, Wong and Hew (2012) focused on improving the ability of students to write a narrative in English. The participants included 36 fifth-grade students in a primary school in Singapore. The researchers also investigated how students perceive the blog as a writing tool and whether the instructions they receive for blogging improve their ability. Each student was assisted to create an individual blog with Blogger and a Gmail account. Students used the e-mail account to invite classmates to correct their blog entries. Tutors instructed them on how to write a narrative on their blog, and students wrote some trial stories that were reviewed by classmates. Quantitative data were collected for the experimental approach. At the end of the experiment, the researchers provided a questionnaire to students with open and closed questions. Pre- and post-test results regarding students' writing performances showed that students' mean scores improved for all three areas involved (i.e., content, language, total score). Further, students showed preference for using the blog as a writing tool rather than using pencil and paper.

The research conducted by McGrail and Davis (2011) focused on how blogging affects students' writing, the content of writing, students' expressions, thoughts, relationships, and contacts among them. Fifteen fifth-grade students in a primary school in the United States participated in the study. The researchers created a blog and then explained its functionality (i.e., browsing of the available content, provision of comments, authoring and editing of content, collaboration with others). They also instructed students in ways to provide polite comments and to evidence respect all users. Additionally, they took writing samples of the participants before and after the research. The analysis of data revealed that when students posted on the blog, they realized that their writing is addressed to the general public, which made them more careful in writing. They also tried to imitate the techniques of a writer related to expression, structure, spelling and content.

Recent Approaches in Secondary Education

Hou et al. (2019) evaluated the learning outcomes of using blogs, the cognitive process that takes place through blogs, and the feedback that embedded cognitive tools provide in the discussions. The research was conducted in the context of the ethics teaching subject and involved 267 senior students in a high school in Taiwan. Students were organized in three groups (i.e., two experimental groups, one control group). The control group used a regular blog. The first experimental group used a blog that incorporated a mind tool, while the second experimental group incorporated in its blog the same mind tool with the addition of the knowledge collection function. All groups completed pre-tests and post-tests on the same subject matter. Online discussions about a subject matter of ethics were held. More specifically, students collected and analyzed relevant online information and then discussed their viewpoints in the blogs. Students in the experimental groups used the mind tools for collection and analysis of information. The content of blog discussions was analyzed to derive the students' level of cognitive thinking. Post-test scores were higher than pre-test scores for all students showing the usefulness of blogs. However, students of the experimental groups performed better compared to control group students and students

of the second experimental group outperformed the other students. Similar results were derived from the analysis of blog discussions.

Giannikas (2019) focused on the frequency and type of feedback that students provide to peers through blogs, the impact of blogs on collaborative learning activities, and the improvement of student literacy skills. The research involved 52 second-grade pupils in a high school in Greece. Students created accounts on the Edublogs platform and were asked to write about various topics on their blogs. Students provided feedback about their classmates' writings as a school work assignment. Students' collaboration concerned in feedback was evaluated by the frequency and type of their blog entries. They also received a questionnaire about their impressions of blogs and the role they played in their learning. The results showed that blogs can effectively support students' writing and collaboration.

The support of blogging in the communication of mathematical thinking, students' attitudes towards blogging and the improvement of students' self-confidence and performance in mathematics were investigated by Kay and Murray (2016). The study involved 27 third-grade students of a high school in Canada. Researchers used quantitative and qualitative data. Quantitative data were obtained from a Likert-type questionnaire and a performance test. Qualitative data were obtained from open-ended and closed-ended questions and from analysis of blog entries. During the research process, students tried to solve mathematical problems. In the beginning of the process they tried to do this individually and then collaboratively through the blog. Most students expressed positive opinions about blogging and the spirit of collaboration it was inspiring. However, mathematical communication was limited due to limited interaction among students and teacher. Finally, student mathematical performance increased significantly.

Watkins (2016) attempted to investigate the way in which students interacted through a blog when they studied a novel. The research involved 13 second-grade students of a junior high school in the United States. The researcher focused on the following aspects: (a) how students interact in blogs, (b) how they respond when they like or dislike the novel, and (c) if they choose to use multimedia items in their entries and if so, the reasons for doing it. The above research questions were derived from the constructive social theory. The methodological approach was qualitative. The interviews and student entries on the blog were used to collect data. Students interacted with each other online, i.e., they commented, asked each other and criticized the comments. The blog also stimulated students to study the novel. Finally, there were students who used multimedia items in their entries for fun and in order to make their entries more appealing.

Zainal and Zamri (2016) investigated three main research questions in high schools in Malaysia. These involved the factors that can mobilize students to learn English literature through blogs, the challenges for learning by using blogs and how is the use of blogs related to enhancing student motivation for learning. The data were collected from 100 students from ten high schools. The researchers concluded that teachers were a primary factor affecting students' motivation to learn English literature through blogs. The other two factors concerned students' interests and their emotions. They also concluded that students benefit as long as some of students' access problems are solved. Finally, a relationship between the use of blogs and students' motivation to learn English literature was found.

Simon (2016) tried to answer the following research questions: (a) the digital literacy practices followed by students out of school, (b) how students use blogging for educational purposes and (c) whether blogging enhances participation in classroom. Five high school students in England participated in this qualitative research. Data were gathered from semi-structured interviews of the participants and comments posted in the blog. Students acquired digital literacy practices from the daily blog use. Blogging

gave students the opportunity to express themselves, to improve their learning with the help of other students' comments and to enhance their participation.

Andersson and Räisänen (2014) tried to investigate the uses of four blogs of a Swedish high school and compared them with uses of blogs cited in international literature such as collaboration, implementation of learning tasks, provision of comments, teaching, publication of supplementary teaching material, classroom and school information, interaction with visitors, and enrichment of the learning process. The researchers, initially, conducted qualitative research and analyzed the content of posts and the comments of the four blogs. Subsequently, they collected data by interviewing the teachers that created the blogs. They also collected quantitative data about blogging. The results showed that the use of blogs focused on classroom and school information, teaching, and supplementary teaching material. Collaboration and discussion were absent. It was also pointed out by the researchers that the main reason for creating blogs was the transparency of assessment. Finally, a significant portion of students accessed the blogs.

An educational blog was designed by Angelaina and Jimoyiannis (2012) to conduct research regarding 21 high school students in Greece. The main aims were to involve students in a project involving multiple learning subjects, to promote student collaboration, to improve digital literacy skills and to evaluate the overall process. Students used the blog at school and at home. They did not have previous experience using educational blogs. The study has shown that project-based blogs can support students in sharing content and ideas and in building knowledge. Appropriately designed blogs can extend students' learning space beyond the classroom and they combine formal, non-formal and informal learning.

Discussion

Table 1 outlines the research aims of the surveyed approaches and the number of studies involving each aim. Improved learning performance is the research aim pursued in more studies (i.e., ten studies) than all other aims. This is logical since one of the important aims of education in general is to improve learning. The aim related to student attitudes and perceptions about blogging is involved in four studies. Students' attitudes and perceptions about educational methods and techniques as well as the use of educational tools are the starting points for the implementation of any learning process. Student collaboration is also an aim in four studies. It is generally desired to develop collaboration with Web-based learning tools. Finally, students' motivation and involvement were aims involved in three studies. The other aims were pursued by one or two studies.

Table 2 outlines the students' benefits from educational blogs. Ten such benefits have emerged from the sixteen research approaches. Nine of these are in line with those mentioned in the international literature. A new benefit has derived from the survey of the above studies and concerns the evolution or progress of research groups through blogging.

Table 3 outlines the methodological approaches which were used by the researchers. In eight studies, qualitative approaches such as analysis of blog content and case studies were used. In three studies, quantitative data were obtained by quasi-experimental and experimental approaches. Finally, in five studies quantitative and qualitative data were used.

Table 4 outlines the sample size of students who participated in the studies. In most studies, less than fifty students participated (i.e., on average twenty-one students). The participating students were more than fifty only in four studies. This is likely to justify the researchers' preference for qualitative approaches.

Table 1. Research aims

Research aims	Number of studies
Improvement in learning performance	10
Blogs' uses in specifically educational environments	1
Ways of using blogs for educational purposes	1
Students' communication	2
Students' feedback	2
Students' attitudes and perceptions	4
Students' motivation	3
Challenges in blogging	2
Students' collaboration	4
Instructions for blogging as scaffolding to improvement of students' skills	1
Students' interaction and reflection	2
Students' engagement	3
Teacher's role in a blended learning environment with blogging	1
Progress of research groups through blogging	1
Features of blogs	1

Table 2. Students' benefits from blogging

Students' benefits	Number of studies
Blogs improve the learning performance	10
Blogs support communication among students	2
Blogs encourage students to provide feedback	2
Blogging strengthens student attitudes	4
Blogging creates motivations for learning	3
Blogging provides learning challenges	2
Blogging promotes collaboration among students	4
Blogging encourages students' interaction and reflection	2
Blogging encourages engagement of students to learning procedure	3
Blogging supports the progress of student research groups	1

Table 3. Research methods used in the studies

Research methods	Number of studies
Quantitative	3
Qualitative	8
Mixed	5

Table 4. Size of the research sample in the studies

Size sample	Number of studies
Fifty students at most	12
More than fifty students	4

Table 5 outlines the grades of primary and secondary school students who participated in the studies. Most primary education studies were conducted in the fifth and fourth grade whereas most secondary education studies involved high school.

Table 5. School grades involved in the studies

School	School grades	Number of studies
Primary school	2nd	1
	4th	3
	5th	4
Junior high school	8th	1
	9th	2
High school	all grades	3
	11th	1
	12th	1

Table 6 outlines the teaching subjects involved in the studies. In two studies, the researchers did not focus on specific teaching subjects. Most studies involved the language course (first language). Foreign language and literature were involved in two studies. Two studies also involved a multidisciplinary project. Finally, one study focused on ethics and another one on mathematics. From the above it is concluded that the use of blogs was mainly done in theoretical teaching subjects.

Table 6. Teaching subjects involved in the studies

Size sample	Number of studies
Language	6
Foreign Language	2
Literature	2
Multidisciplinary project	2
Ethics	1
Mathematics	1
Not focused on a specific subject	2

Guidelines were provided before the blogging activities commenced. For instance, Giannikas (2019) mentioned that the researchers asked teachers to: (a) show students the main features of the blogging platform including aspects such as how to setup an account and personalize the content, (b) provide guidelines about the blogging tasks and (c) provide guidelines about constructive feedback. McGrail and Davis (2011) further mentioned that guidelines were provided to students about their collaboration with others, politeness in comments and showing respect to others.

Certain effort is required from teachers to manage and supervise the blogging process. The overall process is student-centered and teachers need to assume the role of the facilitator of the learning process. As blogs are used in school education in the context of blended learning, teachers need to perform this role in classroom, in the educational blog(s) and in other ways of interaction with students (e.g., with the use of other communication tools). Teachers need to observe the overall process and intervene when necessary. Teachers may need to prompt students often in order to motivate them to participate (Andersson & Räisänen, 2014). The tone in teachers' postings and comments (Andersson & Räisänen, 2014) and their quality (Kay & Murray, 2016) play an important role.

In certain studies, problems and difficulties were mentioned. Yuen and Cheung (2013) explored challenges in blogging. These were the difficulty in spelling, lack of ideas to share, the requirement for considerable thinking, slowness in typing, typos, technical issues (e.g., delays in loading of content), and fear of negative/irrelevant comments. The percentage of students that regarded each of these issues as a challenge ranged from 2.5% to 20%. As far as typos are concerned, Giannikas (2019) noted that in the initial phases of the research it was an issue because students were not accustomed to using laptops. However, in the end, typos were rare as teachers advised students to proofread their work before uploading it. Lack of prior experience in blogging by students and/or teachers is reported in certain studies (Angelaina & Jimoyiannis, 2012; Eteokleous-Grigoriou & Photiou, 2014; Kay & Murray, 2016). Eteokleous-Grigoriou and Photiou (2014) reported that this created difficulties. For instance, teachers may not design appropriately the activities and may not provide clear instructions and guidelines to students. Availability of computers and connection to the Internet at home may be needed. However, certain students may not have access to the required infrastructure at home (Eteokleous-Grigoriou and Photiou, 2014).

Student participation in blogging is another issue. Some students may not participate in certain activities such as posting or provision of feedback to peers (Giannikas, 2019) and provision of feedback to teacher posts (Andersson & Räisänen, 2014) whereas others may be insufficiently active (Andersson & Räisänen, 2014; Eteokleous-Grigoriou and Photiou, 2014). The insufficient student participation is not surprising as it has been observed in approaches in higher education involving interactive media (Antonis, Lampsas, & Prentzas, 2007; Prentzas & Rekalidou, 2014). Kay and Murray (2016) also reported that interaction among students and teacher was limited and considered the absence of a strict blogging routine and the quality of teacher questions and prompts as possible reasons.

FUTURE RESEARCH DIRECTIONS

Most of the surveyed studies described above involved at most 50 students at given sites. Large-scale research studies are needed to provide further results about the usefulness of blogs in schools and the reactions of students and teachers. Such studies would assist in drawing further conclusions about how to integrate blogs in schools.

Teachers who have not integrated Web-based tools in their instructional practices may need assistance in designing a blended learning environment. Therefore, teaching scenarios with blogs that were successfully implemented in schools may prove useful as exemplars. Organized repositories of such teaching scenarios may prove useful in expanding use of blogs in school education. In such a repository, all details of the teaching scenario need to be included (e.g., overall setting, teaching subject, teaching goals, participants, assessment results, types of schools where implemented, setting variations). It would be useful for teachers to be able to edit the information about an available teaching scenario and provide further data following use (e.g., assessment results, variations in use).

Most studies focused on a specific teaching subject. Studies involving multiple teaching subjects could provide further evidence about the effectiveness of blogging in school education and difficulties faced by students and teachers.

The surveyed studies involved a school (or schools) located in a specific country. Studies involving schools in multiple countries could also provide useful data about commonalities and differences of using blogs in diverse locations and information about how blogs enable the implementation of international school projects in diverse contexts (e.g., foreign language learning, intercultural understanding).

CONCLUSION

Educational blogs create conditions for interaction among teachers and students, facilitate communication and collaboration, support constructive learning and provide opportunities for their readers to deepen their knowledge. Generally speaking, they contribute to better learning outcomes and to improving learning.

The research results and findings presented in this chapter covered a wide range of school education aspects (e.g., educational level, curricular focus, student ages, physical location). Most researchers investigated the usefulness of blogs in improving learning. The results of all the studies were encouraging and optimistic, especially in studies where the researchers focused on learning performance, and aligned with those reported in international literature. Besides assessing learning performance, the researchers examined communication patterns, feedback types, collaboration, motivation impact, participant attitudes and student interaction through blogging. This review of research provided an additional advantage that blogging offers in student learning: the creation and evolution of student research groups. This important educational benefit is not mentioned in other reviews.

The researchers used quantitative, qualitative and mixed methods to gather and analyze collected data. Because in most cases the participant numbers were 50 or less, the qualitative methodology was typically used, which is appropriate for the size of samples. The collection of most quantitative data was achieved through experimental approaches.

The research samples for primary education came from students in the three higher grades, whereas in the secondary education, research samples included students from almost all grades. Finally, the researchers chose mainly theoretical teaching subjects in their studies.

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KEY TERMS AND DEFINITIONS

Blended Learning: A type of learning that combines classroom instruction and Internet-based learning. The purpose is to combine the advantages of both types of learning.

Collaborative Authoring: A type of authoring in which content is produced or shaped with the collaboration of multiple persons. Technological and non-technological approaches may be used for this purpose. Web-based tools may facilitate the overall process.

Cooperative Learning: A type of instructional strategy in which learners learn by cooperating and working in groups. Group members share goals and depend on each other.

Distance Learning: A type of instructional venue in which learners and teachers are in geographically dispersed locations and may participate synchronously or asynchronously. It is usually based on Internet platforms, but in previous time periods other means had been mainly used (e.g., traditional mail correspondence, radio, television).

Online Learning Communities: Learning communities fostered through utilization of Internet technologies.

Web 2.0: An evolution of the web in which more emphasis is put on sharing, participation, interaction, and collaborative authoring of content.

Web-Based Learning: A type of instructional strategy that is based on resources available on the web. Learners may learn individually or in groups.

Chapter 15
Essential Features and Critical Issues With Educational Chatbots:
Toward Personalized Learning via Digital Agents

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ABSTRACT

Conversational agents, also known as chatbots, are automated systems for engaging in two-way dialogue with human users. These systems have existed in one form or another for at least 60 years but have recently demonstrated significant potential with advances in machine learning and artificial intelligence technologies. The use of conversational agents or chatbots for education can potentially reduce costs and supplement teacher instruction in transformative ways for formal learning. This chapter examines the design and status of chatbots and conversational agents for educational purposes. Common design functions and goals of educational chatbots are described, along with current practical applications of chatbots for educational purposes. Finally, this chapter considers issues about pedagogical commitments, ethics, and equity to suggest future work in the field.

INTRODUCTION

Instant messaging and text-based chat apps, such as Facebook Messenger, iMessage, SMS, WhatsApp, and Kik, have become increasingly popular in the previous decade. Although text-based communications technologies not new, their presence on the billions of mobile devices globally have facilitated their everyday use (Pew Research Center, 2018). This surge of mobile communications apps has encouraged renewed attention by researchers in education toward the use of automated text-based communications

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for interacting with people. One such automated communications technology is the development of automated **conversational agents**, also known as **chatbots**.

Because of their focus on sustaining one-on-one, two-way conversation, chatbot technologies have the potential to directly meet the interactive educational needs of learners. Both interactive dialogue and personalized one-on-one tutoring are well-known interactive educational approaches that promote effective learning (Daniels, 2016; Mercer, 2002). Thus, improvements in automated conversational technologies have appeal to educators in meeting practical needs within in both formal and informal learning contexts, which also include corporate training, adult skill development, and professional development. Although this nascent technology has yet to provide mainstream results for educational applications, chatbots to date have demonstrated a significant promise toward addressing ongoing calls for personalized learning and differentiated instruction in both formal and informal learning environments.

This chapter examines three critical functions of educational chatbots that are necessary for these systems to achieve educational objectives in a principled way: (1) conversational functionality, (2) educational goals, and (3) pedagogical roles. This examination includes chatbot applications in formal educational settings (e.g., K-12, higher education) and informal ongoing-learning settings (e.g., professional development, corporate training, video games). If designed in a principled and realistically conversational way, chatbots and similar technologies demonstrate substantial promise to support learning in many contexts for both children and adults alike.

BACKGROUND

Definitions

Although these terms are both used in the educational research literature, **chatbots** and **conversational agents** typically refer to the same type of software when concerned with educational applications. Both are most frequently defined as software that enables a human user to have a two-way conversation in authentic, natural language with an automated "virtual being" (Gong, 2008). These systems intend for the "virtual being" to provide a human-like interface to users instead of a static computer or "button" interface and can adaptively act on input received from the user (Woo, 2008).

Other less-common terms have also been used to describe chatbot-type technologies, such as chat app, chatterbot, digital agent, embodied agent, or virtual assistant. These terms are often interchangeably used without distinction in the educational and computer science literature. Although each of these terms may feature specific additional design qualities that are beyond the scope of this chapter, each of these terms also often fundamentally features the key function of chatbot-type software to enable human users to use natural language to engage in conversation with software systems. As such, these terms are also important for practitioners and researchers to be mindful of as they perform work in the educational chatbot field, despite representing variations of similar technologies.

Overview of Educational Chatbots

Conversational software that attempts to mimic human conversation with machines has existed since the early 1960s (Shah, Warwick, Vallverdú, & Wu, 2016; Thompson, 2007; Wallace, 2009). However, early automated conversational applications that were developed up to the 2000s were largely limited

by the large number of computational rules that had to be programmed into the software to account for each possible input from a human user. The need to program individual rulesets and scripts in early AI automated programs led to cumbersome software and substantial difficulty for the software to provide rapid and relevant responses (Brooks, 1999; Thompson, 2007).

Today, modern conversational chatbots employ larger vocabularies and more robust computational power to predict the most accurate responses for their users. For instance, the IBM Watson system processes natural language inputs using supercomputer-based artificial intelligence (AI) and machine learning (ML) approaches to determine the most appropriate language-based response for its human users, most recently demonstrated by its appearance against human opponents on the Jeopardy! trivia game show in the United States (Ferruci et al., 2013). Similarly, voice-based technologies that use vocal conversation to interface with computers are prominently available through the Amazon Alexa, Google Home, and Apple Siri virtual assistant technologies (Hoy, 2018). With readily available cloud computing resources and off-the-shelf AI and ML software today, the capacity for chatbot technologies to interpret and accurately respond to human conversational input has not been previously matched in past years.

Educational chatbots can be defined as automated conversational chatbots that are designed with a specified educational purpose (Bii, 2013; Kerly, Ellis, & Bull, 2009). First, any chatbot can be characterized by its conversational functions that must be enabled, as this is the chief characteristic of any automated conversational software. In an educational context, however, the complexity of chatbot software increases due to the addition of both educational goals and pedagogical roles into the chatbot design. Educational goals refer to specified outcomes that are intended by the designers for the learner to accomplish or for the chatbot to complete. Pedagogical roles refer to teaching and interaction strategies that chatbots implement with human participants to promote learning. Much like a teacher that develops skills in effective strategies for teaching, chatbots should be designed with pedagogical roles that are well-grounded in both educational theory and empirical research of strategies that lead to student achievement and learning (Bii, 2013). In other words, an educational chatbot not only must fulfil the primary function of a chatbot to have a conversation that is believable, but an educational chatbot must also actively play a role in the learner's education toward achieving the educational goals established by a chatbot's designer (much like the work of a teacher, coach, or tutor).

Despite recent developments with automated digital conversation systems, educational chatbots today are generally rudimentary in their design when compared to commercial systems (Heidig & Clarebout, 2011; Kim & Baylor, 2015). One reason for a delay in educational chatbot research is that educational chatbots must account for the additional complexity of working within authentic educational spaces in comparison to chatbots designed for simple conversation or recreational purposes. The additional complexity of educational chatbot design includes the fulfilling above-mentioned elements of educational goals and pedagogical roles in addition to enabling conversation. Educational chatbot designs are objectively more complicated to execute than solely script-based conversational designs of chatbots, which were largely developed for recreational and experimental purposes. Another possible reason for the low level of educational chatbot research is that previous examples of chatbots have often been programmed for specific uses and contexts and are thus would be difficult to generalize to other contexts that matter in educational systems, such as different grade levels or curricula. Finally, educational software research and development typically lacks the same levels of financial, computing, and human expertise resources that are often available in commercial industries. Because of these and other possible factors, educational chatbots that have been reported to date in the educational literature have largely been small-scale projects with little impact outside of single classrooms or an individual curriculum (Bii, 2013).

CRITICAL CONVERSATIONAL FUNCTIONS

The primary function of a chatbot is to have a conversation with the human user. As such, it is essential for an educational chatbot to provide realistic automated conversational functions with students when a human conversation is not possible. Thus, the primary value of chatbots to education then is in the ability to carry on two-way conversations between computer and learner. All educational chatbots must first fulfill this *conversational* directive in their design. To this end, educational chatbots should be able to perform each of the following functions to meet the personalized needs of learners.

Provide a Human-Like Conversational Interface to the Computer

Humans are social and innately use language to communicate, to think, and to learn. In a similar field of educational research concerned with **pedagogical agents**, a "virtual being" or artificial character is employed in educational software to give "life" to the computer with whom the student can interact (Atkinson, Mayer, & Merrill, 2005; Savin & Baden, 2014). Working with an artificial character or more human-like computer has repeatedly been shown by researchers to promote substantial social learning processes and benefits (Gong, 2008; Lee, 2010). In effect, a chatbot itself is a form of pedagogical agent described above, as it provides an "artificial being" for an educational purpose, albeit a more specific type of one.

There is value to employing humanized or automated artificial characters in education, as initial results from studies point to benefits of promoting socioemotional aspects of learning and the use of real language to make sense of educational content (Beale & Creed, 2009; Lee, 2010). Even when using a proxy "virtual being," some scholars suggest that principles of social interaction also allow learners to use computers in more natural ways by taking advantage of language and language cues instead of the more unnatural and impersonal interactions of clicking or tapping on computer screen interfaces (Johnson, Rickel, & Lester, 2000).

Provide Accurate and Useful Responses

This function has been historically implemented through two types of chatbot design. Regarding the first type, most chatbots use a *pattern-matching architecture*. Such systems match pre-programmed scripts with user input. This architecture is still prominent with chatbots today. However, this approach is limited to the programmed scope of user input and does not respond well to input outside of this scope. Thus, time- and labor-intensive work is required to continuously account for emerging use patterns and expanded ranges of input from users.

Due to the limitations of the pattern-matching architecture, chatbots have begun to use *machine-learning and artificial intelligence architectures* to process input and response patterns. These systems dynamically build rulesets for responses by analyzing data from actual dialogue and chat sessions (known as *training data*). These systems use training data to identify statistical patterns between inputs and responses and to subsequently provide responses. As the chatbot engages with users, it also continuously reinforces its ability to provide reliable and relevant responses to the user based on received input. In addition, machine-learning systems often seek feedback from users on whether the provided responses are useful, which further reinforces the system's decision-making rules for responses. Although their use in educational applications is currently limited, machine learning and AI-based systems are promising for

education as each interaction with a student reinforces the system and feedback from system administrators, teachers, and students can continually improve the chatbot's delivery of useful educational information.

Natural Language Processing

Chatbots must accurately parse authentic language input through a process commonly called **natural language processing** (NLP). Digital conversational systems must readily accept and process any language inputs that it could reasonably be expected to encounter. NLP includes not only the ability of software to define words and sentences to determine appropriate responses, but to also interpret the multiple meanings and intents that are embedded in language inputs to reliably deliver relevant responses. This is essential concerning students, whose grammatical rules, spelling, and other literacy practices may not be standardized, represent local dialects and word use, or reflect individual understandings of language. Thus, the NLP function is not only a concern for education, but for all builders of chatbots. As a result, this is an ongoing area of research in many fields, such as computer science, linguistics, communications, and business.

Maintain Two-Way Conversation

It is important also for an educational chatbot to not simply provide scripted responses, but also to promote two-way, realistic conversation with a student for as long as necessary. Chatbots should not just "read from" a script and deliver a sequence of one-way communications (Pelachaud & Bilvi, 2002). Instead, conversations should be dynamically generated based on student inputs, and not just following a sequence of responses. A conversation with a chatbot should then ideally last for as long as it is useful to the student. The design difficulty thus lies in finding a "sweet spot" of not too little conversation, nor too much. Instead, conversations should last for as long as necessary to ensure that each student's personal educational needs are met. To this end, the promise of personalized learning with chatbots stems from a chatbot's ability to maintain one-on-one conversations with learners for as long as they need.

Providing Additional Information to Users

In addition to conversation, chatbots should also be able to match learner queries with external information and educational content as part of an educational activity (Holotescu, 2016). This could be accomplished by pointing users to a linked resource library and multimedia resources for learning that students should be able to use based on their skill level and are relevant to the conversational input with the chatbot.

Solicit Continual Feedback From User to Refine Results

Effective chatbots collect regular information about the validity of the responses generated by the system (VanLehn et al., 2007). Some chatbots modern chatbots ask users whether the information provided was useful to the user, such as with automated customer service chats on business websites. If a system does not automatically update its response scripts (as in the case of AI-based systems), this data can be very useful to designers as they review the system's performance.

In machine learning or AI-based systems, a system *supervisor* can be used when the chatbot is initialized to train the chatbot with authentic previous chat data that represent real dialogue situations. A

supervised chatbot uses training data that detail common inputs and appropriate responses. After initial training, the supervisor provides additional feedback on new results that are generated by the chatbot, which the system uses to revise its decision algorithms accordingly. Alternatively, some systems train themselves by using a provided set of unstructured data to generate responses to inputs without any initial feedback from a user or system supervisor, often called "unsupervised learning" in the AI field.

Both supervised and unsupervised systems are regarded as those that use machine learning approaches to develop response rules. In both of these systems, the chatbot continually learns from each interaction with a user by continually reinforcing its decision-making and language-analysis algorithms based on the inputs received. Thus, it is important for system managers to monitor these systems and implement corruption prevention protocols to ensure that students' needs are being met and that the chatbot has not been corrupted due to malicious users.

EDUCATIONAL GOALS

As a type of educational software, educational chatbots must be designed to meet intended educational goals. Although this statement seems obvious on the surface, it implies that specified, intentional educational goals that support student learning are embedded into the chatbot's design. These goals also determine the content that will be covered by the chatbot and the approaches with which the chatbot will interact with students to meet the goals. As such, educational goals should be defined before a chatbot is designed to meet the pedagogical commitments of the educators who use the chatbots. Drawing from the educational and instructional design research literature, numerous educational goals have been identified that might be embedded in an educational chatbot's design.

Learning Goals

Learning goals are the primary category of educational goals. These goals are primarily concerned with *what will be learned* by students. Learning goals also identify how the intended learning outcomes can be readily measured with students to know whether learning occurred. Once chatbot designers identify the learning goal and how evidence of its achievement will be identified, an accurate evaluation can be accomplished regarding the chatbot's performance toward achieving educational goals. According to best practices in instructional design, learning goals of any software intervention should be as specific as possible (e.g., Gagné, Briggs, & Wager, 1992; Reigeluth, 2013; Richards, 2013; Wiggins & McTighe, 2005). In addition, effective systems will also be able to identify evidence of whether students have achieved the intended goals

Efficiency Goals

In addition to goals related to learning and instruction, educators have identified automated student support systems as an opportunity to increase efficiency and promote more focused teacher support during classroom instruction (Brennan, 2006). In the case of educational chatbots, some benefits might include enabling educators to prioritize resources, maximize class time through direct student instruction, and reduction of mundane tasks such as administrative and class orchestration duties. With additional development in future years, students might work with chatbots in an on-demand and personalized way

when a teacher is not available. In addition, teachers in both K-12 and higher education contexts might offload certain tasks (such as questions about homework and information requests) onto automated digital assistants like chatbots to maintain the ability to focus on instructional activities during class time.

Research Goals

Educational chatbot designers are often also researchers who seek to better understand social learning processes by investigating interactions with digital systems. The conversations from educational chatbot interactions can be easily collected through system logs for analysis in subsequent research on learning outcomes and processes (Kim & Baylor, 2015). In addition to investigating how people learn with chatbots, some researchers also focus on improving interactions through statistical analyses of past conversational data with a chatbot. In one such approach, learner path modeling has been occasionally used in automated interactive education systems. Within a system that models user behavior, previous student interactions are algorithmically analyzed to predict the best "paths" for students to take within the system and to subsequently achieve learning outcomes.

PEDAGOGICAL ROLES AND INSTRUCTIONAL DESIGN

As evidenced in the educational research literature from the past two decades, educational chatbots are often represented as having instructional roles to play in students' learning experiences. In this sense, pedagogy can be generally defined as the various strategies and skills that teachers use with students to help them learn. As such, an educational chatbot would need to assume a pedagogical role in its design if it will teach students. An chatbot with an instructional role can then be seen as an analogue to face-to-face interactions with people who play roles in the teaching and learning process, who include teachers, a student's peers, student groups, and classroom assistants. Over the previous two decades, multiple pedagogical roles of educational chatbots have been reported in the literature, which have highlighted some key instructional design principles for implementing educational chatbots:

As Virtual Instructor or Expert Knowledge Provider

The most common category of pedagogical roles for chatbots is as a virtual instructor or expert knowledge provider. In this case, chatbots are programmed to provide information or *lecture* to students based on their queries. Multimedia resources are delivered to students in sequences based on both their current and prior inputs. In other words, these chatbots provide direct instruction based on the questions asked by users and uses prior history to predict the most valuable multimedia content or answers to deliver (Doering, Veletsianos, & Yerasimou, 2008; Kerley, Ellis, & Bull, 2009). For example, a student may ask a virtual instructor chatbot to provide useful resources or citations on a given topic. In another example, the chatbot may be asked to provide step-by-step procedures and answers to a math problem. The focus of such chatbots is to deliver accurate information and less on the process of learning. Some more sophisticated chatbots might ask follow-up questions to students on whether the information that was delivered is useful to the student, or whether the student understands the content that was delivered (Doering, Veletsianos, & Yerasimou, 2008).

In essence, chatbots performing in the "expert knowledge provider" role are optimized for content delivery. In this model, there is less focus on encouraging students to perform independent research or project work but instead to work through the narratives provided by the chatbot (Heller, Procter, & Rose, 2016). Additionally, chatbots in this category are less focused on developing the processes by which students come to understand concepts and skills. Thus, a priority for development of these chatbots is in the chatbot ability to accurately parse user input and respond with relevant information. Although these types of chatbots focus more on providing accurate content based on user queries and less on the processes by which students come to understand, this is an important area of research that has presented significant challenges in the past and should not be overlooked (Kerly, Ellis, & Bull, 2007).

One particular type of expert knowledge provider chatbot has been regarded as highly successful in recent years. Although the design is simpler than more sophisticated chatbots that accept a broad range of user inputs, *teaching assistant* chatbots accept a narrower range of inputs, but provide accurate frequently requested information about learning activities. In a good example of how chatbots can complement teacher work, teaching assistant systems have been used by teachers to offload the more administrative or repetitive tasks that they often perform in their duties (Bii, 2013; Brennan, 2006). Simple questions about course structure, homework, projects, deadlines, grading policies, and other administrative information is easily handled by a simple chatbot. In higher education, some professors have even officially designated a chatbot as a course teaching assistant, including a name and back history for the virtual persona (Leopold, 2016). Such classroom teaching assistants can respond to frequently asked questions about course projects, course details, or even specific questions about homework assignments. A simple question-and-response, pattern-matching chatbot design is sufficient in some cases to help teachers focus on other more important tasks and devote more time to classroom instruction.

Practical design principles for the "virtual instructor" role have included:

- Provide chatbots a robust corpus of information from which they can draw to answer student inquiries.
- Include feedback mechanisms from students to improve the quality of the results that are recommended by the chatbot, such as asking students if the response was helpful or if they would like to see related content.
- Provide relevant responses to the highest anticipated student inquiries. This information can be drawn from common questions and requests for help from students in previous courses, similar to a 'frequently asked questions" document.
- Enable teaching assistant chatbots to accurately parse queries from students regarding key functions of handling questions about courses, grades, deadlines and schedule, and class policy.

As a Personalized Learning Coach

In contrast to the "expert knowledge provider" role, some chatbot designers have attempted to support the development of students' learning skills and cognitive strategies instead on focusing on knowledge acquisition. This represents the counterpart to expert knowledge chatbots by instead focusing on the *processes of learning* instead of the direct content delivery outcomes. Such personalized learning coaches are more open-ended and require more flexible design to cater to the varied needs and interests of students who might use the system.

Some educational researchers have thus developed pedagogical roles for chatbots that coach students toward the development of productive *learning skills*, *positive attitudes,* and *cognitive strategies*. Although such programs have only been minimally reported in the literature in recent years, chatbots have been deployed in educational settings help students practice effective learning strategies (Beaumont, Norton, & Tawfik, 2011; Bii, 2013; Wijekumar, Meyer, & Lei, 2013), engage with productive problem-defining and problem-solving techniques (Clarebout & Ellen, 2006; Fournier-Viger, Nkambou, & Nguifo, 2010), and invoke interest and motivation among learners toward activities (van der Meij, 2012). Thus, such chatbots attempt to influence the *processes* that influence learning instead of solely on the *outcomes*.

Finally, chatbots can promote learning in informal settings through coaching and reminding people to perform certain tasks. A coaching role would be useful in settings where individuals prefer reminders to help them achieve goals, such as self-directed professional development, providing assistance with well-defined tasks (such as a help desk or technological support), and personal productivity coaching. Such chatbots do not need to promote productivity only, but could also promote mental health or motivation by providing positive messages and encouragement. By employing the pedagogical role of coach, educational chatbots over the prior three decades have been used to enable users to repeatedly practice activities, deliver notifications and encouragement to people to promote desirable behaviors or habits (Beaumont, Norton, & Tawfik, 2011; Cheng et al., 2009), and provide immediate assistance similar to a help desk (Bii, 2011; De Grave, Dolmans, & van der Vleuten, 1999; Holotescu, 2016).

Practical design principles for the "learning coach" role include:

- Chatbots should be designed to perform coaching activities that are grounded in educational research. The coaching strategies, dialogue, and other interactions should mirror known effective strategies for supporting student learning and emotional development.
- Open-ended learning environments in which the end results of student projects and tasks are not known can be supported by chatbots, provided that the chatbot supports the *processes* of learning and engagement (rather than supporting student achievement of end goals).
- Regular reminders, notifications, and other productivity approaches can be used to improve learning experiences. However, students should retain the ability to personalize such reminders, as to not annoy or distract students from performing activities.

As a Learning Companion and System That Students Can "Teach"

In some cases, chatbots are designed specifically to be students themselves. One particular avenue of educational research has demonstrated the benefits of teaching others to one's own personal learning (Blair et al., 2007). These findings have been expanded to the use of chatbots, where students can tutor and teach chatbots about concepts to give students a greater understanding and be able to discuss concepts in different ways with their "learning companion" (Kim, Baylor, & Shen, 2006; VanLehn, 2011). Chatbots ask questions of the student-user, who subsequently proceeds to answer the questions of the chatbot to "teach" it about concepts. Such chatbots can also be designed to ask follow up questions, or to have misunderstandings that the student needs to correct. As such, students benefit from prolonged discussions about concepts under study and are required to critically think about their own understandings to be able to teach the chatbot.

In addition to providing an opportunity for students to teach another about concepts, teachers and researchers can collect important data through chatbots about students' understanding of concepts

(Laureano-Cruces et al., 2014; Lester, Branting, & Mott, 2004). Benefits of teaching, tutoring - students teach the machine in order to gain mastery, machine in turn asks questions and continues to be taught; machine is a collaborator

Practical design principles for the "teachable system" role include:

- "Teachable" chatbots should be enabled with substantial ability to parse natural language to be able to accurately interpret the instructions that students provide.
- Chatbots of this kind should predominantly be conceptualized as having the ability to interpret inputs as a series of instructions, as well as interpret the order and importance of instructions given. As such, these chatbots should be able to interpret and perform operations on language qualifiers that can accurately denote the location in a sequence of instructions (e.g., before, after, next), importance or value (e.g., make sure to, it is important to), and accuracy (e.g., that answer is wrong, that is incorrect, that was done poorly).
- Chatbots that are teachable should actively ask questions of the student to elicit further instructions. Also, these chatbots should be programmed based on known strategies for eliciting critical thinking and other student cognitive strategies based on educational research.

Demonstrating and Modeling Activities for Students

Some chatbots designs can primarily provide a sequence of responses as a method for demonstrating skills and concepts to students that are best learned in a series of steps. This type of chatbot is best deployed in situations where concepts or procedures are best learned as a series of steps or events (e.g., historical events, processes in chemistry, processes for solving math problems), or when students actively construct work piece by piece (e.g., writing, language learning, reading). At each step of the process, the chatbot can ask questions of the student on whether they understand or if they need more information (De Grave, Dolmans, & van der Vleuten, 1999; Moreno, Mayer, & Lester, 2008). Some behaviors and activities could also be modeled for students, such as with writing tasks. In these cases, desirable language use and paragraph structure could be demonstrated to students (Bull, 2006). More sophisticated chatbots have been demonstrated to parse student written input to provide feedback on student work (Wik & Halmarson, 2011). Although such chatbots have not yet reached a high level of maturity, the ability to demonstrate skills and to model what outcomes look like for students is a significant advantage of chatbots to providing on-demand, personalized education.

Practical design principles for the "demonstrator" role include:

- Sequences for demonstrator chatbots should be well-defined, which work best in established domains with systematic procedures, such as programming and math.
- This type of chatbot performs well when the designer knows what "good" and "poor" examples of work look like and provide the chatbot with such information (e.g., proper sentence structure in writing, correct math problem layout). The chatbot should be able to determine what good and poor examples look like in user input, as well as demonstrate both types of examples to students to provide opportunities for students to compare and contrast cases.
- Robust feedback should be provided to students on any work input provided after the demonstration, which can assist with learning further by highlighting areas for improvement.

SOLUTIONS AND RECOMMENDATIONS

With rapid developments in chat applications and automated communications technologies, there are multiple concerns that have been raised in recent years by educators, scholars, industry leaders, and social leaders. Stakeholders in the educational chatbot field should be committed to continued discussion about the personal, educational, social, and legal implications that emerging educational chatbots have on students.

First, there is a substantial concern among educators that any "personalized learning" technology, including chatbots, might signal changes to the teaching profession. These include removal of humans in the learning process, de-professionalization of teachers, or the outright replacement of teachers by machines (Brennan, 2006; Stickler & Hampel, 2015). In addition, automated technologies are often cited as a threat to maintaining the pedagogical and curricular commitments held by teachers or instructional designers, especially when such technologies are developed by non-educators or those not familiar with educational best practices and theories of learning (Kane, 2016). Toward these concerns, chatbot technologies have promise to meet teachers' needs in mutually beneficial ways for students, teachers, and schools. By providing additional coaching, tutorial, or "on-demand" instruction, chatbots present significant opportunities to help teachers maximize instructional time during already-short school days. In the coming years, it will be essential that chatbots designs are founded on sound educational principles and commitments to student achievement and equity.

Another growing concern among some researchers in the field are questions of equity that arise when algorithms used in automated and personalized educational software disproportionately place underrepresented students into less-productive paths. In recent years, scholars have determined that algorithmic decisions by software are increasingly based on systematic misinterpretation or misrepresentation of user inputs along race, religion, or socioeconomic status, among other factors (Selwyn, 2010; Waller, 2007). Special care should be taken even with machine learning and artificial intelligence approaches, as unrepresentative data in system training might create inherent biases in the system. Because of these challenges in developing software that meets the needs of *all* students, chatbot designers will need to consciously address the challenges of algorithmic fairness or algorithmic bias (Hajian, Bonchi, & Castillo, 2016).

Finally, concerns about the ownership and privacy of student data are increasingly legitimate when educational technology providers sell data to advertisers (Kurshan, 2017), reveal sensitive information to third parties to whom students may not be aware are observing (Russell et al., 2018; Wakabayashi, 2017), or inadvertently lose control of data to security breaches (Bogardus Cortez, 2017). Toward protecting sensitive student data from unauthorized or undesired third parties, advocates for student privacy have developed guidelines like the Student Privacy Pledge (https://studentprivacypledge.org/) for educational technology providers to ensure that student data protection remains a top priority (Kelly, Graham, & Fitzgerald, 2018).

To address these issues, educational chatbot developers and other automated systems technology providers would be best to develop a comprehensive set of principles for custodianship and equitable analysis of student data deriving from educational chatbot use. Addressing these areas across the entire field with all stakeholders will be essential for demonstrating commitment to student equity and justice and maintaining the highest levels of trust with users of automated learning software.

FUTURE RESEARCH DIRECTIONS

Educational chatbots have demonstrated substantial promise toward supporting both student learning and the everyday work of teachers. However, the state of research and development of chatbots for educational purposes is still in its infancy. Although many new educational chatbot prototypes have been presented in recent years in the literature, the majority of these reports do not rigorously investigate the effects of the chatbot on educational outcomes, nor do they explore the processes by which learners engage with chatbots. Alongside the creation of new software, developers also need to provide detailed reports that include the technical aspects and educational principles upon which chatbots are designed (i.e., the three features of technical chat functionality, educational goals, and pedagogical roles). Studies that detail each of these three features and engage in rigorous research on student learning with the chatbot will help the field reach maturity.

As new chatbot systems are deployed in educational settings, the field would greatly benefit from rigorous studies that measure the effects that chatbot software has on learning outcomes. In addition to experimental efficacy studies, it will also be desirable for researchers to pursue qualitative or mixed-methods studies that investigate how students interact with educational chatbots in different contexts and how chatbots interact with other learning software, group learning contexts, and formal educational settings. Both approaches are necessary to investigate the role that chatbots have in the learning process for both formal students and informal learners alike.

CONCLUSION

Chatbots pose an exciting possibility for supporting teachers' work and enabling students with a greater degree of personalized instruction. As such, it is important for the field to promote multi-faceted research that examines questions about the role of educational chatbots in the process of learning. This certainly involves a commitment to reporting out to the field the architectural details and designs of new educational chatbot applications (such as with the three characteristics of educational chatbots described in the sections above). However, it additionally requires rigorous study of the effects that chatbots have on achieving educational outcomes and the influence that chatbots have on the learning process when the system assumes certain pedagogical roles. Such research is timely, as chatbots are poised to provide unique benefits and new possibilities to learning environments that are not achievable in more traditional learning situations.

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KEY TERMS AND DEFINITIONS

Chatbot: Automated software intended to facilitate a two-way, ongoing, text-based conversation with users. Synonymous with *conversational agent*.

Conversational Agent: Automated software intended to facilitate a two-way, ongoing, text-based conversation with users. Synonymous with *chatbot*.

Conversational Functions: The ability for a chatbot system to process user input, provide relevant output, and maintain conversation. Critical conversational functionality that must be present with principled educational chatbot design. One of the three primary characteristics of an educational chatbot.

Educational Chatbot: A specific type of chatbot that is designed to intentionally achieve educational goals. Educational chatbots must have three characteristics: *conversational functions, educational goals*, and *pedagogical roles*.

Educational Goals: Specified educational outcomes, goals, or learning objectives for which an educational chatbot is designed. Goals that must be present with principled educational chatbot design. One of the three primary characteristics of an educational chatbot.

Pedagogical Agent: A "virtual being" or artificial character that appears in educational software to provide a person-like, human interface to students as they interact with educational software. An educational chatbot is a type of pedagogical agent.

Pedagogical Roles: The specific teaching or assistive role that an educational chatbot will play in the educational process to meet *educational goals*. The teaching, coaching, or tutoring strategies that educational chatbots will use with students to promote achievement of educational goals. Roles that must be present with principled educational chatbot design. One of the three primary characteristics of an educational chatbot.

Chapter 16
Reflecting on the Results of the Initiative ETiE for Using Tablets in Primary Schools

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ABSTRACT

Mobile devices, such as smartphones and tablets, have taken the world by storm. In education, they have exponentially increased the opportunities for mobile and ubiquitous learning, as their unique features give them a competitive edge over conventional teaching. In light of the above, the chapter summarizes and discusses the findings of a series of short research projects, conducted under the umbrella of the initiative Emerging Technologies in Education, involving the use of tablets for teaching science-related subjects, programming, and Greek mythology to kindergarten and primary school students. All in all, it was found that the learning outcomes, which can be considered as good compared to non-technologically enhanced teaching, are closely related to the teaching method, to certain tablets' features, and to the type of application being used. Then again, the impact on students' misconceptions was minimal. Finally, a number of suggestions to software developers as well as to education administrators and policymakers are being discussed.

INTRODUCTION

Technology is already sweeping through classrooms as the industry creates more and more products with the inherent potential to enhance education. At the same time, traditional educational methods are bound to become obsolete, as there is already an influx of novel teaching/learning models that make use of technology's advantages. The emergence and rapid spread of mobile devices (such as smartphones and tablets) added the element of portability, opening new and previously unexplored paths for research and practice. Indeed, a substantial number of studies concluded that the use of mobile devices can yield

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satisfactory learning outcomes (Bidin & Ziden, 2013). Similarly, a certain type of applications for these devices, described by the term Augmented Reality (AR), seems to be of particular interest.

Several learning theories and instructional methods provide ideas on how these devices can be integrated into education (e.g., mobile and ubiquitous learning). Among the key advantages of both mobile devices and AR are that they can assist the learning process by making it more productive, enjoyable, and interactive (Akçayır & Akçayır, 2017), that they can serve diverse students' learning styles and preferences (Dunleavy, Dede, & Mitchell, 2009), and that they allow a better understanding and visualization of concepts and phenomena. Needless to say, that all the above are among the fundamental requirements for contemporary teaching/learning (Sharples & Spikol, 2017). At the same time, students seem to form positive attitudes towards these tools (Bonds-Raacke & Raacke, 2008). However, as researchers pointed out, we are still in need of a sufficient number of research projects in order, on one hand, to understand, in-depth, the impact of mobile devices on students' learning and, on the other, to find ways to fully exploit their educational potential (Haßler, Major, & Hennessy, 2015).

The initiative Emerging Technologies in Education (ETiE) started about three years ago and although it is not a formal research project, a good number of academics, researchers, graduate, and undergraduate students has already contributed to a substantial number of projects conducted under its umbrella. In short, the objective is to examine the results of the educational use of emerging technologies in primary and junior high schools. As emerging can be considered technologies that either recently became available to the public or older ones that still have a controversial but certainly an unexplored educational potential. Examples of such technologies are drones, virtual reality, 3D printers, and AR. Reasonably enough, a number of ETiE's contributors set as a goal to examine the educational value of mobile devices and AR. As a result, a series of short research projects were designed and implemented over the past year, involving the use of tablets by kindergarten and primary school students for teaching them basic programming concepts, subjects related to plants and animals, geography, the human anatomy, and Greek mythology. Having accumulated a substantial number of such projects, thirteen in total, the chapter at hand re-visits the results and critically re-evaluates them.

BACKGROUND

The emergence of mobile devices, such as smartphones and tablets, liberated education from its spatial and temporal confines, allowing the implementation of what is called mobile and ubiquitous learning. In essence, mobile learning provides ideas on how one can utilize mobile devices in education (Sharples & Spikol, 2017). Respectively, ubiquitous learning refers to the constant opportunity for learning due to the easy access to teaching and other material from anywhere and at any time (Murphy, 2011).

There is a fairly extensive literature regarding the effectiveness of mobile learning; better learning outcomes and increased incentives for learning (Chang, Chang, Hou, Sung, Chao, Lee &, 2014), rich educational experiences (Wilkinson & Barter, 2016), personalization/customization to the learning needs of each student (Clarke & Svanaes, 2014), development of metacognitive skills (Kearney, Schuck, Burden, & Aubussona, 2012), opportunities for continuous self-assessment, greater autonomy and control over one's learning process (West, 2013), are some of its advantages. Also, mobile devices can assist collaborative learning, as they allow interactions and cooperation between students (Bidin & Ziden, 2013).

On the other hand, a number of problems have been reported that can act as barriers to the successful integration of mobile devices in education. For example, the implementation of mixed learning with the

use of these devices requires changes in the way and the duration of teaching (Bidin & Ziden, 2013). Technical problems, such as the need for frequent charging and the small size of the screen, have also been reported (van't Hooft, 2013). A major problem is the lack of educationally sound applications (Bidin & Ziden, 2013). Others highlighted students' increased cognitive load due to the overuse of multimedia features in mobile applications (Chu, 2014). Finally, the distraction of students can be an issue, as they tend to use these devices for non-educational purposes during teaching (Henderson & Yeow, 2012; Wilkinson & Barter, 2016).

Quite interestingly, teachers can be a problem too. Their lack of relevant experience and, possibly, their negative views on the use of such tools, can lead them to avoid using mobile devices during their teaching (Domingo & Garganté, 2016). There are reports in the literature where the learning outcomes were not that good (Perry & Steck, 2015), and, because of that, a number of specialists expressed the view that we are in need of a well-developed pedagogy that will allow a better utilization of mobile devices in teaching (Clarke & Svanaes, 2014). Finally, in research, many people argue that the data is not yet sufficient, because most studies had small sample sizes, that the number of interventions was small, and that, in general, detailed empirical studies are scarce (Clarke & Svanaes, 2014).

An interesting category of applications for mobile devices is that of AR. AR is a technology that mixes, in real-time, the real world with virtual objects (2D or 3D), multimedia elements, and information, while the user can interact with the above (van Krevelen & Poelman, 2010). These characteristics of AR applications can facilitate the learning process and make it more attractive (Dunleavy, Dede, & Mitchell, 2009). Indeed, research has demonstrated that the use of tablets and AR applications for teaching, primarily science-related courses, yielded satisfactory results (Fokides & Atsikpasi, 2017), increased the interest of students and their motivation for learning (Bower, Howe, McCredie, Robinson, & Grover, 2014). A possible explanation for these results is that the increased interaction between the user and the cognitive material presented to him/her in AR leads to a better understanding of complex or abstract concepts that need good visualization in order to be understood (Ibáñez, Di Serio, Villarán & Kloos, 2014).

Having in mind the arguments presented above, under the umbrella of ETiE and during the last year, thirteen short research projects were designed and implemented. Their purpose was to examine the learning outcomes when primary school students use tablets for studying various subjects. Their attitudes and views regarding the use of these devices were also examined. Thus, the main research hypotheses were that (a) the learning outcomes are better when students use tablets compared with other teaching schemes and (b) students form positive attitudes and views when they are taught using tablets.

A BRIEF PRESENTATION OF THE PROJECTS AND OF THEIR RESULTS

The total sample size of the projects was 1,163 students. Table 1 summarizes the projects, their method, and results. In two projects, basic programming concepts were the learning subject. The characteristics of animals were the learning subject in one project, while plants were the theme in three projects. In another project, the learning subject was the Greek mythology and in two projects geography was taught. Lastly, human organ systems were taught in four projects.

Research Design and Procedures

A quasi-experimental design was applied to all projects because data were collected from intact classes. All students attended public primary schools and the samples were homogeneous in terms of students' socioeconomic status and performance. In each project, the participating students were divided into three groups (with the exception of one project in which there were only two groups), two control and one experimental. The teaching to the first control group was conventional and reflected the way students are usually taught on a daily basis in Greece; the teachers presented the learning material, students studied the relevant units from their textbooks (while the teachers provided guidelines and help) and completed the exercises and activities. The second control group was taught utilizing contemporary teaching methods grounded in the views of constructivism; students worked in pairs, they were free to collaborate and discuss, while the teachers acted as facilitators of the process by constantly discussing, exchanging ideas, and collaborating with students.

Coming to the experimental groups, it has to be noted that the same teaching scheme was not applied to all of them; however, all had in common students' work in pairs, the use of tablets, and all were based on constructivist teaching methods. From then on, two alternatives were tested regarding the type of application being used and two regarding the teacher's role. In five cases the applications were developed by the teachers or by the researchers and in eight cases, commercial applications were used. In all but two projects (the ones where programming was the learning subject) AR applications were used. Also, in five projects students in the experimental groups worked completely on their own, while the teachers' role was limited to providing technical assistance. In the remaining eight cases, the teachers were actively involved in the learning process by starting or joining in students' discussions and by providing ideas and directions, but without imposing their own views (as in the second control group). The ratio of tablets and students was 1:2, with the exception of one project in which tablets were provided to all students and the textbooks were removed so that students could study using tablets even at their homes.

The number of teaching sessions (control and experimental groups alike) varied and ranged from three to eight in each group, depending on the subject and the availability of teaching hours. In any case, each session lasted for two teaching hours.

Instruments

Data were collected using evaluation sheets, whose number was equal to the number of sessions. Also, pre-tests and delayed post-tests were administered. The purpose of the former was to determine the initial knowledge level of students and to confirm (or reject) the common cognitive starting point, which allowed the better interpretation of the rest of the results. The purpose of the latter was to determine the sustainability of knowledge. It should be noted that the questions in all the evaluation sheets (a) were of escalating difficulty, (b) half of them examined knowledge acquisition, and (c) the other half checked whether students were able to apply this knowledge to other situations and required a certain degree of critical thinking. Also, in three projects students' misconceptions were examined, with specially designed for this purpose evaluation sheets. Finally, a questionnaire was administered to students who used tablets, aiming to record their views, attitudes, and ideas regarding the use of tablets.

Table 1. The research projects

Project	Subject	Ages	Sample	Application type	Method			Number of 2-hour sessions/ group	Results
					Group1	Group2	Group3		
1	Anatomy	11-12	162 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher actively participated	8	Group3 outperformed groups 1 and 2
2	Anatomy	11-12	75 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher actively participated	4	same as above
3	Anatomy	11-12	50 (2 groups)	commercial	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher did not actively participate	-	3	Group 2 outperformed Group1
4	Anatomy	11-12	66 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher did not actively participate	3	groups 2 and 3 had the same results and outperformed Group1
5	Geography	11-12	66 (3 groups)	tailor-made	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher did not actively participate	4	same as above
6	Geography	11-12	60 (3 groups)	tailor-made	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher did not actively participate	3	same as above
7	Programming	7-9	135 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated, board game	constructivist teaching, group work, tablets, the teacher actively participated	6	Group3 outperformed groups 1 and 2
8	Programming	7-8	75 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated, board game	constructivist teaching, group work, tablets, the teacher actively participated	3	same as above
9	Plants	11-12	246 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher actively participated	5	same as above
10	Plants	11-12	60 (3 groups)	commercial	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher actively participated	3	same as above
11	Plants	11-12	60 (3 groups)	tailor-made	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher did not actively participate	4	all groups had the same results
12	Animals	5-6	45 (3 groups)	tailor-made	conventional teaching	constructivist teaching, group work, the teacher actively participated, computers	constructivist teaching, group work, tablets, the teacher actively participated	3	Group3 outperformed Group1
13	Mythology	8-9	63 (3 groups)	tailor-made	conventional teaching	constructivist teaching, group work, the teacher actively participated	constructivist teaching, group work, tablets, the teacher actively participated	3	Group3 outperformed Group2

Results

Coming to the results, presented in detail in the Appendix, in almost all cases, students who used tablets outperformed students who were taught conventionally. This holds true even in those cases where the students worked on their own and the teachers had an extremely limited role. On the other hand, when compared with students of the second group (contemporary teaching but without the use of tablets), the results were mixed; in some cases, the results were the same, in others students who used tablets had better results. By taking a closer look to these results, it becomes evident that when students worked on their own the results were the same (projects 4, 5, 6, and 11; tables 7, 8, 9, and 14) and when the use of tablets was combined with the active participation of teachers the results were better (projects 1-3, 7-10, 12-13; tables 4-6, 10-13, 15-16).

As far as students' misconceptions are concerned, there was one case in which all three groups had the same results (project 5, Table 8) and two cases where students who were taught conventionally were outperformed by the other two groups (projects 1 and 9; tables 4 and 12). Then again, in all three cases, there were no statistically significant differences between the two groups that were taught using constructivist methods (with or without the use of tablets).

Finally, the results in the questionnaires clearly indicated that, in all cases, students found their teaching with the use of tablets interesting and formed positive views and attitudes (tables 2 and 3). Also, the cooperation with their classmates seemed to have worked out successfully. Although observations were not a research tool utilized in the projects, the teachers reported a number of technical problems such as poor Wi-Fi connectivity and slow Internet connection, the low battery life of tablets, and that sometimes the applications stopped functioning properly and they had to reset the devices in order to overcome this problem. Also, some teachers reported that, during the first and second sessions, a number of students used the tablets for playing games. Although the games were uninstalled before the tablets were handed

Table 2. Questionnaire 1, applicable to projects 1, 2, and 5

	Project 1	**Project 2**	**Project 5**
Question	*M (SD)*	*M (SD)*	*M (SD)*
I collaborated with my fellow student nicely.	4.11 (0.33)	4.30 (0.45)	4.11 (0.39)
I feel that working as a pair helped me to learn.	3.87 (0.62)	4.40 (0.55)	4.20 (0.60)
I think that using tablets during the lesson is boring.	4.03 (0.76)	4.11 (0.81)	3.95 (0.76)
I think that using tablets during the lesson is an enjoyable activity.	4.20 (0.55)	4.60 (0.70)	4.62 (0.50)
Working with tablets was fun.	4.32 (0.58)	4.48 (0.77)	4.51 (0.42)
I enjoyed working with tablets.	3.94 (0.81)	4.36 (0.86)	4.12 (0.76)
Working with tablets made me want to learn more about the human body	3.71 (0.60)	3.94 (0.70)	4.22 (0.40)
I was eager to conduct the project's lessons.	4.42 (0.50)	4.14 (0.90)	4.05 (0.70)
I found the courses very interesting	4.42 (0.54)	4.21 (0.67)	4.07 (0.77)
I do not feel that I have learned anything.	3.58 (0.66)	3.81 (0.44)	3.72 (0.48)
I believe that the application was like a game	4.02 (0.57)	4.16 (0.31)	4.20 (0.33)
Working with tablets was difficult.	4.12 (0.61)	4.52 (0.71)	4.41 (0.50)
I did not like the courses at all.	4.32 (0.60)	4.30 (0.51)	4.22 (0.60)

to students, access to the Internet was not restricted, because the tablets had to have access to the servers hosting the applications, so games could be downloaded. Browsing the Internet, for reasons not related to what students were taught, was also reported.

Table 3. Questionnaire 2, applicable to projects 3, 4, 6, 9, 10, and 13

	M (SD)					
Question	**Project 3**	**Project 4**	**Project 6**	**Project 9**	**Project 10**	**Project 13**
How much did you like the application?	4.60 (0.70)	4.36 (0.66)	3.63 (1.46)	3.90 (1.15)	3.80 (1.28)	4.48 (0.50)
How much did you like the animations?	4.36 (0.81)	4.91 (0.29)	2.74 (1.15)	3.75 (1.42)	4.30 (0.92)	4.41 (0.42)
How much did you like the 3D objects?	4.48 (0.77)	4.50 (1.01)	3.32 (1.29)	4.26 (0.94)	3.95 (1.28)	4.67 (0.51)
How much did you like the information?	4.16 (0.90)	4.50 (0.60)	3.74 (1.45)	3.80 (1.10)	3.85 (1.14)	4.44 (0.51)
How much did you like collaborating?	4.64 (0.64)	4.68 (0.48)	3.84 (1.42)	3.90 (1.50)	3.65 (1.42)	4.05 (0.42)
How easy was to use the application?	4.52 (0.71)	4.27 (0.77)	4.00 (1.29)	4.50 (0.76)	4.50 (0.76)	4.95 (0.16)
How much do you agree that the application was like a game?	3.96 (0.93)	4.55 (0.86)	3.58 (1.61)	4.20 (1.05)	4.00 (1.26)	4.75 (0.38)
Did you enjoy working and playing at the same time?	4.64 (0.70)	4.41 (0.59)	3.68 (1.42)	3.95 (1.24)	4.40 (0.68)	4.64 (0.42)
How much do you think that you have learned?	4.80 (0.58)	4.18 (0.73)	4.11 (0.88)	3.70 (0.92)	3.60 (0.88)	4.54 (0.48)

SOLUTIONS AND RECOMMENDATIONS

An interesting observation that emerged during the analyses of the results was that, in most cases, to the first couple of sessions there were no statistically significant differences between the three groups of students. A plausible explanation is that students needed some time to adapt either to the teaching method or to the use of tablets or to both. Consequently, the differences between the teaching methods became clearer a bit later. Also, conventional teaching rarely was able to produce the same (or better) learning outcomes compared with constructivist teaching methods (with or without the use of tablets); in the vast majority of cases, the results were clearly worse. As a result, what the studies were called to answer was whether the use of tablets/AR can lead to measurable and substantial differences compared with well-organized teachings, grounded in contemporary pedagogical perceptions. The answer to this question is affirmative. That is because, in the worst case, the results were the same, usually when the applications were “amateurish”, (i.e. developed by the teachers or the researchers involved, who were definitely non-specialists in software development) (see projects 5-6 and 11-13; tables 8-9 and 14-16). In the majority of cases where commercial software was used (see projects 1-4, 7-10; tables 4-7 and 10-13), the differences were statistically significant.

Although the results related to knowledge acquisition were quite clear and satisfactory, the same does not apply to students' misconceptions. In two out of the three cases in which this parameter was examined (see projects 1, 5, and 9, tables 5, 8, and 12), some differences were observed and only between the groups that used tablets and the ones that were taught conventionally. This means that well-organized teaching, either with or without the use of tablets, will have the same effect on students' misconceptions for a given learning subject. Then again, one has to keep in mind that misconceptions are particularly persistent and it takes time for one to overcome them (Barman, Stein, McNair, & Barman, 2006). It would be unrealistic to expect tablets to have a significant impact on projects lasting for a short period of time and with a small number of sessions.

Results' Interpretation

The interpretation of the above results can be based on the teaching methods used, on the use of tablets/AR, or on a combination of both. First, the results in students' questionnaires indicated that cooperation between them was trouble-free and, in fact, students appreciated the contribution of their peers to their own learning (see tables 2 and 3). These findings confirm previous research which indicated that the use of tablets enhanced collaboration (Henderson & Yeow, 2012), leading to positive learning outcomes (Clarke & Svanaes, 2014). Also, the teaching schemes allowed students to work at their own pace and study the learning material for as long and whenever they liked. Increased autonomy, control of one's own learning process, and self-guided learning are closely linked to positive learning outcomes (Clarke & Svanaes, 2014; Kearney et al., 2012; Wilkinson & Barter, 2016).

In addition, elevated levels of enjoyment were noted when using tablets/AR (see tables 2 and 3) which confirmed the relevant literature (Akçayır & Akçayır, 2017). Fun and enjoyment act as facilitators of the learning process (Zydney & Warner, 2016), leading to motivation for learning (Al-Mashaqbeh Al & Shurman, 2015), as demonstrated by students' responses to the corresponding questionnaires' items. Other items reflected students' positive attitudes in the use of tablets, which also act as a facilitator of the learning process (Chen et al., 2017).

It is very likely that certain features of the AR applications (especially of the commercial ones) to have played an important role. The multimodal presentation of the learning material (e.g., 3D models, 3D animations, videos, and illustrations) allowed students to study it from multiple perspectives and in diverse ways, leading to enhanced learning (Al-Mashaqbeh Al & Shurman, 2015), as well as to the sustainability of knowledge (Ferdousi & Bari, 2015) as noted in the delayed-post tests.

The lack of problems related to the use of tablets per se indicated that they are compatible with students' ICT skills (Görhan, Öncü, & Şentük, 2014) and that their introduction in teaching will not cause additional problems to them. On the other hand, there were cases in which problems related to how students used the tablets during teaching and technical problems were observed. As Wilkinson and Barter (2016) noted, distraction was an issue, although not in that many cases; students browsed the Internet or used the schools' Wi-Fi to download and play games. A better organization of teaching and keeping students occupied with learning activities might help to deal with such incidents. Some technical issues were also observed and were a cause for concern (Bidin & Ziden, 2013). Tablets' low battery life, the need to reset them when the applications were not running smoothly, and the schools' slow Internet connection resulted to the loss of valuable time, students became restless and lost their interest.

Implications for Practice

While the studies' results confirmed -more or less- previous research, it is quite important to discuss their implications for educational software developers, educators, and policymakers. On the basis of the results, when the applications were developed by amateurs (whether these were the teachers or the researchers involved) the results were not that different from well-organized conventional teaching. Statistically significant differences were noted when commercial applications were used. However, in this case, selecting the appropriate software was challenging. Although numerous applications are available, associated with the learning subjects which were studied, few were deemed suitable for educational purposes and even fewer were considered of high quality (in terms of the comprehensiveness of the educational material, compatibility with the curricula, and students' age). There are two possible solutions to the above problem. The first is teachers to become skilled producers of educational applications. Even though this will allow the development of software highly adapted to the needs of a specific class (or even to the needs of specific students), it is questionable whether teachers are able or willing to undertake such task. The second solution is the cooperation between software developers and education professionals, as suggested by Shuler, Levine, and Ree (2012). The former do not have the necessary educational background, while the latter are not fully aware of technology's affordances and limitations. Thus, close collaboration between these two groups of experts is probably the ideal arrangement for the development of technically, as well as educationally sound applications.

The availability of applications in languages other than English also proved to be a major problem. Since the studies were conducted in Greek schools, the applications had to be in Greek, but only a handful of them was available in this language. Other countries, in which the software industry is not well-developed and, at the same time, the language is not among the ones that are most commonly spoken internationally, probably face a similar situation. State-funded projects is a plausible solution, though in Greece it was tried a number of times but did not work out well.

Each session, in all the projects presented in this study, lasted for two teaching hours for two key reasons. First, to settle the students down, boot the devices, and load the applications, takes more than a few minutes. Not only that, but technical problems can always arise when ICT tools are used by students for in-classroom activities; valuable teaching time can be lost in trying to overcome such incidents. Second, it was considered of utmost importance for students to have enough time at their disposal for studying and using the tablets/applications at their own pace. Indeed, on the basis of the results, two-hour sessions proved to be sufficient. Therefore, for tablets to be successfully integrated into schools and become the norm, education policymakers should consider revising the school's timetable and allocate more teaching hours to subjects taught using tablets (or any other ICT tool for that matter).

As others have already suggested, we are also in need of a robust pedagogy for taking full advantage of tablets' educational potential (e.g., Clarke & Svanaes, 2014). In the projects presented, constructivism provided the theoretical framework and the teaching methods were -more or less- based on Driver's and Oldham's model (1986) or on Bybee et al.'s 5Es model (2006). While the application of both the theoretical framework and of the teaching models proved to be able to produce good results, one should be reminded that both were developed long before tablets became mainstream. Therefore, it is necessary either to update the existing or to develop new teaching methods to fully exploit the potential of these devices.

FUTURE RESEARCH DIRECTIONS

While the studies were meticulously designed and implemented, there are limitations that need to be addressed. The sample sizes were, in some cases, marginally sufficient for statistical analysis. Also, the teaching/learning subjects were limited to science-related, programming, and Greek mythology courses. Therefore, the generalizability of the results is limited. Finally, research data were collected using only quantitative tools (questionnaires and evaluation sheets). The above limitations can set the guidelines for future research. Larger sample sizes and different age groups can provide useful information about the impact of tablets on all educational levels. Towards this direction, a wider variety of subjects can also help. Quantitative together with qualitative data collection methods, such as interviews and observations, will allow the researchers to understand, in-depth, the benefits that tablets bring to education. Finally, comparisons between tablets and other ICT tools can provide a clearer picture of the advantages (or disadvantages) of these devices.

CONCLUSION

Overall, the studies' results, as presented in the preceding sections, were interesting, as well as thought-provoking, and helped to have a clearer picture regarding their educational potential. All things considered, it can be concluded that tablets together with AR applications are indeed an interesting alternative method for teaching several subjects to primary school students. However, it seems that a lot more can be done before they are fully integrated into education.

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KEY TERMS AND DEFINITIONS

Augmented Reality: A technology that provides to the user an interactive experience of a real-world environment which is "augmented" by computer-generated information.

Cognitive Load: A term used in cognitive psychology, that refers to the effort being used in the working memory. According to the cognitive load theory, there are three types of cognitive load intrinsic, extraneous, and germane.

Constructivism: A learning theory which argues that humans generate knowledge and meaning from their experiences. Although not a specific pedagogy, is the underlying theme of many education reform movements.

Misconception: A mistaken belief, a wrong idea, because it is based on faulty thinking or understanding.

Mobile Learning: Education or training conducted by means of portable computing devices such as smartphones or tablets.

Tablet: A portable computer, typically with a mobile operating system, a touchscreen, and a rechargeable battery in a single thin, flat package.

Ubiquitous Learning: An alternative term for learning anywhere, anytime; thus, it is associated with mobile devices. It is grounded in situated learning which supports the view that we learn better when learning takes place in the context of real-life activities.

APPENDIX

The projects' results (all tables present the means and standard deviations per group and per evaluation sheet, the results of the ANOVA testing, and the post-hoc pairwise comparisons when applicable)

Table 4. Project 1

	Group						**ANOVA testing**		**Post-hoc tests**	
	Group1 (N = 54)		**Group2 (N = 54)**		**Group3 (N = 54)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	16.45	3.22	15.86	2.98	16.28	3.20	$F(2, 159) = 0.51$	.604		
Misconceptions pre-test	7.18	3.02	6.49	2.12	7.40	2.32	$F(2, 159) = 1.92$	.150		
ES1	13.36	2.18	12.85	1.67	13.29	1.99	$F(2, 159) = 1.08$	.343		
ES2	12.68	2.46	13.59	2.22	13.05	1.87	$F(2, 159) = 2.34$	.099		
ES3	15.18	2.11	17.91	2.41	18.92	2.45	$F(2, 159) = 37.29$	.001	1-2	< .001
									1-3	< .001
									2-3	.065
ES4	14.17	2.47	16.92	2.12	18.64	2.71	$F(2, 159) = 45.91$	< .001	1-2	< .001
									1-3	< .001
									2-3	.001
ES5	11.45	3.04	13.33	2.51	16.62	2.89	$F(2, 159) = 46.43$	< .001	1-2	.002
									1-3	< .001
									2-3	< .001
ES6	14.86	2.27	18.35	3.04	20.28	3.22	$F(2, 159) = 49.37$	< .001	1-2	< .001
									1-3	< .001
									2-3	.002
ES7	15.99	1.63	17.63	2.32	21.09	1.95	$F(2, 159) = 92.73$	< .001	1-2	.001
									1-3	< .001
									2-3	< .001
ES8	13.88	1.99	16.31	2.05	18.07	2.31	$F(2, 159) = 53.12$	< .001	1-2	< .001
									1-3	< .001
									2-3	.001
Delayed post-test	19.18	3.31	22.65	2.87	25.76	3.24	$F(2, 159) = 59.12$	< .001	1-2	< .001
									1-3	< .001
									2-3	< .001
Misconceptions post-test	11.71	2.05	12.59	1.89	13.02	2.19	$F(2, 159) = 5.75$	.004	1-2	.069
									1-3	.003
									2-3	.521

Table 5. Project 2

	Group						ANOVA testing		Post-hoc tests	
	Group1 (N = 25)		**Group2 (N = 25)**		**Group3 (N = 25)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	15.16	4.06	15.80	3.23	16.32	3.06	$H(2) = 0.975$	.614		
ES1	14.16	3.76	15.88	3.59	17.92	2.20	$H(2) = 14.18$	.001	1-2	.084
									1-3	.001
									2-3	.028
ES2	14.86	3.45	16.70	3.87	17.68	2.60	$H(2) = 7.91$	.019	1-2	.064
									1-3	.005
									2-3	.510
ES3	14.36	3.87	15.64	3.98	16.64	3.05	$H(2) = 4.30$	.109		
ES4	12.84	3.27	14.72	4.62	17.80	1.91	$H(2) = 24.25$	.001	1-2	.033
									1-3	.001
									2-3	.017
Delayed post-test	21.40	7.90	26.44	5.14	30.68	3.61	$H(2) = 21.30$	.001	1-2	.016
									1-3	< .001
									2-3	.002

Table 6. Project 3

	Groups				ANOVA testing
	Group1 (N = 25)		**Group2 (N = 25)**		
	M	*SD*	*M*	*SD*	
Pre-test	15.80	3.23	16.32	3.06	$H(2) = 0.975$, $p = .614$
ES1	15.88	3.59	17.92	2.20	$H(2) = 14.18$, $p = .001$
ES2	14.72	4.62	17.80	1.91	$H(2) = 24.25$, $p < .001$
Delayed post-test	26.44	5.14	30.68	3.61	$H(2) = 21.30$, $p < .001$

Table 7. Project 4

	Group						ANOVA testing		Post-hoc tests	
	Group1 (N = 22)		**Group2 (N = 22)**		**Group3 (N = 22)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	18.64	4.14	17.27	4.44	18.36	4.04	$F(2, 63) = 0.65$	.53		
ES1	16.82	6.35	17.73	4.33	2.64	4.74	$F(2, 63) = 29.14$	< .001	1-2	.83
									1-3	.001
									2-3	.001
ES2	11.90	3.68	14.18	3.28	16.27	3.84	$F(2, 57) = 11.5$	< .001	1-2	.016
									1-3	< .001
									2-3	.140
ES3	12.73	5.28	13.45	2.5	14.82	4.26	Brown-Forsythe $F(2, 46.04) = 1.42$	$p = .25$		
Delayed post-test	13.64	4.12	17.09	3.62	19.64	3.06	$F(2, 63) = 15.14$	< .001	1-2	.007
									1-3	< .001
									2-3	.059

Table 8. Project 5

	Group						ANOVA testing		Post-hoc tests	
	Group1 (N = 22)		**Group2 (N = 22)**		**Group3 (N = 22)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	13.75	2.48	14.46	2.22	13.38	3.15	$F(2, 63) = 0.95$	.39		
Pre-misconceptions test	6.55	2.31	7.16	2.55	6.18	1.55	$F(2, 63) = 1.14$	.33		
ES1	14.18	4.15	16.54	3.84	16.89	4.19	$F(2, 63) = 2.90$	.14		
ES2	16.11	3.45	18.52	2.99	20.66	3.12	$F(2, 63) = 11.18$	.001	1-2	.039
									1-3	< .001
									2-3	.075
ES3	13.78	4.15	17.12	3.20	20.04	3.66	$F(2, 63) = 15.85$	< .001	1-2	.011
									1-3	< .001
									2-3	.029
ES4	17.69	3.50	21.51	3.18	22.88	4.01	$F(2, 63) = 12.42$	< .001	1-2	.002
									1-3	< .001
									2-3	.418
Delayed post-test	19.87	3.12	23.11	4.02	25.98	3.87	$F(2, 63) = 15.09$	< .001	1-2	.014
									1-3	< .001
									2-3	.032
Post-misconceptions test	11.85	2.19	13.58	3.11	12.66	2.44	$F(2, 63) = 2.42$	.10		

Table 9. Project 6

	Group						ANOVA testing		Post-hoc tests	
	Group1 (*N* = 20)		**Group2 (*N* = 20)**		**Group3 (*N* = 20)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	13.15	2.28	14.20	3.29	12.40	2.28	$F(2, 57) = 2.32$	.11		
ES1	12.60	3.02	13.20	4.43	15.20	1.58	$H(2) = 6.91$	.03	1-2	.253
									1-3	.004
									2-3	.355
ES2	10.00	4.05	11.85	5.90	13.80	3.33	Brown-Forsythe $F(2, 46.040) = 3.48$	.04	1-2	.487
									1-3	.007
									2-3	.413
ES3	10.85	1.98	18.10	4.22	15.35	2.06	$H(2) = 32.67$	< .001	1-2	< .001
									1-3	< .001
									2-3	.005
Delayed post-test	9.80	2.71	13.05	3.70	15.35	1.80	Brown-Forsythe $F(2, 44.534) = 18.67$	< .001	1-2	.010
									1-3	< .001
									2-3	.053

Table 10. Project 7

Test	**Group1 (*N* = 45)**				**Group2 (*N* = 45)**				**Group3 (*N* = 45)**			
	2nd grade (N = 23)		*3rd grade (N =22)*		*2nd grade (N = 23)*		*3rd grade (N =22)*		*2nd grade (N = 23)*		*3rd grade (N =22)*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
ES1	12.48	2.42	13.05	1.88	15.35	1.85	15.18	1.59	17.88	1.34	18.25	1.68
ES2	6.54	1.68	7.15	1.55	9.85	1.48	10.18	1.35	10.56	1.57	10.82	1.36
ES3	9.56	1.52	10.55	1.69	11.38	2.12	11.84	1.45	13.46	1.70	14.05	1.85
Delayed post-test	10.13	2.45	11.08	2.18	13.58	2.91	14.01	2.57	16.85	2.17	17.15	2.28

Table 10. Project 7 (continued)

Test	Grade	*F*	*p*	Post-hoc tests	
				Pair	p
ES1	2nd	Brown-Forsythe $F(2, 51.45) = 35.78$	< .001	1-2	< .001
				1-3	< .001
				2-3	< .001
	3rd	$F(2, 63) = 50.76$	< .001	1-2	< .001
				1-3	< .001
				2-3	< .001
ES2	2nd	$F(2, 66) = 42.47$	< .001	1-2	< .001
				1-3	< .001
				2-3	.286
	3rd	$F(2, 63) = 41.76$	< .001	1-2	< .001
				1-3	< .001
				2-3	.302
ES3	2nd	$F(2, 66) = 27.10$	< .001	1-2	.003
				1-3	< .001
				2-3	< .001
	3rd	Brown-Forsythe $F(2, 50.89) = 37.54$	< .001	1-2	.034
				1-3	< .001
				2-3	< .001
Delayed post-test	2nd	$F(2, 66) = 40.63$	< .001	1-2	< .001
				1-3	< .001
				2-3	< .001
	3rd	$F(2, 63) = 37.74$	< .001	1-2	< .001
				1-3	< .001
				2-3	< .001

Table 11. Project 8

	Group						**ANOVA testing**		**Post-hoc tests**	
	Group1 (N = 25)		**Group2 (N = 25)**		**Group3 (N = 25)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
ES1	11.12	1.45	14.16	1.78	14.86	2.32	$F(2, 72) = 31.46$	< .001	1-2	< .001
									1-3	< .001
									2-3	.067
ES2	8.87	1.51	11.06	1.85	13.65	2.05	$F(2, 72) = 29.51$	< .001	1-2	< .001
									1-3	< .001
									2-3	.011
ES3	11.96	2.30	14.80	1.85	17.88	2.13	$F(2, 72) = 38.02$	.006	1-2	< .001
									1-3	< .001
									2-3	< .001
Delayed post-test	10.24	2.85	12.33	2.19	16.59	2.22	$F(2, 72) = 33.55$	< .001	1-2	.028
									1-3	< .001
									2-3	< .001

Table 12. Project 9

	Group						ANOVA testing		Post-hoc tests	
	Group1 (*N* = 82)		**Group2 (*N* = 82)**		**Group3 (*N* = 82)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	11.49	3.99	10.81	3.81	11.33	3.55	$F(2, 243) = 0.71$	.492		
ES1	12.79	4.71	15.15	4.78	17.45	3.32	$H(2) = 37.80$	< .001	1-2	.002
									1-3	< .001
									2-3	.003
ES2	11.91	5.22	13.30	4.39	15.33	3.80	$H(2) = 19.79$	< .001	1-2	.102
									1-3	< .001
									2-3	.003
ES3	11.30	5.00	13.49	3.53	15.87	2.33	Brown-Forsythe $F(2, 241.37) = 65.63$	< .001	1-2	.004
									1-3	< .001
									2-3	< .001
ES4	10.71	3.69	15.27	3.78	16.43	3.43	$F(2, 243) = 56.63$	< .001	1-2	< .001
									1-3	< .001
									2-3	.105
ES5	9.83	2.90	11.06	2.83	11.93	2.35	$F(2, 243) = 12.47$	< .001	1-2	.011
									1-3	< .001
									2-3	.780
Delayed post-test	14.90	4.41	18.02	3.66	20.83	3.85	$F(2, 243) = 45.37$	< .001	1-2	< .001
									1-3	< .001
									2-3	< .001
Misconceptions post-test	10.62	3.88	13.51	3.30	13.88	3.25	$F(2, 243) = 21.43$	< .001	1-2	< .001
									1-3	< .001
									2-3	.103

Table 13. Project 10

	Group						ANOVA testing		Post-hoc tests	
	Group1 (N = 20)		Group2 (N = 20)		Group3 (N = 20)					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	4.43	1.11	5.02	1.27	4.77	1.38	$F(2, 57) = 2{,}16$	.41		
ES1	5.85	1.73	7.50	1.99	9.65	2.48	$F(2, 57) = 16.68$	< .001	1-2	.040
									1-3	< .001
									2-3	.028
ES2	3.70	1.56	4.50	1.85	5.95	1.79	$F(2, 57) = 8.61$	.001	1-2	.320
									1-3	.001
									2-3	< .001
ES3	3.25	1.62	4.40	1.35	5.55	1.44	$F(2, 57) = 12.41$	< .001	1-2	.041
									1-3	< .001
									2-3	.041
Delayed post-test	11.10	4.61	14.35	4.11	17.80	3.82	$F(2, 57) = 12.78$	< .001	1-2	.045
									1-3	< .001
									2-3	.031

Table 14. Project 11

	Group						ANOVA testing		Post-hoc tests	
	Group1 (N = 20)		Group2 (N = 20)		Group3 (N = 20)					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	8.10	2.91	7.95	2.56	5.95	2.4	$F(2, 57) = 4.16$	.021		
ES1	12.03	3.55	13.20	3.27	11.35	3.33	$F(2, 57) = 1.53$	.226		
ES2	9.30	4.55	13.08	5.27	12.03	5.38	$F(2, 57) = 2.94$	.061		
ES3	10.28	4.56	10.95	4.63	11.15	5.77	$F(2, 57) = 0.17$	.846		
ES4	8.55	2.44	11.48	2.39	10.95	4.2	$F(2, 57) = 4.98$	.010	1-2	.01
									1-3	.05
									2-3	.86
Delayed post-test	10.59	3.70	10.71	4.34	11.16	3.42	$F(2, 57) = 0.12$	.886		

Table 15. Project 12

	Group						ANOVA testing		Post-hoc tests	
	Group1 (*N* = 15)		**Group2 (*N* = 15)**		**Group3 (*N* = 15)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	14.80	2.48	14.67	2.19	15.00	2.39	$F(2, 42) = .076$	.927		
ES1	13.20	1.97	14.93	2.19	16.13	1.25	Brown-Forsythe $F(2, 36.219) = 9.577$	< .001	1-2	.075
									1-3	< .001
									2-3	.178
ES2	14.80	2.57	17.80	2.48	18.40	1.81	$F(2, 42) = 10.444$	< .001	1-2	.003
									1-3	< .001
									2-3	.758
ES3	17.80	1.66	20.13	1.92	21.20	1.42	$F(2, 42) = 16.071$	< .001	1-2	.001
									1-3	< .001
									2-3	.203
Delayed post-test	22.33	2.19	23.73	1.87	24.60	1.50	$F(2, 42) = 5.573$	.007	1-2	.114
									1-3	.005
									2-3	.423

Table 16. Project 13

	Group						ANOVA testing		Post-hoc tests	
	Group1 (*N* = 21)		**Group2 (*N* = 21)**		**Group3 (*N* = 21)**					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	**Pair**	*p*
Pre-test	15.81	1.63	15.43	1.96	16.62	1.35	$F(2, 60) = 2.783$	.070		
ES1	22.95	1.80	21.19	2.82	24.24	1.67	$F(2, 60) = 10.,534$	< .001	1-2	.028
									1-3	.140
									2-3	< .001
ES2	22.33	1.90	22.24	2.11	23.29	1.48	$F(2, 60) = 2.045$	.138		
ES3	23.24	1.18	21.81	2.64	24.19	1.07	Brown-Forsythe $F(2, 34.983) = 9.510$	.001	1-2	.078
									1-3	.025
									2-3	.002
Delayed post-test	19.52	1.60	19.67	1.68	21.24	1.44	$F(2, 60) = 7.615$	.001	1-2	.954
									1-3	.002
									2-3	.006

Chapter 17
FeedForward With Screencasts

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ABSTRACT

Feedforward is an educational strategy in which a professor gives orientations to students, prior to a certain task or assessment, in order to show them how to perform well in that upcoming task. This chapter explores the contribution of screencasts as one possible solution to providing feedforward. A screencast is a digital recording of computer screen output, including audio voiceover. If well planned and recorded, screencasts can expose students to the common errors in a certain field, as well as to the best practices that avoid or correct those mistakes. This chapter tests the following hypothesis: students who were exposed to feedforward with screencasts (experimental group) had better grades than those who did not see these common mistakes screencasts (control group). The students were Portuguese undergraduates of physiotherapy, taking a course of Inferential Statistics. The results show that the 48 students in the experimental group achieved an average of 11.64 (in a scale of 0 to 20), significantly higher than the average of 9.96 of the 41 students in the control group.

INTRODUCTION

One of the ways a student has to learn is through the feedback that the professor gives him, in relation to some activity that he has performed. If this activity is not a final assessment, the student can take advantage of feedback not only to learn but also to improve his or her grading in future assessments. However, if the evaluation is a final one, there will be no time to receive feedback from the professor, and the opportunity to correct poorly assimilated learning is lost.

This is where FeedForward comes in, as a strategy that the professor can use not only to comment on the past and present behavior of the student, but mainly to anticipate his future one. In other words, what the student should do and avoid in the evaluation to come, in order to approach the behavior of an expert in that area of knowledge. Here the emphasis is on trying to avoid the common mistakes that learners usually make when they are learning a new area of knowledge, that is, when they are trying to model the behavior of an expert in that area.

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Feedback allows you to treat mistakes as learning opportunities, rather than just failures. Feedforward also allows you to treat (common) errors as opportunities to get a better grade in the next assessment.

In this chapter, the author explores the contribution of screencasts as one possible solution to providing feedforward. A screencast is a digital recording of computer screen output, including mouse movements and clicks. Also known as a video screen capture, screencasts can include audio narration to explain the process that is being documented by the screencast. If well planned and recorded, screencasts can expose students to the common errors in a certain field, as well as to the best practices that avoid or correct those mistakes. Due to its multimedia nature and flexibility, screencasts are a much richer way of providing feedforward that the written form.

BACKGROUND

FeedBack and FeedForward

In the simplest form, feedback consists of a teacher who corrects errors in students' performance and gives advice on how they can improve performance in similar future situations (Hendry, White, & Herbert, 2016). Although this definition is understandable, it is far from being all-inclusive. There are other agents, besides teachers, who can give feedback; and there is more to feedback than just correcting errors.

Thus, as researched by Hattie and Timperley (2007) in their meta-analyses compilation, feedback is defined as any kind of information provided by an agent (e.g., teacher, peer, book, parent, self, video) regarding aspects of one's performance or comprehension. A teacher or parent can provide corrective information, a peer can provide an alternative strategy, a book or video can provide information to clarify ideas, and a learner can look up the answer to evaluate the correctness of a response. Feedback thus is a "consequence" of performance and its purpose is to confirm, expand, overwrite, or restructure the students' knowledge or performance.

Except when it confirms a student's outcome (because it is correct), feedback aims to fill the gap between what is understood and done by the student, and what he should be understanding and doing (the desired goal) (Koen, Bitzer, & Beets, 2012).

To close that gap, Hattie and Timperley (2007) claim that effective feedback should answer these three questions:

1. Where am I going? (What are the goals?)
2. How am I doing? (What is right and wrong?)
3. Where to next? (What should I change?)

The same authors named each of the above questions as Feed Up, Feed Back, and Feed Forward, respectively.

Learning goals must be SMART (Specific, Measurable, Attainable, Realistic, Timely), i.e., they cannot be vague to the extent that the student (and the teacher) does not know if he/she have reached them or not. Feedback will tell you whether the success criteria of these goals have been met or not. Nevertheless, sometimes feedback is diverted from these goals (e.g., the purpose is to write an interesting story, but feedback only points out spelling errors).

In most cases, the question "How am I doing?" is answered with tests, which can give accurate information about what is right and wrong in a student's response. However, tests are just one way to address this issue and often fail to provide feedback that helps teachers and their students know how they are doing. For students, feedback means gaining information about how and what they understand and misunderstand, and having instructions on what to do to improve those incomplete knowledge and skills. For the teacher, feedback means getting information from his students, that allows him to evaluate the effectiveness of his teaching, that is, whether the students have already reached the learning goals, so that he knows what to do next. There are assessments that can give these two types of feedback, but tests often fail to do so effectively (Hattie & Timperley, 2007).

As for the third question (Where to next?), the sequential nature of instruction often lead professors to advance to the next module or learning goal, i.e., to give more instruction. Teachers who do that are wasting the power of feedback because in that same task or module, students can be more self-regulated, can gain greater fluency and automaticity, can obtain deeper understanding, in a nutshell, can approach the behavior of an expert. This feedforward question can have some of the most powerful impacts on learning (Hattie & Timperley, 2007).

That is why some professors have tried to provide 'feedback' before students attempt their assessments; or, in other words, tried to give feedforward, which is, by definition, timely and future-oriented in relation to the upcoming task. It involves alerting students to avoid common mistakes that learners of a particular subject often make, and to give them tips on how to correct them (Hendry, White, & Herbert, 2016). Thus, feedforward is a pedagogical strategy aiming to provide students with prior exposure to, and prior practice with assessment, in order to clarify expectations and achieve better results in the next evaluation (Baker & Zuvela, 2013).

Hattie and Timperley (2007) also mention that feedback can address the following four levels:

1. The results of a task (such as whether its final result is correct or incorrect);
2. The processing of a task (was the task performed the right way, regardless of its final result?);
3. The self-regulation of the task performer (was the strategy used to complete the task the most effective (as an expert does)?)
4. The task performer as a person (e.g., "You are very intelligent!")

Moreover, they add that the last kind of feedback is the least effective; the two in the middle are the most powerful because they deepen the processing and mastery of tasks, and the first one is scarce on information as to correct bad results, leading to more trial-and-error strategies, than understanding the relationships between the concepts underneath the task. In other words, the first level of feedback is more suitable for declarative knowledge (knowing THAT something is the case) and the two in the middle are more suitable for procedural knowledge (knowing HOW to do something). Besides that, knowing how to master a certain kind of task, leads to better final products of that task in particular, and good results in general, for similar tasks. In short, the ideal feedback cycle (and instruction) should start by promoting good task results, followed by modelling good strategies to accomplish those results, increasingly close to the experts' behavior (which implies autonomy, self-control, self-direction, and self-discipline). In the next section we'll see that screencasts are the ideal tool to give the second and third types of feedback.

Screencasts

A screencast is a digital recording of computer screen output, often accompanied by audio narration to explain the process being described (Robinson, Loch, & Croft, 2015). As the PrintScreen key allows capturing the image of a computer screen, a screencast is a film of what can be seen in this screen, over a given period of time.

Hence, there is the need for a specific software in order to record screencasts (a screencasting software). Besides recording what is happening on the screen, this software also allows the edition of the screencast's sequences (e.g., cutting a part where the speaker coughed), and the production of the final result in a universal file format (e.g., MP4) (EDUCAUSE Learning Initiative, 2006).

However, unlike face-to-face classes that can be recorded with a traditional video camera, or even an audio recorder, classes that deal with computer-based content require a higher quality recording, in order to allow an effective viewing (and hearing) of the computer screen content. Normally, with regular video cameras one cannot achieve that quality.

Screencasts are typically indicated to show tasks that are performed with a computer (such as how to operate with a particular software), but not only...

Within a course, the demonstrative tasks are the first candidates to be recorded in screencasts (e.g., "How to check for mean differences with a t test?"). However, also the lectures can be made available in screencasts, not just to be accessible to students who miss face-to-face classes, but also because these classes can be more effective this way than face-to-face (at least for some students). Why? Basically for these three reasons (Jesus & Moreira, 2009):

- Unlike a classroom lecture, students can view the screencasts when they want to, especially in the times of the day that enhance their ability to concentrate / retain the subject matter (e.g., there are students who prefer to study in the evening, others in the morning, etc.).
- In addition, there are students who feel that the classroom environment contains a certain 'noise'–e.g., the whispering from behind, the side colleague who asks a question–that hinder the full message reception transmitted by the teacher. When viewing the screencast of the class, the student can eliminate this 'noise'.
- Furthermore, the student can stop the screencast when he wants to and continue viewing it later; or else, if he gets confused, he can rewind the screencast, and repeat the visualization of the most difficult parts to understand them better. The same goes even weeks or months later–the student can always go back to the screencast to refresh his memory in relation to any topic of interest.

Of course, these reasons apply to screencasts of all kinds of classes, but with particular relevance to lectures, because they can address contents of a higher level of abstraction.

Another major advantage of screencasts is that the recording task does not require a class taking place face-to-face, in order to be recorded "live". The recording phase can (and should) be conducted during the planning of classes, prior to the beginning of the school year. Thus, screencasts of all the course's subjects can be delivered to students in the first day of the semester. Among other things, this means that the most interested students can also view the screencast of the next class before it takes place. Those who do, will take an additional advantage of screencasts–use them to prepare face-to-face classes, taking advantage of the time with the professor, mostly to elucidate questions and doubts that

did not get perfectly understood by simply viewing the screencast. This is the major teaching strategy advocated by flipped learning supporters (Faculty Focus, 2015).

SCREENCASTS AND FEEDFORWARD – A CASE STUDY

In order to discover if the feedforward with screencasts is effective in facilitating the students' learning, a study was designed with a group of physiotherapy undergraduates. Do students who were exposed to feedforward with screencasts had better grades than those who did not see these common mistakes screencasts? Have they ever made any of these common mistakes?

These are some of the questions that are answered in the next section. It starts by identifying the research methodology, followed by the major results found and its discussion.

Methods

Participants were third year students from Instituto Politécnico de Saúde do Norte (a Portuguese private higher education school). The statistics course that they took aims to prepare physiotherapy students to perform statistical analysis of research data in their field.

The sample included 89 students divided into 4 groups of 22/23 who had classes together, in a fully equipped classroom with broadband Internet connection and personal computers (one per student), equipped with the latest version of IBM SPSS (a statistical analysis software).

During 8 weeks, at the end of 2017/2018 academic year, classes took place in a blended-learning format (Pima, Odetayo, Iqbal, & Sedoyeka, 2018). That is, they took place partially face-to-face in the classroom, and partially at distance, via a page in a Moodle platform, and screencasts of all the course's subjects to support the course during and between classes (these were instructional screencasts and not common mistakes screencasts). In addition, it was used the flipped classroom approach (Eppard & Rochdi, 2017), where students gained their first exposure to new material before class meetings, by watching screencasts; and then, during class time, students applied and developed their understanding of the screencasts' material through problem solving. In week 1, students received a schedule of what they should do each week and a reminder, every week, with the tasks they should do until the next face-to-face class.

A week before the final exam, the professor released the common mistakes screencasts (9 videos with a total duration of about 1h20), and promoted their viewing. As these students had only one major final exam, they could not benefit from feedback to improve performance at the next assessment. Therefore, the professor used the common mistakes of the previous year students to record these feedforward screencasts. Note that these screencasts served both to warn against common mistakes and to promote desired practices. Something like Baker and Zuvela (2013) did in their project, using also video tutorials.

Immediately before taking the final exam, the students answered a questionnaire, which among others had the following question: "How many common mistakes screencasts did you watch?". The options were: "none", "less than half", "more than half" and "all". Hence, all the students who answered in the first two options, were placed in the control group–those who did not see the screencasts. Only the students who answered in the last two options were placed in the experimental group–those who saw the screencasts.

Thus, the type of study used to conduct this project was a quasi-experimental research design, because there was an intervention–the exposure to the common mistakes screencasts–and a control group, but no random distribution of students between groups. Therefore, there was no lack of ethics in this project

because all students had the chance to watch the common mistakes screencasts. The point is that some decided to watch them, and the others did not. Nevertheless, appropriate ethical consent was obtained from the university's ethics committee before collecting data.

The final exam consisted of a practical test, in which each student had to analyze data of a hypothetical research project, using SPSS. Upon completion of the computer test, each student delivered an output file to the teacher, with the statistical analysis made. By viewing that file, the professor was able to confirm if the student used the correct analysis (including its prerequisites), if he/she interpreted the results in the right way, shortly if the student can perform a good statistical analysis.

The questionnaire filled out by the students contained sociodemographic questions (including academic profile), as well as questions related to the usefulness and satisfaction with the course's settings (blended-learning, flipped classroom, instructional and common mistakes screencasts, Moodle resources and face-to-face classes).

Besides this questionnaire, data collection methods included the students' grades in the course's assessment moments (continuous assessment and final exam). All this information was stored and utilized for analysis after removing all individual identification data in order to protect the research subjects' privacy. The participants were informed of that practice prior to the beginning of the study, and signed a consent form approving that method.

The collected data were analyzed with descriptive and inferential statistics methods (using SPSS version 25). The author used chi-square tests, as well as mean differences tests (e.g.: independent samples t test and Mann-Whitney U test) to confirm that both groups were homogeneous in terms of sociodemographic and academic profile variables, and also to test the main hypothesis, always with a significance level of 0.05.

Results and Discussion

In order to test the main hypothesis–students who were exposed to feedforward with screencasts had better grades than those who did not see these common mistakes screencasts–it is necessary to compare the final exam grades between experimental (EG) and control (CG) groups. But before that, one has to make sure that both groups are homogeneous, in terms of sociodemographic and scholarly characteristics.

In fact, is shown in Table 1 that both research groups had similar distributions of men and women, with the latter prevailing; and similar representation of working students, although the majority of participants had no jobs while studying.

The predominance of women is consistent with national statistics for higher education in health. In 2017, there were 75.5% female health students and 24.5% male students in Portugal (FFMS, 2017). This homogeneity of gender between groups is important because female students tend to achieve better grades than male students (Thiele, Singleton, Pope, & Stanistreet, 2016; Bayrak & Gulati, 2015). So, if in this case study the experimental group has better grades than the control group, one can attribute those findings to the intervention–screencasts with feedforward–and not to gender differences.

Similarly, if one group had much more working students than the other, that could bias the results of the study, because students who have to reconcile work with studies manage their study priorities differently than nonworkers (Dundes & Marx, 2006).

In terms of age, the groups were not homogeneous with the students who did not see the screencasts with feedforward being older than those who saw the common mistakes screencasts (p-value = 0,014; Mann-Whitney U test). That is because older students (including those returning to college a few years

after interrupting studies) are more used to traditional face-to-face classes, and they reported that they preferred to accompany those classes, and tended to disregard technologic materials. This same preference was reported in the literature (Amro, Mundy, & Kupczynski, 2015; Chan, et al., 2017), but the homogeneity in all the other factors (including the pre-condition grades), allows us to minimize this age difference between groups.

Table 1. Sample characterization by group (N=89)

Factor	EG	CG	p-value
Female Male Total	35 (72.9%) 13 (27.1%) 48	27 (65.9%) 14 (34.1%) 41	0.470
Working students	17 (35.4%)	18 (43.9%)	0.414
Age (Mean ± SD)	21.23 ± 1.52	22.27 ± 2.46	0.014
HE admission grade (Mean ± SD)	13.70 ± 1.13	13.57 ± 1.14	0.605
Continuous assessment grade (Mean ± SD)	30.00 ± 7.11	28.47 ± 7.67	0.330
Hours of study in Statistics (Mean ± SD)	1.83 ± 0.76	1.87 ± 1.53	0.443
Physiotherapy as first option of admission	42 (87.5%)	36 (87.8%)	0.965
Motivated to study Statistics	39 (81.3%)	28 (68.3%)	0.158

In fact, is shown in Table 1 that there were no statistically significant differences between groups, neither in higher education (HE) admission grades, neither in the statistics course continuous assessment grades. In the former, that is, in the grades that students applied to the Physiotherapy degree, the averages were very much the same (13.70 vs. 13.57 in a scale of 0 to 20). In the latter, that is, in the assignments that students did before the statistics course final exam, the averages were also very similar (30.00 vs. 28.47 in a scale of 0 to 50). These findings allows us to rule out the idea that brighter students were predominantly the ones who saw the common mistakes screencasts, and due to that increased intelligence and effort, reached better grades in the final exam. Confirming that the effort was similar between groups is also the analogous hours of study in Statistics, with EG students dedicating 1.83 hours per week, and CG students studying Statistics 1.87 hours per week, on average.

Finally, in terms of motivation, the research groups were also homogeneous, with the majority of students being motivated, either to study in Physiotherapy, either to study Statistics. In the former, almost 88% of the students–regardless of group–stated that they chose the Physiotherapy course as their first option of admission in college. In the latter, there were more students motivated to study Statistics in the experimental group (81.3%), than in the control group (68.3%), but that difference was not statistically significant (p-value = 0.158; chi-square test).

Now that the homogeneity of groups is verified, one can answer the main hypothesis, without fear of confounding factors affecting the final exam grades (at least the major ones). And, in reality, students who were exposed to feedforward with screencasts had better grades than those who did not see these common mistakes screencasts. The 48 students in the experimental group achieved an average of 11.64 ± 4.21 (in a scale of 0 to 20), and the 41 students in the control group achieved an average of 9.96 ±

4.33. This 1.68 mean difference was considered statistically significant (p-value = 0.027), by the Mann-Whitney U test.

Some other findings that confirm the usefulness of the common mistakes screencasts are the following:

- More than 90% of the students who saw them said they had already made at least one of these mistakes;
- More than 96% of the students who saw them said that they would like the other courses to have a list of common mistakes students often make;
- These screencasts were considered the third most useful component for learning, with an average of 61.6%, only surpassed by the instructional screencasts (average of 82.5%), and by "Doing exercises in class (with the teacher's explanations)" (average of 78.5%).

This last topic shows that in the top three useful components for learning (in the participant students' opinion) are both distance and face-to-face strategies. Hence, it is not odd that the vast majority of students (87.6%) said that they preferred the blended-learning format, and only 10% preferring just face-to-face.

SOLUTIONS AND RECOMMENDATIONS

When questioned about the quality of feedback received from their teachers, university students said they would like to receive more complete, not so vague, comments (Murtagh & Baker, 2009; Duncan, 2007). But teachers would take a long time to give rich and personalized feedback in courses with many students, and the process would become repetitive and could lead to inconsistencies, especially if several teachers were involved (Baker & Zuvela, 2013).

Even when teachers give useful and future-oriented feedback, it can be too late if it is the result of a final exam, because there is almost no opportunity to act on feedback except in an uncertain way in the future (Cathcart, Greer, & Neale, 2014). In addition, it may happen that students consider a good quality work, the one that teachers consider faulty, and once the teacher explains the rationale for the faultiness, this becomes clear (Hendry, White, & Herbert, 2016).

All the above are motivations to give better feedback, as is the case of feedforward; and also to give better feedforward than the one that has been traditionally delivered – consuming class time when given by professors, based on peer review, and based on model essays.

Giving feedforward based on peer review is not the ideal solution. It may solve the time restrictions that teachers have, especially in large classes, but the type of commentary that significantly improves performance is the most difficult to teach (Gielen, Peeters, Dochy, Onghena, & Struyven, 2010).

Giving feedforward based on exemplary essays of past students also has its limitations. Students tend to imitate the best exemplars, losing some creativity in doing better and above all, different (Sadler, 2010).

Hence, it is suggested that feedforward approaches can be adapted to the blended-learning setting, to flipped classrooms, and to multimodal learning styles of contemporary students. Due to its flexibility, screencasts fit perfectly in blended-learning and flipped classroom approaches, and because they can include text, images, diagrams, audio, video and simulations, they are also very well suited to reach several learning modalities, including the preferred ones of a particular student (Jesus, 2018).

Besides the aforementioned, one of the challenges that a reviewer (professor or peer) as to face when giving feedback to a student is to focus on the performance, and not the person. That is very difficult

to achieve when giving feedback because, normally, it is given to a single student relative to his/her coursework, and people tend to take criticism personally (Goldsmith, 2008). In the case of peer review, there is also the possibility of a student giving harsh commentary to another colleague (Kelly, 2015), which aggravates the personal criticism.

With feedforward there is no such problem because there are no comments to any particular student, but rather to the wrong behaviors common to several apprentices of that subject. Anyway, when recording the feedforward screencasts, teachers should avoid an inflammatory tone, pointing only to the error, but instead they should emphasize that is common to make those kind of mistakes, in the early stages of learning that new subject, why it happens and how to fix it.

FUTURE RESEARCH DIRECTIONS

Two future research opportunities arouse from the intersection of the literature review and the author's experience with screencasts.

The first one is to propose an assignment to students, inviting them to record feedforward screencasts. In their perspective, and after performing a particular assessment, what clues they would like to give to next year colleagues, in order to perform better in that type of assessment? This suggestion was motivated by the results of Lauren Kelly (2015), who found that only 48% of students in their peer review experience claimed to have benefited from peer review as recipients of the comments; but 63% of the students said that they benefited from having been reviewers.

The second suggestion is to give rubrics to the students as they see the feedforward screencasts. Thus, students can understand why the performance being described by the screencast is conducive to high grades. That is because it models the experts' behavior in that task, and also because it fulfills the assessment criteria (that can be thoroughly explained in the screencast).

CONCLUSION

Normally in higher education, a professor's role is to instruct students how to be experts in a certain area of knowledge (or at least start this path). For this to happen, we–professors–have to give them the opportunity to model the behavior of an expert, and we have to give them access to the structured information network of our area of knowledge.

One of the obstacles to this objective is the lack of understanding, by the students, of what constitutes a good quality work, in our area of expertise. In order to overcome this obstacle, the first step is showing students what is expected of them in respect of task criteria and standards.

By doing this, for instance, with rubrics and feedback, we are enhancing the students' level of performance in their subsequent assessment (Hendry, White, & Herbert, 2016). However, this is not enough to promote the good quality work aforementioned (Baker & Zuvela, 2013).

The next step to go beyond task criteria and standards is to give feedforward in order to explain quality. In other words, to what extent a work is structured as a whole to achieve the intended objective and to provide a guideline of performance in the entire area of expertise (Sadler, 2010). Due to its media richness and "look over my shoulder" nature, screencasts are the closest way to being side-by-side with

an expert, who provides tips and intricacies as to reach a good quality work and avoid errors, in one word, of providing feedforward.

Additionally, in the case study presented in this chapter, students who were exposed to feedforward with screencasts had better grades in their final exams, than those who did not see these common mistakes screencasts. That is why the author intends to use an action research project in the next academic year, in which there will be two assessments. The idea is to verify if there is a change of behavior, in the students who choose not to watch the feedforward screencasts in the first assessment, when they perceive that their colleagues who saw them, had higher grades. This research variation will also allow a certain triangulation with this year's research project.

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KEY TERMS AND DEFINITIONS

Blended-Learning: Instruction that is given partially face-to-face in the classroom, and partially at distance.

eLearning: Contraction of electronic learning. Interactive training, available through the Internet or other means of electronic communication, making the learning process independent of time and place.

Feedback: Information provided by an agent (usually, a professor) regarding aspects of one's performance or comprehension.

Feedforward: Tips and orientations given prior to a certain task or assessment, in order to show the students how to perform well in that upcoming task (e.g., how to avoid common mistakes).

Flipped Classroom: Educational approach in which the students gain their first exposure to new material, at distance and autonomously, before class meetings (e.g., by watching videos at home); and then, during class time, students apply and develop their understanding of the material with the professor's help and expertise.

Moodle: Open source learning management system used by all types of schools and training centers, to add web technology to their courses.

Screencast: Digital recording of computer screen output, including audio voiceover.

Chapter 18
Developing Computational Thinking Using Lego Education WeDo at 4th Grade of Primary Education:
A Case Study

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ABSTRACT

The research was carried out at the School Santísima Trinidad in the framework of robotics education and social science. The aims of the study were to determine participants' perceptions about the effectiveness of the experience to meet the learning objective, to construct and programme robotics models, and to help pupils to become familiar with computational concepts and practices. Based on these goals, it employed a case study method in which were involved a teacher and 52 students of the fourth grade of primary education. The instruments used to collect data were a questionnaire, a semantic differential, a semi-structured interview, and a monitoring guide. The findings suggested participants' positive perspective towards the project to achieve the objectives and contents of the unit; acquire the skills of critical thinking, creative thinking, problem solving; apply their knowledge to real-world problems; and become familiar with some mechanical movements and with a set of computational concepts.

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INTRODUCTION

The intent of this study is to contribute to the overall knowledge base about best practices in Robotics Education since, as Toh et al. (2016) state, comprehensive and detailed studies of what pupils learn through robotics education and how they actually engage with educational robots are still needed. Specifically, the present research focuses on the use of LEGO Education WeDo materials in Primary Education to analyse participants' perceptions about its effectiveness to meet the learning objective of social science, construct and programme robotics models, and help pupils to become familiar with computational concepts and practices.

In the current society, technology plays a relevant role and has transformed the way we live, communicate, work and train. The different opportunities that technologies afford have determined the way in which curricula are implemented and taught, and they have also provided the tools to carry out the teaching-learning process in an innovative new way (Lamoyi, 2012). As Butler-Kisber (2013) states, there is a movement in many countries to create curricula for STEM subjects (science, technology, engineering and mathematics) that allows learners to be prepared for the challenges of contemporary and future society, and its demands. This implies to train students in what it is called digital language (Hafner et al., 2015) and in all the necessary digital skills to be part of the current digital world and to come across really well in it. They should acquire the ability to put into practice the basics of programming as a way to solve problems, and computational thinking (CT) as working paradigm (Llorens, 2015). As Wings (2006) defines CT is "a fundamental skill for everyone, not just for computer scientists (…). Computational thinking involves solving problems, designing systems, and understanding human behaviour, by drawing on the concepts fundamental to computer science" (p.33). It is not just a synonym of the ability to programme a computer but it requires a thinking that is run in different levels of abstraction, and is independent of technological devices (Valverde et al., 2015). Many researchers have defined CT as a concept that includes abstract thinking, logical thinking, modelling thinking, and constructive thinking (Flores, 2011; Liu & Wang 2010) since it is a problem-solving process in which problems are formulated in a way that allows using computers and other technological tools to solve them through algorithmic thinking. Data are represented through abstractions and are organized and analysed in a logical way. Moreover, the possible solutions are analysed and implemented to know the most effective combination of steps and resources, and to generalize and transfer a specific problem solving process to other problems (ISTE 2011). As many studies highlight, CT cannot only to be applied in computer and information science but in other disciplines. It must be integrated into the basic curriculum (Bundy, 2007; Lee et al., 2011), accessible to everybody, and learnt early and often (Lu & Fletcher, 2009; Perkovic et al., 2010; Qualls & Sherrell, 2010).

BACKGROUND

In the current study, researchers refer to robotics education as the implementation of educational robotic models in the teaching-learning process. The paper describes how to introduce robotics education and computational thinking in primary education through the use of LEGO Education WeDo robotics set, a material designed by LEGO Group in collaboration with Massachusetts Institute of Technology (MIT). This material is a simple-to-use construction set composes of more than 150 elements that favour that pupils can learn the basics of programming. This set offers opportunities to students to construct and

work with twelve models that can be plugged into a computer and programmed through the use of LEGO WeDo software. These 12 activities are organized around four themes. The first one, amazing mechanisms, focuses on physical science concepts; the second one, wild animals, focuses on technology, emphasizing the concept of sensing and responding to external stimuli; the third one, play soccer, focuses on mathematics; and the fourth one, adventure stories, focuses on language using the model to dramatize events. LEGO Education WeDo robotics materials have been implemented in different national and international educational experiences, proposing their use in schools and studying its benefits for children education to build robotic models, put into practice the basics of programming and teach 21st-century skills, such as logical thinking, creative problem-solving and computational thinking. In 2010 Ilieva carried out an experience to introduce robotics through LEGO constructional material in primary schools. The teaching approach described had been developed for many years of everyday teaching practice in primary schools in Bulgaria. In the experience developed the robotics lessons took place in a new inviting and challenging environment that helped and made demands on the pupil in order to think, act, have ideas, create, and be emotionally engaged. Castledine and Chalmers (2011) presented a descriptive qualitative case study method whose aims was to confirm if LEGO robotics were effective problem-solving tools to correlate classroom problem-solving lessons to real-world contexts, and to ascertain what problem solving strategies primary students engaged with when working with these materials. The study involved 23 students of 6th grade with no prior robotics instruction participating in robotics activities at a Brisbane primary school. The results of the research emphasized that the robotic activities developed through LEGO robotic materials allowed students to analyse and reflect on the problem-solving decisions they made about robot design and programming. It was also highlighted how the majority of the students could relate their problem solving strategies to real-world contexts. Mayerová (2012) developed an experience with two groups of pupils of the 3rd Grade of Primary Education of the Joint Elementary School of Cpt. Nálepka in Stupava. The goal of the study was to observe and analyse the first-contact experience of these students with LEGO Education WeDo. The research tried to find evidences that proved that the use of educational robotics and robotic software influenced learners' ability to solve problems, and it was the easiest way for students to understand programming language. Romero, López and Hernández (2012) carried out a pilot study of robotics in elementary education using LEGO materials whose objectives were to train teachers in robotics and provide a space to evaluate relevant curriculum activities, and to support robotic clubs from the participant's elementary schools while evaluating students' experiences. The study provided evidences of how to improve the partnerships between teachers, engineers, and educators. Moreover, it concluded that adequate robotic tools and a planned curricular design were the key factors for successful implementation of the project. In 2014 Elkin et al. presented a case study that tried to explore how robotics could be integrated and used as a new educational tool. The study presents an early educator's experience whose objective was the design and implementation of a robotics curriculum, using LEGO Education WeDo, integrated with a social science unit. The experience was carried out in a primary school in a mix-aged class of 19 students from 1st, 2nd and 3rd grade. The data demonstrated the benefits of teaching robotics in classroom and concluded that robotics could be used as a tool that allows children to tackle new materials. Scaradozzi et al. (2015) presented in this work a new project that had been introduced in Italian primary schools whose main objective was the introduction of Robotics at that educational level as a normal subject in the curricula besides being proposed as an extra curricula activity to be performed out of official school hours. The purpose was to teach pupils to program and consider robotics as a normal method of work rather than an exceptional way of operating. Moreover, they wanted to bring the students a different opportunity to develop their logical ability and creativity

through robotics. They used the LEGO materials to develop the project and concluded that the project allowed pupils to get awareness of robotics and develop a good knowledge of the technological tools they used and the necessary skills to be successful in the society of the 21th century. In 2016 Veselovská and Mayerová developed an experience with students of two classes of 5th grade at lower secondary school in Stupava, Slovakia. During that experience learners carried out different tasks with robotic kit LEGO Education WeDo. The researchers tried to identify the activities that the pupils resolved correctly and those in which they made mistakes.

THE PROJECT

The research was carried out at the School *Santísima Trinidad* in Salamanca (Spain), a pioneer school in the use of technology. The teaching staff has an appropriate training in technological resources, and a great experience and recognition in educational innovation. The regional government accredits the school with Level 4 in the integration of ICT. That implies that the use and management of technologies is widespread at the school. They are implemented in 75% of the organizational processes of the centre and the majority of the institutional documents reflect this use in the educational and organizational processes. The acquisition and improvement of teachers' digital competences are the main objectives of the training activity of the centre. Knowledge of the use of ICT as didactic-methodological instruments or as means of management is high. Teachers use ICT in the educational processes as instruments of extension and reinforcement, and this is reflected in their pedagogical and didactics planning.

The experience was carried out in the area of social science and implemented for five weeks, carrying out a total of 10 two-hour sessions. The project was developed in the framework of the Erasmus+ project *Creating Tomorrow's Schools Today (CTST) 2014-2017* whose goal was to compile a multidisciplinary and multilevel European Teacher's toolkit packed with didactic resources and practical classroom strategies.

Project Phases

The project was developed in four phases (*Connect, Construct, Contemplate and Continue*) that directly referred to the 4C framework in which LEGO Education WeDo set was based.

In the *Connect phase*, pupils were helped to build new knowledge, activating their prior one through different questions, presentations and activities. LEGO Education WeDo materials underpin the socio-constructivist-based learning and emphasize the idea of learning by doing (Papert, 1980), building things on their own using a set of tangible pieces (Ackermann, 2004). Ackermann et al. (2009) state that "Constructionism is based on the idea that usually people learn more effectively by making things and emphasizes student-centred discovery learning since students are encouraged to work and build things with real and touchable objects using their prior knowledge" (p.56). This idea is connected with experiential learning, the use of pupils' experience for learning "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). During this first phase, teacher activated students' prior knowledge to help them to make connection between what they already knew and what they were going to learn, to become mentally engaged in upcoming learning and focused on the topic. She also pointed out the objectives of the unit 9 of social science *Forces and machines*, explained the main contents that

referred to types of machines, their characteristics and their uses in daily life, and the new vocabulary of the topic through a blog designed for the project.

She provided students the information needed to develop the experience and projected four videos regarding the 4C phases to show pupils specific examples of any of them. She observed if they had really understood the experience in which they were going to participate, and its relevance for their learning.

Although the participants in the research were familiar with the use of LEGO Education WeDo materials and the terminology was assumed, the teacher reviewed the rules of use established in the framework of the Erasmus+ project: *Creating Tomorrow's Schools Today (CTST) 2014-2017*.

In the *Construct phase*, teacher divided the pupils of each classroom into mixed-level groups of three students (high, average, and low) in order to create heterogeneous groupings of collaborators. As Robinson (2008) states, heterogeneous ability groups have many advantages since they improve students' attitudes towards their classmates and schoolwork, and allow building a learning community of which they are part. Towns et al. (2000) also emphasize how mixed-ability groups enhanced achievement since it requires that pupils participate and become more active in their learning.

During that phase, the teacher gave a LEGO Education WeDo Construction Set and the step-by-step instructions to each group pupils who were asked to build two robotic models, Dancing Birds and Smart Spinner, which were part of the Amazing Mechanisms theme, that focuses on physical science concepts. Specifically, the model Dancing Birds allowed students to learn about pulleys and belts, experimenting with the size of pulleys and the crossing and uncrossing of the belt. In the case of the Smart Spinner model, they explored the effect of smaller and larger gears on a spinning top.

After finishing the constructions, the pupils were asked to programme the robotic models. The teacher reviewed the environment and the basic icons of commands of LEGO WeDo Software and reminded pupils how to connect the robotic models to computers.

In the *Contemplate phase*, the pupils observed the models and reflected about the process. That brought them the opportunity to deepen their understanding and establish connections between previous and new knowledge. They had the opportunity to share insights that they gained during that phase, and showed their ideas and conclusions to their classmates. During that phase, the teacher asked questions to guide the learners' presentations and be sure that the learning was explicit since when they verbalized what they had done, they consolidated what they had learned.

In the *Continue phase,* the teacher encouraged learners to change the model previously built, using the contents that they had learned.

METHOD

Based on the main goals of the research a case study method was employed. As Yin (1989) defines a case study research method is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used." (p.23). Creswell (2009) described case study methodology as "a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time." (p.13). Yin (2009) also states that the use of multiple sources of evidence ensures the robustness of the case study conducted. Regarding the nature of the case study, the present research is a descriptive one since the

phenomenon and the real-life context in which it took place are clearly and intensively described (Yin, 1989). It is a heuristic, unique, and inductive case study (Merriam, 1998; Pérez, 1994). It is heuristic as it discovers new meanings, extends experience or ratifies what is known to provide a full understanding of the case. It is unique since it is oriented to understand the singular reality. And it is inductive since it is based on the inductive reasoning to generate hypotheses and discover relations and concepts from the meticulous system where the case takes place. Detailed observations allow us to study multiple and varied aspects and to examine them in relation to others, and within their environments.

Objectives, Hypotheses and Questions

The aims of the current case study were:

O1: To determine participants' perceptions about the effectiveness of the experience to meet the learning objective of the unit Forces & Machines, and construct and programme robotics models.
O2: To help pupils to become familiar with computational concepts and practices.

The research focused on the following research questions:

Q1: How do participants perceive the educational experience in terms of effectiveness?
Q2: Do the learners think that the robotics education experience provide a natural environment for authentic practice?
Q3: Do the students perceive that the experience developed support collaborative learning?

And tried to test the next hypotheses:

H1: Pupils learn how to build and programme robotic models.
H2: The experience developed promotes collaborative learning.
H3: Pupils think creatively to solve the problems.
H4: The experience developed helps pupils to know the results of their decisions.

Participants

In the experience developed around robotics education and social science were involved a teacher and fifty-two students of the 4th Grade of Primary Education of the School *Santísima Trinidad.* The 52 pupils were enrolled in the compulsory subject of social subject in the academic year 2015-2016, and were divided into two classes of 26 students, Group A and Group B. 48.1% were boys (n=25) and 51.9% were girls (n=27), and they were between 9 (53.8%, n= 28) and 10 (46.2%, n=24) years old. All of them had participated in previous experiences in which they had the opportunity to work with Scratch and LEGO Education WeDo. Moreover, 34.6% (n=18) were enrolled in a Robotics workshop, and had also experience in the use of Sketch Up, a 3D modelling software. All the participants pointed out that they had a good knowledge of the use of other technological tools as laptops, tablets and interactive whiteboard.

Instrument

The researchers used different instruments to collect data: a questionnaire and a semantic differential to collect pupils' perspectives, and a semi-structured interview and a monitoring guide to collect learning results and teacher's perceptions.

The instrument used to collect pupils' perceptions was divided into three parts: (1) Pupils' General Details, (2) the Development of the Project, and (3) Strong and weak aspects of the Project. The first part contained 9 items: age, gender, nationality, educational level, subject, digital competence, knowledge of the use of other technological tools, robotics workshop, and years enrolled in the robotics workshop. There were open, close, and multiple-choice questions. The second part referred to Pupils' Perceptions about the Development of the Project. It was used a semantic differential adapted from the research led by García-Valcárcel (2015). It was composed of 18 items of 7-point scales anchored by bipolar adjectives or situations (opposite-meaning terms) at each end. The last part of the test included 3 items (open questions) in which the participants were asked about the aspects of the experience that they liked more; the things they liked least; and the problems they had to develop the tasks.

On the other hand, teacher' valuations were carried out by a monitoring sheet also adapted from the research led by García-Valcárcel (2015), and a semi-structured interview. The monitoring sheet was composed of three parts: Objectives, contents and method with a total of 23 items of 3-point scale ranged from 1 to 3 (1=some, 2=quite a bit, 3=very much). Regarding the interview, the researchers decided to use a semi-structured interview, an interview guide approach so before starting the session, the researchers prepared a set of open-ended questions that referred to the specific phenomenon of the research. Although the researchers had that list of questions, they were free to change their order or even to reword them. The interview was divided into three parts in which the teacher was asked about the context in which the project was developed, the method used, and the assessment.

Data Collection and Analyses

Data were collected in May 2016 when the experience had finished. The data from the questionnaire and the semantic differential were coded, using the program Statistical Package for the Social Sciences (SPPS) version 24. Once the fieldwork was finished, the data were transferred to the personal computer. Secondly, researchers prepared the register coding to process the data collected in the 52 tests in an ad hoc file. After creating the data matrix, researchers started introducing and debugging the data, and carried out descriptive (frequency and percentages) and inferential analyses.

The monitoring sheet was completed during the experience, and the semi-structured interview was conducted in May 2016, and it was recorded to facilitate the later transcription.

RESULTS

Regarding the results obtained in the semantic differential (Table 1), pupils assessed in a positive way the experience developed in the framework of the Erasmus+ project: *Creating Tomorrow's Schools Today (CTST) 2014-2017* around robotics education and social science. The mean of most items of the semantic differential were between 6 and 7. The pupils considered that the experience was funny (Item 12, $\bar{x}$=6.77), useful (Item 20, $\bar{x}$=6.69), and interesting (Item 16, $\bar{x}$=6.63). They clearly stated that they

loved that way of working (Item 21, $\bar{x}$=6.77), and wanted to learn more about the topic of the *Unit 9 Forces & Machines* of Social Science (Item 19, $\bar{x}$=6.77). The participants also stated that they clearly understood the activities done (Item 17, $\bar{x}$=6.65), had maximized time (Item 13, $\bar{x}$=6.17), learned more things than usual (Item 14, $\bar{x}$=6.52), and had the opportunity to develop the tasks in groups (Item 25, $\bar{x}$=6.46) (this results accepted the H2). Regarding their opinions about the teacher's role, they considered that she clearly explained what they had to do (Item 23, $\bar{x}$=6.71), helped them to develop the tasks (Item 22, $\bar{x}$=5.88), and guided them during the experience (Item 29, $\bar{x}$=5.81).

The results also emphasized the positive pupils' perceptions about the possibilities offered by LEGO Education WeDo materials to build the robotic models (Item 24, $\bar{x}$=6.31) (this result accepted the H1), and by LEGO WeDo software to learn about the basics of programming (Item 15, $\bar{x}$=6.50). They also emphasized positive participants' perceptions towards LEGO Education WeDo materials to promote creative thinking to construct the robotic models (Item 27, $\bar{x}$=6.37), to reflect about the tasks (Item 18, $\bar{x}$=6.42), to solve problems in a creative and logical way (Item 26, $\bar{x}$=6.29) (this result accepted the H3), and to know the results of their decisions (Item 28, $\bar{x}$=6.38) (this result accepted the H4).

Table 1. Statistics of the Items of the semantic differential

	$\bar{x}$	1	2	3	4	5	6	7
Item12	6.77	-	-	-	-	1.9%	19.2%	78.8%
Item13	6.17	-	-	1.9%	-	17.3%	40.4%	40.4%
Item14	6.52	-	-	-	5.8%	1.9%	26.9%	65.4%
Item15	6.50	-	-	-	-	11.5%	26.9%	61.5%
Item16	6.63	-	-	-	-	7.7%	21.2%	71.2%
Item17	6.65	-	-	-	1.9%	3.8%	21.2%	73.1%
Item18	6.42	-	-	-	1.9%	3.8%	44.2%	50%
Item19	6.77	-	-	-	-	3.8%	15.4%	80.8%
Item20	6.69	-	-	-	-	3.8%	23.1%	73.1%
Item21	6.77	-	-	-	-	5.8%	11.5%	82.7%
Item22	5.88	1.9%	-	5.8%	7.7%	15.4%	23.1%	46.2%
Item23	6.71	-	-	-	1.9%	7.7%	7.7%	82.7%
Item24	6.31	1.9%	-	-	-	3.8%	50%	44.2%
Item25	6.46	-	1.9%	-	-	9.6%	25%	63.5%
Item26	6.29	-	1.9%	1.9%	-	5.8%	42.3%	48.1%
Item27	6.37	-	-	-	5.8%	1.9%	42.3%	50%
Item28	6.38	-	-	3.8%	-	1.9%	42.3%	51.9%
Item29	5.81	-	-	7.7%	13.5%	11.5%1	25%	42.3%

Most students (61.5%, n=32) pointed out that what they had liked most was the possibility that they had had to build the robotic models and learn about the basics of programming. Secondly, 23.1% (n=12) emphasized that they could work as a team, sharing their ideas and efforts. Finally, 15.4% (n=8) high-

lighted that the project allowed them to work playing what enabled to get more involved in the project and learn more than in traditional lessons.

Regarding the points that pupils liked least, most of them (46%, n=24) answered that nothing. On the other hand, 32.7% (n=17) pointed out that they did not have enough time to build the models and learn the basics of programming them, so they considered that they needed more practice to learn how to do it. Moreover, 11.5% (n=6) indicated that it was quite difficult to work as a team since sometimes they did not agree with the development of the activities or because some of them wanted to do everything without taking into account their classmates' opinions. Only 3 of the 52 students (5.8%) stated that what they liked least were some of the resources used since they believed that they did not have enough tools, and some of them needed to be updated. Finally, just 3.8% (n=2) considered that the thing that they liked least of the experience was to destroy what they had previously built.

Pupils were also asked about the problems they had had to build and programme the robotic models. In that case, more than half of the pupils (51.9%, n=27) stated that they did not have problems at all. On the contrary, 15.4% (n=8) answered that they had had difficulties to understand how to programme the robots and that had demotivated them to carry on with the rest of the tasks. The students also answered that they had had problems with some of the resources (13.5%, n=7) or with the teamwork (11.5%, n=6). Just 7.7% (n=4) considered that they had not had enough time to finish all the activities.

We analysed the previous results to know if there were statistically significant differences (CI 95%) between the gender groups. We calculated the Nonparametric Tests for Independent Samples, the Mann–Whitney U test, to determine statistically significant differences between these two groups in the items of the semantic differential (Table 2).

According to the results, there were statistically significant differences (CI 95%) between gender groups in the items that refer to:

- **Item 15:** LEGO WeDo software offers possibilities to learn about the basics of programming.
- **Item 18**: LEGO Education WeDo materials promote reflection about the activities developed.
- **Item 24:** LEGO Education WeDo materials offer possibilities to build the robotic models.
- **Item 26:** LEGO Education WeDo materials allow solving problems in a logical way.
- **Item 27**: LEGO Education WeDo materials emphasize creative thinking to construct the robotic models.
- **Item 28:** LEGO Education WeDo materials allow pupils to know the results of their decisions.

Regarding the results, the boys assessed better the possibilities offered by LEGO WeDo software to learn about the basics of programming (Item 15) and by LEGO Education WeDo materials to build the robotic models (Item 24). On the other hand, girls assessed better the possibilities offered by LEGO Education WeDo materials to promote reflection (Item 18), to solve problems in a logical way (Item 26), to emphasize creative thinking to construct the robotic models (Item 27), and to know the results of their decisions (Item 28) (Table 3).

Teacher' valuations about the experience developed around robotics education and social science, using LEGO Education WeDo materials, were quite positive. In the following lines, the qualitative results are presented in a more specific way, including the verbatim quotes from the teacher.

She considered that the pupils' achieved the learning objectives of the *Unit 9 Forces & Machines* of Social Science that referred to the types of machines, their characteristics and their uses in daily life. Moreover she stated that the students worked and assimilated the contents through the development of

Table 2. Nonparametric tests for independent samples, the Mann–Whitney U test

	Gender	Mean Rank	Sum of Ranks	Mann-Whitney U	Sig. (2-tailed)	Z
Item12	Boys	25,66	641,50	316,500	,588	-,542
	Girls	27,28	736,50			
Item13	Boys	23,92	598,00	273,000	,204	-1,271
	Girls	28,89	780,00			
Item14	Boys	24,56	614,00	289,000	,289	-1,061
	Girls	28,30	764,00			
Item15	Boys	35,58	889,50	110,500	,000	-4,813
	Girls	18,09	488,50			
Item16	Boys	26,68	667,00	333,000	,917	-,104
	Girls	26,33	711,00			
Item17	Boys	24,82	620,50	295,500	,321	-,993
	Girls	28,06	757,50			
Item18	Boys	14,42	360,50	35,500	,000	-6,228
	Girls	37,69	1017,50			
Item19	Boys	26,30	657,50	332,500	,894	-,134
	Girls	26,69	720,50			
Item20	Boys	25,22	630,50	305,500	,448	-,758
	Girls	27,69	747,50			
Item21	Boys	25,74	643,50	318,500	,597	-,529
	Girls	27,20	734,50			
Item22	Boys	24,86	621,50	296,500	,425	-,798
	Girls	28,02	756,50			
Item23	Boys	25,88	647,00	322,000	,666	-,431
	Girls	27,07	731,00			
Item24	Boys	39,04	976,00	24,000	,000	-6,465
	Girls	14,89	402,00			
Item25	Boys	25,24	631,00	306,000	,499	-,676
	Girls	27,67	747,00			
Item26	Boys	13,80	345,00	20,000	,000	-6,448
	Girls	38,26	1033,00			
Item27	Boys	13,42	335,50	10,500	,000	-6,698
	Girls	38,61	1042,50			
Item28	Boys	13,98	349,50	24,500	,000	-6,472
	Girls	38,09	1028,50			
Item29	Boys	24,94	623,50	298,500	,453	-,751
	Girls	27,94	754,50			

Table 3. Descriptive statistics mean

Gender $\bar{x}$		Item15	Item18	Item 24	Item 26	Item 27	Item 28
Boy	Mean	6,96	5,88	6,92	5,60	5,72	5,76
Girl	Mean	6,07	6,93	5,74	6,93	6,96	6,96

the phases in which the project was developed, and emphasized how most students were able to integrate the new contents with their prior knowledge to generate significant advances in the topic.

The experience developed through the use of LEGO Education WeDo materials has been quite appropriate to achieve the learning objectives and the contents of the topic.

The activities developed during the project have been very effective and students have had the opportunity to practice and acquire the objectives and contents activating prior ones.

I am very satisfied since pupils have clearly showed that they have acquired the main objective and contents of the unit and they are able to put them into practice.

She believed that the success of the achievement of the learning objectives was due to the tasks carried out. Specifically, she made the following assessments:

(a) She stated that the activities allowed students to be fully immersed in what they were doing; having the possibility to transfer the knowledge they already had to a specific area.

It has been surprising to see how all the pupils were such confident and involved in the activities to build and programme the models.

The experience has allowed students to transfer the knowledge that they had studied in other subjects to the specific tasks that they have had to develop.

(b) The tasks motivated the students and aroused their curiosity, being free to explore the possibilities to build the different robots and learn the basics of programming.

They students have felt that they have been part of the teaching-learning process and have loved the tasks developed through LEGO materials what has increased their motivation. They have felt free to decide and explore all the possibilities offered in the experience to build the models and programme them.

(c) They facilitated the students' active role, being solution-seekers, and the collaborative work. She emphasized that the fact of working collaboratively implied that students had a better understanding of the topic and an active role towards the community.

The students have had an active role in the teaching-learning process in which they learn interacting with others, and being placed at the centre of that process.

The pupils have had the opportunity of sharing their work and points of view with their classmates.

The way in which it has been designed has favoured the collaborative work, the teamwork. It has been a collaborative work in which they have learned together and have shared everything.

Finally, she believed that (d) activities fostered the students' creativity, problem solving skills and critical thinking.

The instructional approach designed has fostered a learning environment in which it has been promoted creative thinking and problem solving encouraging pupils to think creatively and critically.

The teacher also assessed in a very positive way the technological resources used. She specifically pointed out that: (a) they were very useful and facilitated the achievement of the objectives and contents of the unit. (b) They contributed to motivate the students who were favourably predisposed towards the experience from the first moment that they saw the technological materials they were going to use (LEGO Education WeDo materials, tablets and computers). (c) They helped to explore the possibilities to solve problems that could be more difficult to solve without them, and allowed students to develop problem-solving skills such as initiative, creativity, and trial and error.

There is no doubt that the use of all technological tools, in that case the LEGO materials, motivates students. They are familiar acquainted with them and respond better to the activities developed through technology what facilitate the achievement of learning objective and contents.

The technological tools used have helped students to solve problems addressing them from different perspectives and also reflecting about the best solution to do each task and get the goals.

The materials designed and developed by LEGO make easier the development of these kinds of educational experiences, and the acquisition of the skills as logical thinking, creative problem-solving and computational thinking needed in the contemporary society.

The teacher also evaluated as very appropriate the type of grouping proposed in the experience. She considered that the distribution of pupils in mixed-level groups of three students (high, average, and low) to create heterogeneous groupings had favoured the development and success of the tasks, improving the students' performance significantly. The fact of working in groups allowed the students to play different roles as builders, programmers, or presenters during the development of the project, and to promote positives attitudes towards the peers.

The fact of working in groups has improved pupils' attitudes towards their classmates and tasks, and also the creation of a learning community of which they were part.

The students have had an active role during the development of the project and they have acted as builders, programmers, or presenters.

Finally, regarding the facilities and space used, the teacher stated that they met the requirements for developing the project around robotics education and social science in an education environment. Although the teacher was completely satisfied with what had been accomplished, she also affirmed that it would be necessary to have more practice to consolidate learning.

FUTURE RESEARCH DIRECTIONS

The ongoing research suggests that CT is an essential twenty-first century skill that pupils should acquire. Educational professional all over the world are carrying out different experiences to embed computational thinking in schools. Based on this perspective, it is possible to predict that CT will be an important part of curricula and its current relevance will increase in the future. The studies conducted about CT in the future should focus, on one hand, on teachers' training, on their acquisition of the pedagogical skills, and teaching and assessment strategies in order to carry out useful educational experiences, and, on the other hand, on how to support schools to implement these experiences providing them the necessary resources and materials. Moreover, researches policy actions that consider how to introduce transversally CT and programming in school curricula and official guidelines of different subject areas of all levels of education, or even to implement CT and programming as a single and mandatory subject. Additionally, researches should focus on the necessary measures and actions to promote computational thinking for all learners independently of their personal circumstances.

CONCLUSION

To meet the aim of the study, researchers analysed pupils and teacher's perceptions about the experience developed around robotics education and social science. The results of the research proved that the project was effective to meet the learning objectives and construct and programme robotics models. It was also emphasized its effectiveness to help pupils to become familiar with computational concepts and practices.

The research provides specific evidences of the pupils' satisfaction towards the project and their positive attitude to go more deeply into the topic. They considered that it helped them to understand better the tasks they had to develop, and to learn more things than usual in a innovative way (Kazimoglu et al., 2011).

The fact of working in heterogeneous mixed-level groups improved their attitudes towards their classmates and schoolwork, and allowed building a learning community of which they felt part. There was a change from the traditional individualism to the collective construction of knowledge that was a dynamic, active process in which learners participated actively (Pinto-Llorente, Sánchez-Gómez & García-Peñalvo, 2017, 2018a). Working as a group brought them the opportunity of teaching, learning, helping and motivating each other. The way in which the project and the tasks were designed allowed them to share ideas and reflect about the best solution to do each activity. They had to share their points of view about the contents of the activities, the different perspectives in which they could address the contents, and decided the roles and functions of each member of the group. The tasks required nego-

tiation on the part of the pupils, as well as the exposition and respect of different opinions. The pupils could address the tasks of building and programming from different perspectives and that developed their ability of reflection, and valued the benefits and richness of considering the different perspectives suggested (Walsh & Kahn, 2010; Pinto-Llorente, Sánchez-Gómez & García-Peñalvo, 2018b).

It was observed the strong pupils' motivation in the building and programming of the robotic models that was driven by the opportunity they had to learn by doing (Sorbi et al., 2014). That learning favoured the development and success of the tasks, and improved their performance significantly (Kolb, 1984). They could manipulate the materials that facilitated to remember what they were learning through reflection on doing in authentic situations, in a natural environment for authentic practice. On the other hand, the research showed students' active role, playing different roles as builders, programmers, or presenters (Yeh & Swinehart, 2017). That favoured a constructivist learning in a constructivist environment that involved the students in the development of knowledge by having an active role in the teaching-learning process in which they learned interacting with others (Pinto-Llorente, Sánchez-Gómez & García-Peñalvo, 2015). All that promoted a learner-centred pedagogy, since students were placed at the centre of the teaching-learning process and took a principal role in its development. That is opposed to traditional tutor-centred pedagogy in which teachers had the knowledge, and were experts and responsible for transmitting that knowledge to students who had to learn it, memorize it and repeat it (Allan, 2007).

To a large extend, the success of the experience relied on the teacher' role. It was fundamental her role as a guide, explaining clearly the tasks the pupils had to develop (Zapata-Ros, 2015). The design of the experience did not only allow pupils to reach the objectives but also to verbalise the problems and solutions, reflecting during the phases in which the experience was developed. The project also helped learners to acquire relevant key competences as Digital competence; Mathematical competence and basic competences in science and technology; linguistics communication competence; Learning to learn; Social and civic competences; and Sense of initiative and entrepreneurship.

It was highlighted the potential usefulness of the LEGO materials, allowing pupils to get awareness of CT (Kazimoglu et al., 2011), and promoting critical thinking and problem solving skills. There were evidences of the possibilities offered to reflect and think creatively about the opportunities they had to fulfil the activities correctly, to know the results of their personal or group decisions, and to solve the problems in a logical way (Bers et al., 2014). These results agree with those obtained in the researches of Atmatzidou and Demetriadis (2012), Barak and Zadok (2009) and Goikhman et al. (2016).

The study has proved the potential of LEGO materials to promote CT, its concepts (coding, programming, sequence, loops, parallelism, events, conditionals, etc.) and practices (testing and debugging, reusing and remixed, and abstracting and modularizing) (Sorbi et al., 2014), and to engage pupils in programming and problem solving. The experience has allowed integrating robotics in the teaching-learning process to help learners to familiarize with these tools and their uses in the real-life context (Sorbi et al., 2014). Something that, as Lu & Fletcher (2009) point out, is necessary in the contemporary society.

The main limitation of the study was the sample size since the research focused on one teacher and 52 pupils from one grade of primary education and from one school. The results obtained can probably vary if the sample size increases or if the research is conducted in grades and schools where pupils and teachers can have different backgrounds.

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KEY TERMS AND DEFINITIONS

Case Study: It is a research method in which the researchers investigate in depth an experience, an event, a process, or one or more individuals in the real-life context over a period of time.

Collaborative Learning: It refers to a situation in which a group of students learn together and have an active role in creating and sharing knowledge.

Computational Thinking: It is a problem-solving process that implies the use of technological tools as well as algorithmic thinking and logical thinking to organize the data, analyse them and present the solutions. It is a fundamental skill in the 21st-century.

Learner-Centred Pedagogy: It refers to a pedagogy that places students at the centre of the teaching-learning process. Students are more active and participative, and the process turns knowledge into a negotiation between teachers and students. Furthermore, this pedagogy starts from students' interests and objectives, and it carries out a learning process based on real situations and materials, using the current technologies to favour this process.

Learning Community: It refers to a group of students who work collaboratively, share knowledge and have common learning objectives.

Primary Education: It is the first step of compulsory and formal education. Primary Education in Spain consists of six grades.

Robotics Education: It is a discipline that allows students to learn about the basics of building robots and programming them, and to acquire the 21st-century skills, such as logical thinking, creative problem-solving and computational thinking.

Chapter 19
Assessment of the Use of Social Media by Students of the National Open University of Nigeria, Abeokuta Study Centre

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ABSTRACT

Social media sites have been recognised as important resources for education. They facilitate effective interaction between teachers and students and promote prompt and frequent interactions among students. Hence, this study was aimed at assessing the use of social media by students of National Open University of Nigeria (NOUN). To achieve this, the study attempted to determine the extent to which students of NOUN use social media, what the students use social media for, and the challenges and benefits of the use of social media by the students for academic purpose. Selected theories for this study are uses and gratification and diffusion of innovation theories. The study employed survey method of research. The study discovered that all the respondents had access to social media sites. The study also observed that majority of the respondents share academic materials through their social media sites. Some of the identified challenges in accessing social media include weak internet connection, inconsistent power supply, limited financial resources.

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INTRODUCTION

This paper presents an assessment of the uses of social media by students of the National Open University of Nigeria, Abeokuta Study Centre. In spite of the widespread use of social media, little is known about impact on tertiary academic activities. Social media sites although have been recognised as important resources for education. In realisation of the inherent benefits of social media in facilitating social interaction among people of similar interest, social media has been adopted by many (educators, academics and students) as a major medium of the learning platform. It has among other benefits facilitates effective interaction between teachers and students and promotes prompt and frequent interactions among students. Hence, this study was aimed at assessing the use of social media by students of National Open University of Nigeria (NOUN**).** To achieve this, the study attempted to determine the extent to which students of National Open University of Nigeria use social media; what the students of National Open University of Nigeria use social media for; and the challenges and benefits of the use of social media by the students of National Open University of Nigeria for academic purpose. To advance this, the study looked at different theoretical frameworks that best explain what media users do with media and how new ideas or technology spread. Selected theories for this study are uses and gratification, technological determinism and diffusion of innovation theories. The study employed survey method of research and deployed questionnaires as its research instrument to solicit responses from students of the National Open University of Nigeria, Abeokuta Study Centre. The study discovered that all the respondents had access to social media sites and the extent to which they access social media sites was very high. The study also observed that majority of the respondents share academic materials and views through their social media sites, while some of them confessed that they also engage in some social activities online. Some of the identified challenges in accessing social media by the respondents include weak internet connection, incessant power supply, limited financial resources, limited local academic materials and low information and technology literacy. They listed some of the benefits inherent in the use of social media as opportunity for interactive learning, increased access to online academic materials, and reduction in the cost of acquiring academic materials. The study recommended that further studies be conducted on effect of social media on students' academic performance.

BACKGROUND

Social media is a phrase being tossed around these days, but it can sometimes be difficult to answer the question. If **MYSPACE** is a social media site and **MAG.NOLIA** is a social media site, and **WIKIPEDIA** is a social media site, then what is social media?

Social media according to Kaplan and Haenlein (2010) refers to "group of internet-based applications" that builds on the ideological and technological foundations of web 2.0 and that allows the creation and exchange of user-generated content. It is a form of electronic communication which facilitates interaction based on certain interests and characteristics. Social media use web-based technologies to transform media monologues into social dialogues. They support the democratisation of knowledge and information and transform people from content consumers to content producers.

It comprises of activities that involve socialising and networking online through words, pictures and videos. Social media is redefining how we relate to each other and how we as individuals relate to the

organizations that serve us. It is about dialogue (two way or multi-way) discussions that bring people together to discover and share information (Solis, 2008).

Social media technologies facilitate social interaction, make possible collaboration, and enable deliberation by stakeholders across boundaries, time and space. These technologies include; blogs, wikis, media (audio, photo, video, text) sharing tools, networking platforms (including Facebook), and virtual worlds (Bryer and Zavatarro, 2011).

The rise of social media sites as another platform on the internet has gained popularity over the last decade. According to Boyd, & Ellison (2007), social media sites have attracted millions of users worldwide. Many people are changing the outlets where they search for news, information, business and entertainment. These social media sites let those who use them create personal profiles, while connecting with other users of the sites. Users can upload photographs and post what they are doing at any given time (Pempek, Yermolayeva, & Calvert, 2008).

These media by their nature have the capabilities of educating, informing and entertaining audience. Above all, they possess a contagious and outreaching influence which the conventional media lack. This potential is most likely what Osahenye (2012) refers to as "unstoppable power of the social media".

Social media are elements of the new media. According to Danny Shea in the Huffington Post (accessed 20th June 2010), they have become the highest activity on the internet. The rapid growth of social media activities that has been observed over the last two to three years is indicative of its entry into mainstream culture and its integration into the daily lives of many people. In parallel with this, social media have also gained considerable attention from the academic and business worlds. Thus, it is imperative to note that new media, and by extension social media, by their very nature are drivers of social change, national development and organizational development. They possess the capability to increase work efficiency and speed as well as reduce cost (Ikpe and Olise, 2010).

In spite of the widespread use of social media, little is known about impact on tertiary academic activities. Social media sites although have been recognised as important resources for education. Some studies have shown that students use social networking sites such as Facebook for fun, to kill time, to meet existing friends or to make new ones (Ellison et al, 2007).

Based on its increasing use by youth (particularly students), the use of social media has generated intense concerns considering the gradually increasing amount of time youths spend online. In Nigeria, undergraduates spend more time on facebook, twitter and other social media sites through smart phones that are now in abundance among them and most of them cannot go for two-three hours without checking and updating their profiles on these social networks even at the detriment of other activities such as educational and career pursuit (Idankwo, 2011)

The emergence of social media as a result of advancement in technology and expansion in internet software has raised concerns among academics on its impacts on academic studies. Students at all levels of learning now have divided attention to studies, as a result of available opportunities to be harnessed from social media. Whether these opportunities can be adapted to support academic activities is a question that needs to be answered.

According to Facebook Statistics (2012), at least four million, seven hundred and fourteen Nigerians are on facebook, with a good number of them being young Nigerians. However, there is no comprehensive knowledge of their activities as well as how this form of media can impact on various aspects of their academic life.

It is important to begin to examine if and how students of tertiary institutions in Nigeria are appropriating social media for academic activities. This study seeks to find out the extent to which the students of

National Open University of Nigeria (NOUN) use social media; what do the students of National Open University of Nigeria (NOUN) use social media for and what are the challenges and benefits of the use of social media by the students of National Open University of Nigeria (NOUN) for academic purposes?

Scope of the Study

The study was aimed at assessing the use of social media by students of National Open University of Nigeria (NOUN), Abeokuta Study Centre. To achieve this, the study attempted to determine the extent to which students of National Open University of Nigeria use social media; what the students of National Open University of Nigeria use social media for; and determine the challenges and benefits of the use of social media by the students of National Open University of Nigeria for academic purpose.

CONCEPTUAL REVIEW

The Concept of Social Media

Social media started as a concept many years ago but has evolved into sophisticated technology. The concept of social media can be dated back to the use of the analog telephone for social interaction.

Commonly, the phase ''social networking sites'' is used as an umbrella term for all social media and computer mediated information, including but not limited to Facebook, Twitter, LinkedIn, and Myspace, as well as the social networking sites of cyworld, bebo, and friendster. Ellison and Boyd (2007) define social network sites as web-based services that allow individuals to construct profiles, display user connection, and search traverse within the list of connection.

Social networking is only one layer of social media technology. Reminiscent of Winston Churchill's (1939) radio address regarding the actions of Russia, social media technology is complex, much like ''a riddle, wrapped in a mystery, inside an enigma'' that is continuously being investigated and briefly understood before it changes once more. As each application is experienced, other innovative technologies rapidly emerge, enabling new utilities for users. Over the last ten years, a proliferation of differentiated services has shown this to be true as micro blogging sites such as Twitter, location based services like Foursquare, and consume review platforms including Yelp have all worked collaboratively to provide a totally new and engaged media experience which has now become more accessible through mobile devices (Reuben, 2008).

The entire range of social media applications noted above share the innate ability to enable social behaviour through multiple way discussions, thus, providing the opportunity to discover and share new information (Solis, 2008). Therefore, social media technology is a vast landscape of software with many different applications which are not merely limited to social networking, video sharing, or blogging. Rather the broad definition of social media technology includes the totality of digital products and services enabling online, user generated social behavior and exchanges around primarily user generated content.

History of Social Media: Then and Now

The roots of social media stretch far deeper than one can imagine. Although it seems like a new trend, sites like facebook are the results of many centuries of social media development.

Social Media Before 1900

The earliest method of communication across great distances used written correspondence delivered by hand from one person to another, in other words, letters. The earliest form of postal service dates back to 550 B.C, and this primitive delivery system would become more widespread and streamlined.

In 1792 the telegraph was invented. This allowed messages to be delivered over a long distance faster than a horse and a rider could carry them. Although telegraph messages were short, they were a revolutionary way of conveying news and information.

Although no longer popular outside of drive through banking, the pneumatic post, developed in 1865, created another way for letters to be delivered quickly between recipients. A pneumatic post utilizes underground pressurized air tubes to carry capsules from one area to another

The telephone was invented in 1890 and the radio in 1891. Both technologies are still in use today, although the modern versions are much more sophisticated than their predecessors. The emergence of telephone and radio in 1891 enabled people to communicate across great distances.

Social Media in the 20th Century

Technology began to change very rapidly in the 20th century. After the first super computers were created in the 1940s, scientists and engineers began to develop ways to create networks between those computers, and this would later lead to the birth of internet. The invention of the internet is traceable to a project by the US Defence Department during the Cold War. HTML, invented by Sir Tim Berners-Lee, popularise the internet and made its potentials clearer to journalists, politicians, business people, etc.

The earliest forms of the internet, such as Compuserve were developed during this time. By the 1970s, networking technology had improved, and 1979's UseNet allowed users to communicate through a virtual newsletter.

By 1980's, home computers were becoming more common and social media was becoming more sophisticated. Internet relay chats, or IRCs, were first used in 1988 and continued to be popular well into the 1990's. The first recognizable social media site, Six Degree, was created in 1997. It enabled users to upload a profile and make friend with other users. In 1999, the first blogging sites became popular creating a social media sensation that is still popular today.

After the invention of blogging, social media began to explode in popularity. Sites like MySpace and LinkedIn gained prominence in the early 2000s, and sites like Photobucket and Flickr facilitated online photo sharing. YouTube came out in 2005, creating an entirely new way for people to communicate and share with each other across great distances.

Today, there is a tremendous variety of social networking sites, and many of them can be linked to allow cross posting. This creates an environment where users can reach the maximum number of people without sacrificing the intimacy of person-to-person communication. We can only speculate about what the future of social networking may look in the next decade or even 100 years from now, but it seems clear that it will exist in some form for as long as humans are alive.

Social Media as Educational Tool

A lot of criticism has been leveled at social media and the effect it has on the way students process and retain information, as well as how distracting it can be. However, social media offer numerous opportunities for learning and interactivity.

Social networking sites have attracted a huge number of followers among teenagers and university students (Lenhart & Madden, 2007; Salaway & Caruso, 2008). It is not surprising to find social networking sites making its way into the educational environments with many claiming that these social applications have more potential to improve learning and sharing of information among learners and teachers (Ferdig, 2007; Maloney, 2007; Pence, 2007; Simões, & Borges, 2008).

According to Lumbano and Nawe (2004), the internet has emerged as an important component in academic institutions as it plays a pivotal role in meeting information and communication needs of institutions. They observed that the internet makes it possible to access a wide range of information that is current. It enables scholars and academic institutions to disseminate information to a wider audience through hosting websites and search facilities. Furthermore, students and lecturers can communicate via the internet irrespective of their geographical boundaries. They also agree that distance learning has also been made accessible by the internet.

In the same vein, Rehman and Ramzy (2004) opined that the internet has established a place in the personal and professional lives of researchers and scholars through their daily use of the internet for serious work and personal communication. Lazinger et al (1997) also agreed that the internet has transformed information access, use, exchange and application for the university community and other professionals. In his findings, Lund (1998) noted that the advent of the internet has brought about a steady growth in the number of online courses and virtual universities in the world thereby transforming the whole concept of distance education.

Baym, Zhang and Lin (2004) studied social interactions of college students across all media. Their results indicated that 64 percent still prefer face-to-face interaction, 18.4 percent prefer the telephone, and only 16.1 percent prefer the internet for making social contacts. The internet interactions reported showed that e-mail was by far the most dominant form of contact, followed by chat and instant-messaging (Baym et al, 2004). Of the 51 participants in the study, 49 reported conducting their social life contacts through at least two, and often three, methods on any given day (Baym et al, 2004).

Different researchers have conducted research to ascertain the influence of social media on users. For instance, Moon (2011) in a study on "impact of facebook on undergraduate academic performance," stated that social media have negative impact on students. According to the result, the more students use facebook, the more it affects their academic performance.

Similarly, Oye (2012) noted that most of the younger students use social media mainly for socializing rather than for academic purpose. He further observed that most of the students do feel that social media have more positive impact on their academic performance. In another study conducted by Shana (2012), it was revealed that students use social media mainly for making friends and chatting. The result showed that only 26 percent of the students (respondents) indicated that they use social media for academic purpose.

Young (2006) in a study titled "the effect of internet use and social capital on the academic performance of students" observed that the internet expands its reach to teenagers' school life. Young noted that students are more reliant on the internet to access information about school life as well as entertainment. The researcher further added that internet, though consumes time, has less effect on studies.

Despite the many obvious advantages of the internet to students, the amount of time spent by some higher education students online might be cause for concern. Students who have difficulty controlling the time they spend online may suffer from internet addiction, resulting in their studies being adversely affected (Young, 1998; Chen & Peng, 2008, Cao & Su, 2007). Much research has been conducted to examine the time spent by students accessing internet. For example, Yu (2001) found that, on average, university students spent 164 minutes per day on the internet. Robinson (2005) found that 47 percent of African-American college students spent an average of two hours per day online while a small percentage of the students spent 5 – 6 hours.

In a research involving students from nine different faculties in a Turkish university, Toprackci (2007) found that 15.4 percent accessed the internet more than 3 hours per day, while 62.9 percent accessed the internet between 1 to 3 hours per day. A study by Guan, Mohammed Isa, Hashim, Kumar Pilai and Harbajan Singh (2012), based on a sample of 162 medical students in Malaysia, revealed that the average duration of time spent by these students on the internet was 13.31 hours. In Nigeria, the findings of Awoleye and Siyanbola (2006) indicated that, on average, university students would access the internet one hour per week. Tella (2007) reported that a majority of students from a Botswana university accessed the internet 1-5 hours per week.

To maximize the potentials of the new media for learning, Dunn (2012) opined that more emphasis must be placed on *learning with technology.* The default setting for many academics remains on *teaching with technology.* The two perspectives, when not aligned, can create very different experiences for students. Providing support for this line of thought, Laird and Kuh (2005) stated that active learning and deep interactions between students and their teachers requires an extended degree of technological engagement.

How the technology is used and how it is integrated into the learning process is important. Zepke and Leach (2010) suggested that motivation and student dispositions will influence their ability to engage in interactive learning, where the line between online learning and socialization is becoming blurred.

According to a study conducted by Englander et al (2010), students spend more time using social media for other purposes apart from educational use, thus affecting their academic performance. In another study, Nalwa and Anand (2003) established that students like to use internet for their own responsibilities and this affects their academic performance. This study is further elaborated by Karpinski's (2009) who stated that social media users had lower grade rankings than students who never engaged in online social interactions.

With social media, learning can take place anytime, anywhere including at home, in a car, in hotels. This is invaluable for work-based training especially for open and distance learners. PDAs or tablets holding notes and e-books are lighter and less bulky than bags full of files, papers and textbooks, or even laptops. It's much easier to accommodate several mobile devices in a classroom than several desktop computers. A good example is the online chat where people use blackberry even while on traffic or bedroom. The wasted times can be valuably utilized.

Theoretical Framework

The theories that were used for this study include; uses and gratification theory and diffusion of innovation.

The Uses and Gratification Theory

The theory was propounded by Elihu Katz, Jay Blumler and Micheal Gurevitch in 1974. The uses and gratification theory belongs to the realm of the active audience theories. Those theories, Baran and Davis (1995) described as rather focusing on assessing "what people do with media" than attempting to understand what the media do to people. The theory emphasizes the audience member's motive for consuming specific media or their content, as well as the consequences of such choices.

Uses and gratifications analysis shifts attention and focus from media production and transmission to media consumption. According to Folarin (2002:72), the central issue becomes, "who uses which content from which media under which conditions and for what reasons". The theory seeks to explain the uses of media and the satisfactions derived from them in terms of the motives and self-perceived needs of audience members (McQuail, 2005:569). It emphases the fact that the audience are not passive receivers of media contents, but that, "they actively influence the message" in that they "selectively choose, attend to, perceive and retain the media message on the basis of their needs, beliefs, etc." (Anaeto et al, 2008:71). Media audiences usually derive gratifications from three different sources, namely, media content, media exposure and the social context of exposure (Blumler and Katz, 1974).

Uses and gratification theory has a heuristic value today because it gives communication scholars a ''perspective through which a number of ideas and theories about media choice, consumption, and even impact are viewed. This communication theory is positivist in its approach, based on the socio-psychological communication tradition, and focuses on communication at the mass media scale.

The driving question of uses and gratifications theory is: why do people use media and what do they use them for? Uses and gratifications theory discusses how users deliberately choose media that will satisfy given needs and allow one to enhance knowledge, relaxation, social interaction/companionship, diversion or escape.

According to Katz, Blumler, and Gurevitch (1974), the assumptions of the theory are:

- The audience is conceived as active. This idea focuses around the assumption that the viewers are goal-oriented and they attempt to achieve their goals through the media source
- In the mass communication process, much initiative in linking need gratification and media choice lies with the audience member. This is encompassing the idea that people use the media to their advantage more often than the media use them. The receiver determines what is going to be absorbed that does not allow the media to influence them otherwise.
- Many of the goals media can use can be derived from data supplied by the individual audience members themselves. This idea claims that people are very aware of their motives and choices and are able to explain them verbally, if necessary.
- The media competes with other sources of need satisfaction. This focuses on the idea that an individual has several needs. In response to this, they have created a wide range of choices that will meet these needs. The strongest rival to media base sources includes face to face communication. This can often help an individual cope most effectively with the circumstances surrounding them. Because of this, mass communication must compete strongly with non-media related sources and help create a need for itself as well as a proper balance between the two.
- Value judgments about cultural significance of mass communication should be suspended while audience operations are explored on their own terms. The theorists believe the audience can only

determine the value of the media content. It is the individual audience members who make the decision to view the media; therefore they plan the value on it by their individual decision to view it.

From the foregoing, uses and gratification theory will provide theoretical assumptions regarding the use of social media by students of the National Open University of Nigeria and the perceived benefits of the sue of social media.

Diffusion of Innovation

Diffusion of Innovation theory, developed by E.M. Rogers in 1962, is one of the oldest social theories. It originated to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. The end result of this diffusion is that people, as part of social system, adopt a new idea, behavior, or product.

This is a theory that seeks to explain how, why and at what rate new ideas and technology spread through cultures. Everett Rogers, a professor of communication studies, popularized the theory in his book, *Diffusion of Innovations.* According to Rogers (2003), diffusion is the process by which an innovation is communicated through certain channels over time among the participants in a social system. The origins of the diffusion of innovations theory are varied and span multiple disciplines. Roger proposes that four elements influence the spread of a new idea: the innovation itself, communication channels, time and a social system. This process relies heavily on human capital. The innovation must be widely adopted in order to self-sustain. Within the rate of adoption, there is a point at which an innovation reaches critical mass. The categories of adopters are: innovators, early adopters, early majority, late majority, and laggards.

Diffusion manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process. Researchers have found that people who adopt an innovation early have different characteristics than people who adopt an innovation later. When promoting an innovation to a target population, it is important to understand the characteristics of the target population.

Diffusion of New Technology

Peres, Muller and Mahajan (2010) suggest that diffusion of a new technology is "the process of the market penetration of new products and services that is driven by social inñuences which include all interdependencies among consumers that affect various market players with or without their explicit knowledge".

Diffusion of existing technologies has been measured in S curves. These technologies include radio, television, VCR, cable, flush toilet, clothes washer, refrigerator, home ownership, air conditioning, dishwasher, electrified households, telephone, cordless phone, cellular phone, per capita airline miles, personal computer and the internet.

According to Baran and Davis (2003), empirical studies in the USA "show that when new technological innovations are introduced, they will pass through a series of stages before being widely adopted." Most people will become aware of the innovation often through the media in the first stage. A small group of early adopters adopt it at the second stage. Opinion leaders learn from early adopters and try the innovations themselves at the third stage. Opinion leaders find the innovation useful and encourage their friends, the opinion followers, at the fourth stage. Finally, after most people have adopted the innovation, a group of laggards or late adopters make the change.

Rogers (1995) cited in Anaeto, S; Onabajo O., & Osifeso J. (2008) suggests that interactive innovations, or those that offer two-way communication, can have a speedier adoption process because they attain a critical mass of users more quickly. In a study of the adoption of an electronic news product produced by a metropolitan newspaper, Weir (1998) found that the use of the new medium was related to opinion leadership, the perception of internal incentives and perception of external benefits but not to knowledge of computers or general status as an innovator.

Research Design

The study adopted survey research method to generate necessary information. Survey research is a scientific method for collecting and analysing social data via highly structured and often detailed questionnaires in order to obtain information from large numbers of respondents presumed to be representatives of a specific population. The study concentrated on assessment of the use of social media by National Open University students, with focus on Abeokuta Study Centre. Students of the National Open University of Nigeria, Abeokuta Study Centre, constituted the population of the study. One hundred students of National Open University of Nigeria, Abeokuta Study Centre were targeted. Convenience/availability sampling technique was adopted in selecting respondents for the study. This was due to the fact that the National Open University is an e-learning university, hence, students academic activities are flexible and online.

Structured questionnaires were designed to elicit information from the respondents (students of National Open University of Nigeria). The questionnaire consisted of both open-ended and close- ended questions to enable the target audience effectively express their views.

Data Analysis and Discussion of Findings

One hundred questionnaires were personally administered on the respondents by the researchers, of which 90 were dully filled and returned. The data presentation and analysis is focused on the identified units of analysis as featured in the research questions for this study. The units of analysis are as follow

Research Question One: To what Extent do the students of National Open University of Nigeria (NOUN) use social media?

In an attempt to determine the extent to which respondents use social media, the researchers posed some questions to the respondents. Responses to the questions are captured below:

Table 1. Extent of the use of social media by students of National Open University of Nigeria (NOUN).

Question	Responses option					Total
Do you access information on social media?	Yes No 100% (90) 0%					100% (90)
Question	**Responses option**					**Total**
How often is information accessed on social media?	Daily 71.1% (64)	Weekly 12.2% (11)	Fortnightly 3.3% (3)	Monthly 0%	Occasionally 13.3% (12)	100% (90)

According to research result, 100% (90) of the respondents accepted that they access information through social media. This means that all the respondents access social media.

According to the research result, the frequency of respondents' social media activities varies, 71.1% (64) of the respondents admitted to accessing social media daily, 12.2% (11) admitted to having access to social media weekly, 13.3% (12) admitted to accessing social media occasionally, while the remaining 3.3% (3) admitted to accessing social media fortnightly.

Based on this, significant majority of the respondents have access to information on social media regularly (daily). This means that the extent to which the respondents (students of National Open University of Nigeria) access social media is very high.

Research Question Two: What do the students of National Open University of Nigeria (NOUN) use social media for?

Table 2. Use of social media by students of National Open University of Nigeria (NOUN).

Question	Responses Option				Total
What do you use the social media sites for?	Interaction with friends 66.6% (60)	Access news 63.3% (57)	Entertainment 34.4% (31)	Academic research 70% (63)	100% (90)

According to research result, 70% (63) which is the majority of the respondents access social media mainly for academic research, 66.6% (60) admitted to accessing social media to interact with their friends, 63.3% admitted to using social media to access news and other timely information, while the remaining 34.4% (31) admitted to using social media to share social media entertainment products e.g. movies, music and pictures.

According to research result, majority of the respondents claimed that they access social media for academic research purposes (to download research materials, download course contents, share academic materials, etc.); close to that were those who equally claimed that they interact with friends on social media (like facebook, whatsapp, twitter, etc.). Also some of the respondents claimed to access news and other timely information and the remaining respondents claimed to access social media to share social media entertainment products (movies, music, pictures etc)

Research Question Three: What are the challenges and benefits of the use of social media by the students of National Open University of Nigeria (NOUN) for academic purposes?

Table 3. Challenges and benefits of the use of social media by students of National Open University of Nigeria (NOUN)

Question	Responses option					Total
What are the challenges faced in the use of social media for academic purposes?	Weak internet connection 48.8% (44)	Unreliable power supply 16.6% (15)	Financial challenges 38.8% (35)	Limited academic materials 12.2% (11)	Low IT skills 15.5% (14)	100% (90)
Question	Responses option					Total
What are the benefits in the use of social media for academic purposes?	Interactive learning 56.6% (51)	Dissemination of ideas 43.3% (39)	Reduction in cost of acquiring academic materials 30% (27)			100% (90)

According to research result 48.8% (44) attested to encountering the challenge of weak internet connection, 38.8 (35) identified the problem of financial challenges, 16.6% (15) pointed to the challenge of epileptic power supply, 15.5% (14) identified the challenge of low IT skills, while the remaining 12.2% (11) encountered the challenge of limited local academic materials online.

56.6% (51%) attested that social media is beneficial in enhancing interactive learning, 43.3% (39) admitted is very effective in dissemination of ideas, while the remaining 30% (27) identified reduced cost of acquiring academic materials as one of the benefits of using social media.

Discussion of Findings

According to the research result, all the respondents claimed to access information on social media. Also, majority of the respondents admitted to accessing information on social media daily. This indicates that majority of the respondents access social media for various activities mostly on daily basis. This confirms the diffusion of innovation theory, which states that when an innovation fulfils certain requirement like simplicity and adaptability, it may be quickly accepted.

It was also discovered that the majority of respondents use social media for different purposes. 70% (63) attested to using social media for academic research purposes, 66.6% (60%) attested to using social media in their interactions with friends, 63.3% (57) use social media to access news and other timely information, the remaining 34.4% (31) attested to using social media to share social entertainment products e.g. movies, music and pictures. This emphasizes the audience member's motive for consuming specific media or their content, as well as the consequences of such choices. Furthermore, the responses gathered from the questionnaires indicate that most of the respondents access social media for academic purpose.

Concerning the challenges and benefits inherent in the use of social media which addressed research question three: 48.8% (44) claimed that weak internet connection is one of the major challenges faced by students in the use of social media, 38.8% (35) pointed at financial challenges i.e. subscription is one

of the challenges faced by students in the use of social media, 16.6% (15) claimed that incessant power supply is one of the challenges faced in the use of social media, 15.5% (14) identified low IT skills, while the remaining 12.2% (11) claimed that limited local academic materials is one of the issues faced by students in accessing social media.

According to the research findings, 56.6% (51) attested that social media enhance interactive learning among students, 43.3% (39) attested that social media allows dissemination of ideas among students, while the remaining 30% (27) attested that social media help in the reduction of cost of acquiring academic materials. This confirms the uses and gratification theory that emphasizes the importance of the uses people dedicate media technology to.

Recommendation

Listed below are recommendations for development of social media. These recommendations are directed to the Government and academic officials:

- Improvement in internet connection
- Reduced charges on subscription in accessing the internet
- Provision of adequate academic materials
- Provision of stable and adequate power supply
- Improved IT training and learning

Future Research Directions

The researchers suggest further studies on effects of social media on university students' academic performance.

CONCLUSION

This study has so far proved that social media has positive role in the day to day lives of university students. The study was aimed at accessing the use of social media by students of National Open University of Nigeria with focus on Abeokuta study centre. Thus, the role of social media cannot be over emphasized, because it is a medium that readily connects with university students in all ramifications.

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KEY TERMS AND DEFINITIONS

E-Book: It is a like a web page providing the reader with additional features that enable fast navigation through hyper linking, annotation and keyword searches supporting multiple reader's journey through the content.

Network: It is what connects several people together through social media. It is a group of two or more devices that can communicate. It comprises of a number of different computer systems connected by physical and/or wireless connections.

Social Media: It is web and mobile based technologies used to turn communication into interactive dialogue between two or more people. Examples are Instagram, Whatsapp, Twitter, Facebook, etc.

Chapter 20
Multimedia-Enabled Dot Codes as Communication Aids

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ABSTRACT

Grid Onput is a set of novel two-dimensional codes comprising extremely small dots. The present authors recently developed software to overlap the dot codes on the user's designed sheet, to create a content to replay audios, to create a standalone application to replay multimedia, and to create an application to replay multimedia on iPad. Simply touching the dot codes with a speaking-pen and/or a dot-code reader enables users to directly access the corresponding digital information; a maximum of four mediums can be easily linked to each dot code icon. In collaboration with schoolteachers all over the world, one of the authors, Shigeru Ikuta, has been creating a variety of original self-made content and conducting various activities at both general and special needs schools. This chapter outlines the recent development of the state-of-the-art Grid Onput dot code technology and presents basic information regarding the creation of original teaching materials using newly developed software and the use at both general and special needs schools.

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INTRODUCTION

There are many reasons why students may struggle in the classroom. As educators and parents look for ways to help children, they often find undiscovered learning disabilities that interfere with learning. These disabilities know no cultural or geographical boundaries. The identification of students with special needs may vary, but the overwhelming need for understanding best educational practices does not change.

A disability is defined as a condition or function judged to be significantly impaired relative to the usual standard of an individual or group. The term refers to individual functioning and includes physical impairment, sensory impairment, cognitive impairment, intellectual impairment, mental illness, and various types of chronic disease. It also includes learning disabilities, which are neurologically based processing problems that can interfere with learning basic skills such as reading, writing, and/or mathematics, as well as with higher-level skills such as organization, time planning, abstract reasoning, and long- or short-term memory and attention (Leaning Disabilities Association of America, 2019). Each student with Autism Spectrum Disorders (ASD) has some problematic core verbal and nonverbal communication symptoms, such as a delay in learning to talk or a complete lack of verbal ability (WebMD, 2019; National Institute of Mental Health, 2019).

The availability of computers and a concept keyboard specially adapted for Pictogram makes it possible for students with nonverbal communication to tell others their will and desires. This has led to Pictogram's use today as one of the main alternatives to the written word. These picture symbols provide children and adults who lack the ability to read and write in normal texts with a simple aid for their memories and thoughts, making it possible for them to keep diaries of what they have done and use their calendars to plan what they will do in the future (Dubé, 2019; Falck, 2019).

Each student with a disability has different hopes, needs, and desires, and a unique learning history. Each year, teachers at special-needs schools feel it deeply when a wonderful teaching aid and specific materials suitable for one student in the previous class do not fit a new student at all. Because each student with a disability may need individual self-made teaching aids and materials, a reasonable possibility might be easier-to-handle and cheaper software and tools that could provide the indispensable means for schoolteachers to create their own content for each student in their classes.

Widely used augmentative and alternative communication (AAC) technologies provide students with severe speech, language, and communication difficulties with opportunities to improve their communication and, by extension, their relationships with others. AAC systems utilize assistive technology (AT) devices that range from no-tech to high-tech (Beard, Carpenter, & Johnston, 2011; Beukelman, & Mirenda, 2012; Theng, 2011). Dell, Newton, and Petroff (2012) describe the practical use of such devices in a classroom. A widely used AAC tool, voice-output communication aids (VOCAs) or speech-generating devices (SGDs) (Communication Matters, 2017; Inclusive Design Research Center, 2017; Research Autism, 2017) utilize single-level or multilevel outputs to convey sounds. Although a variety of VOCAs cater to students with different abilities and needs, most devices are severely hampered by their low-output numbers and short lengths of recording time.

More than 14 years ago, in order to address these problems, Shigeru Ikuta, one of the authors of this chapter, started using Scan Talk dot codes, developed by Olympus Co. (1999) (Ikuta, Endo, Nemoto, Kaiami, & Ezoe, 2013). Such codes transform voices and sounds into two-dimensional dot codes directly outputted on ordinary paper. However, students with severe hand, finger, or mental challenges could not correctly trace fairly long Scan Talk codes using the Scan Talk Reader. Therefore, Ikuta used new dot codes (Grid Onput) that Gridmark Inc. (2004), the company of Masamichi Watanuki and Shinya Abe

(the coauthors of this chapter), had developed independently. Also, Ikuta conducted school activities with original self-made teaching materials overlaid with Grid Onput dot codes. In the authors' work, multimedia sources such as movies, Web pages, and PowerPoint files, in addition to voices and sounds, can be reproduced on PC and/or a tablet screen just by touching the "invisible" dot codes printed on the paper or symbol icons, using a speaking-pen and/or a dot-code reader. The authors have been developing several new software packages and handy tools to help users (especially schoolteachers) create original teaching materials and conduct invaluable activities at both special-needs and general schools.

This chapter outlines recent development of the state-of-the-art Grid Onput dot-code technology and presents basic information regarding the creation of original self-made teaching materials using newly developed software, and their use in both general and special-needs schools.

BACKGROUND

Outline of Grid Onput Dot Code Technology

In Japan, the Course of Study (noticed in 2008) required "Foreign Language Activities" in the fifth and sixth grades at all elementary schools. Although this newly required subject triggered additions to the market of many new packages of English textbooks, side-readers, and picture books with speaking-pens, many companies had already withdrawn from the market such side-readers packaged with speaking-pens. Indeed, such package contents were not widely used in either schools or homes. As a result, several large *juku* schools (private-tutoring schools) in Japan, such as Kumon Institute of Education Co. Ltd. (2015), Z-kai Inc. (2018), and Benesse Co. (2018), as well as institutes of foreign language, such as ECC (ECC Co., 2012), created only for their students their own original packaged side-readers (i.e., supplementary textbooks) with speaking-pens, by using the Grid Onput dot code.

Grid Onput (Gridmark, 2004) is a set of novel two-dimensional codes consisting of extremely small dots. Such dot codes can invisibly overlay any graphically printed letters, photos, and illustrations with no impact on the designed visual images, meaning that letters, photos, and illustrations on the images can be changed into information-trigger icons. A maximum of four voices and sounds can be linked to each icon, as well as other media, such as movies, pictures, and Web pages. Simply touching the dot codes printed on ordinary paper with a speaking-pen (e.g., G-Talk or G-Speak) or a dot-code reader (e.g., G-Pen Blue) enables users to directly access the corresponding digital information.

Printing document content that includes the "invisible" Grid Onput dot codes requires industry-standard cyan-magenta-yellow-black (CMYK) processes. More specifically, carbon ink that absorbs infrared rays is used only for dot-code printing, while noncarbon ink is used to print graphics. The speaking-pen and dot-code reader read the invisible dot codes using built-in infrared cameras.

Recently, the authors of this article developed four new software applications to overlap Grid Onput dot codes on the user's designed sheet (GM Authoring Tool), to create content for a speaking-pen to replay voices/sounds (Sound Linker) and multimedia, such as movies, pictures, and Web pages, using a standalone application on the desktop of a Microsoft Windows PC and/or tablet (File Linker), and create an application to replay multimedia on iOS devices like iPad and iPhone (GCV). The authors also developed a new dot-code reader with Bluetooth functionality (i.e., G-Pen Blue and G-Pen BT)—users do not need to connect these dot-code readers to their PC or tablet any more.

Ikuta organized a fairly large research project in collaboration with more than 200 schoolteachers all over the world and made original sheets in A4 and B5 sizes (called Magical sheet) with "Post-It" sticker icons, overlaid with dot codes beforehand. He forwards these Magical sheets, handy tools such as a speaking-pen and dot-code reader, and software to the participating schoolteachers for free, and promotes their making original teaching materials and conducting school activities in their classes.

FOCUS OF THE ARTICLE

Each and every student has individual hopes, needs, and desires, as well as a history of learning. Therefore, schoolteachers ideally should develop original independent content suitable for each individual student. Given the challenges of doing so, easy-to-handle and less-costly software and hardware solutions are crucial to schoolteachers for creating original content for students in their class (Ikuta, 2018; Ikuta et al., 2013; Ikuta et al., 2015; Ikuta et al., 2017; Ikuta et al., 2019, Ishitobi et al., 2019).

Ikuta's research project has 200 schoolteachers all over the world helping students, especially those with various disabilities. Several companies still put a speaking-pen on the market, but almost none distribute the software that can create original contents for users. Only a few companies distribute software to users, but the license fees are so costly that no schoolteacher can afford the contract. Only Masamichi Watanuki's and Shinya Abe's (the other two authors of this chapter) company, Gridmark Inc., now kindly provides Ikuta and his research project with free software. One of the two types of specially designed sheets that Ikuta designed (*Magical sheets*), with "Post-It" sticker icons overlaid with Grid Onput dot codes beforehand, is illustrated in Figure 1. The icons on the sheet can be taken off and pasted on any real items. In addition to speaking-pens and self-made sheets with Post-It sticker icons, Ikuta provides the schoolteachers, free of charge, valuable software created by the authors, for making original self-made content and conducting fruitful school activities. With Ikuta's help, many collaborative teachers have created self-made contents for nonverbal students—for example, by the use of various type of Pictograms for communicating needs and desires to others (Ikuta et al., 2019, Ishitobi et al., 2019). The Post-it-like sticker icon overlaid with dot codes was pasted on each Pictogram card and/or the Grid Onput dot codes were overlaid on each Pictogram card by the use of a specially designed software, GM Authoring Tool, described below.

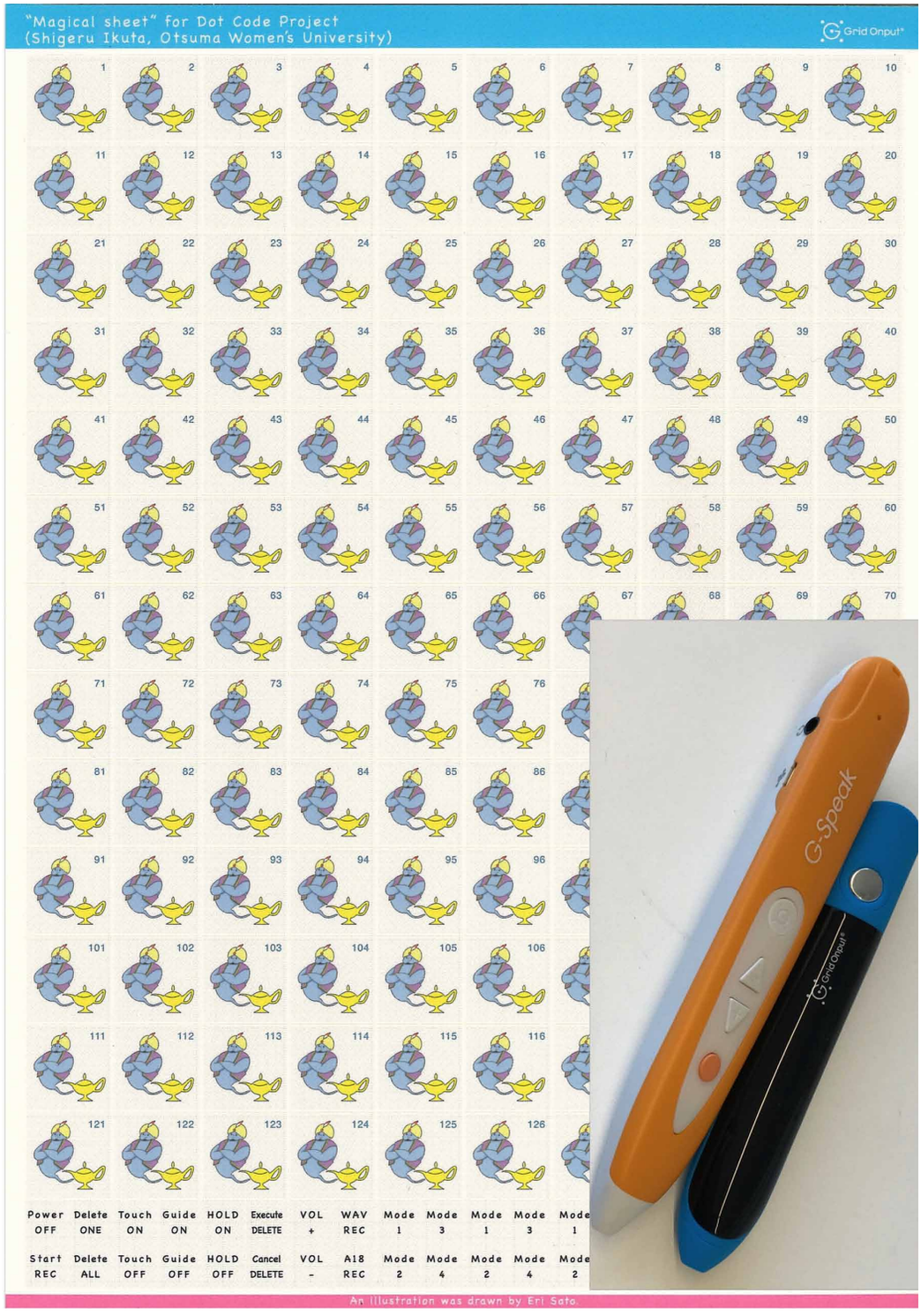
In this chapter, the authors outline the recent development of the state-of-the-art Grid Onput dot-code technology, and present basic information regarding the creation of original self-made materials using newly created software and hardware (dot-code readers) with Bluetooth functionality, and their use at both general and special-needs schools.

SOLUTIONS AND RECOMMENDATIONS

Original Self-Made Content and School Activities

Users can now easily link a maximum of four audio clips to each dot-code icon with the new software Sound Linker (Figure 2-a). In order to create original contents for a speaking-pen, they should proceed with the following steps:

Figure 1. Newly created Magical sheet with Post-It sticker icons overlaid with Grid Onput dot codes, a speaking-pen (G-Speak) and a dot-code reader (G-Pen Blue)



- Drag a maximum of four audios into Mode sections; for example, if users want to link two audios to icon 1, they should drag and drop the first audio to the Mode 1 section and drag and drop the second one to Mode 2.
- Increase the dot-code number (placed at the upper-right corner) to two and drag and drop the corresponding audios like in the above step.
- Repeat the above step as many times as they want.
- Push the "Output" button located at the lowest-right to obtain content for a speaking-pen and set a path directory where the content folder is saved; an "Output" folder including the content folder GMVRC is created.
- Copy the GMVRC folder in the "Output" folder onto a MicroSD card in a speaking-pen.

Since Ikuta distributes the Sound Linker software, Magical sheets with Post-It sticker icons, and speaking-pens to schoolteachers for free, they can now create original self-made content and conduct school activities in their class without buying anything. Touching the sticker icons pasted on the real item or just beside the illustrations and texts on the users' designed document causes a speaking-pen (G-Talk or G-Speak) to play back the original voices and sounds clearly.

A standalone application, an executable file that can reproduce multimedia, such as movies, with the same speaking-pen can now be created easily with the newly developed software File Linker (Figure 2-b). In order to create an original application, users should use the following procedure:

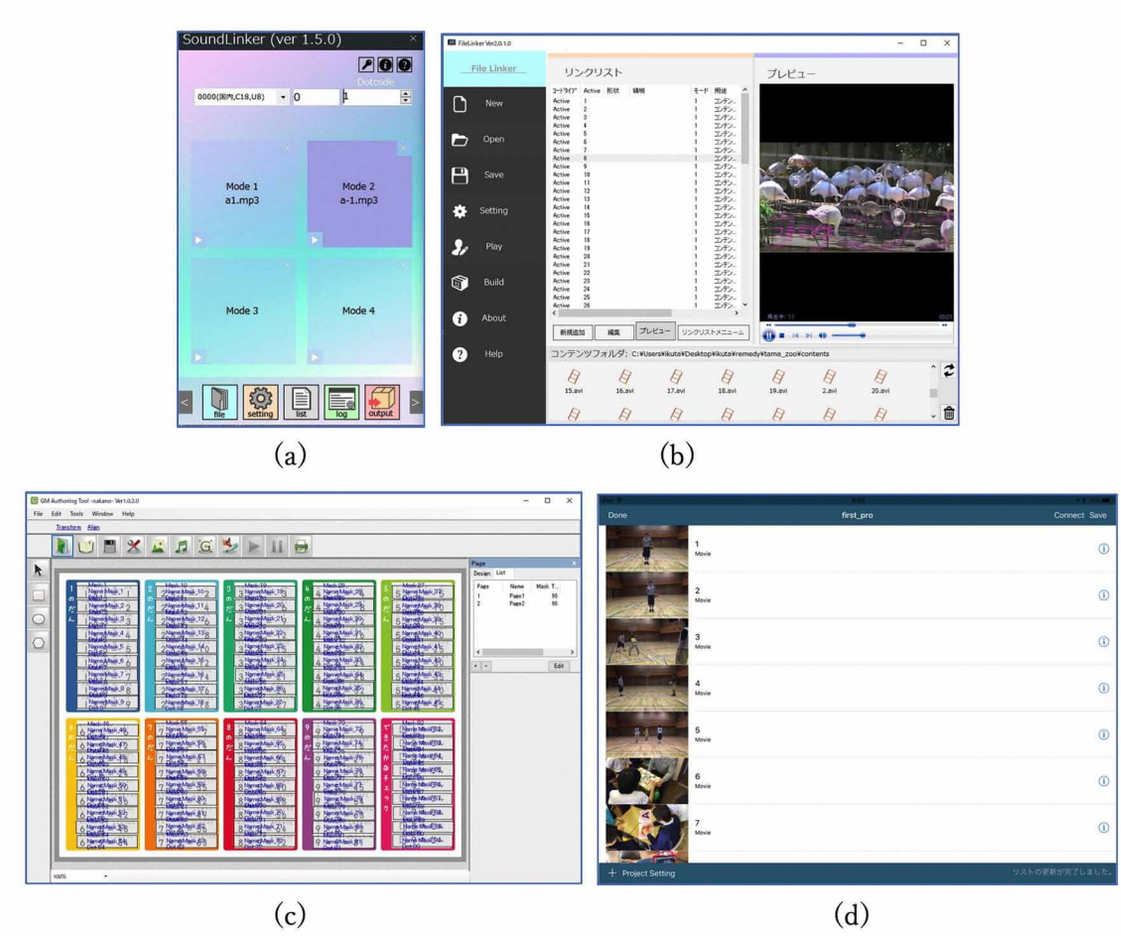
- Define a project name and set a path directory to save it.
- First drag and drop all the multimedia they want to link into "Content Folder."
- Connect the speaking-pen G-Speak with their Windows PC using a USB cable.
- Touch icon 1 with the speaking-pen and choose multimedia from the "Content Folder," then link the multimedia to icon 1.
- Repeat the above step as many times as desired to link (the next icon to be linked should be icon 2).
- After linking all the multimedia, push the "Build" button to get a standalone application to replay the multimedia on the desktop of the PC.
- Copy the created application into any Windows PC to replay the multimedia, if desired.

Users can now replay the multimedia by touching the Post-It sticker icons pasted on the real items with a speaking-pen G-Speak connected with the PC. Recently developed new dot-code reader G-Pen BT with Bluetooth functionality enables users to replay the linked multimedia without connection to their PC quite nicely.

With GM Authoring Tool, users can put the multimedia-enabled dot codes on their designed document at any place, in any size, and in any number the users might like. Figure 2-c provides a screenshot of the GM Authoring Tool; the multiplication table for second-grade students was created there. The procedure to overlap the dot codes consists of the following:

- Define a project name and set a path directory to save it.
- Import a designed document.
- Overlap dot codes on the document at any place, in any size, and in any number the users want.

Figure 2. (a) Sound Linker to create contents for a speaking-pen G-Speak, (b) File Linker to create a standalone application to replay multimedia on the desktop of Windows PC, (c) GM Authoring Tool to overlap the dot codes on the document, and (d) GCV to create content to replay the multimedia on iOS devices



- Add a new page, import a new designed sheet, and overlap dot codes again at any place, in any size, and in any number the users want.
- Repeat the above procedure as many times as users want.
- After completing the dot-code overlapping on all pages, users can output each document page as a PDF file with the dot codes.
- Print out the PDF file with dot codes by using Adobe Reader at 1200 dpi, where carbon ink that absorbs infrared rays is used only for dot-code printing, while noncarbon ink is used to print graphics.

The documents overlaid with dot codes by the software GM Authoring Tool can be used exactly like the Post-It sticker icons that Ikuta created; a maximum of four multimedia can be linked to each overlaid dot code. This software is not on the market, but users may ask Ikuta to try it.

The new in-development software program GCV easily creates content that can replay multimedia (such as movies, photos, audio files, and Web pages) on iOS devices like iPad and iPhone with a newly-released dot-code reader, G-Pen Blue, which is equipped with Bluetooth functionality. Figure 2-d shows a screenshot of GCV. The procedure to create content on iOS devices consists of the following steps:

- Recognize a G-Pen Blue dot-code reader (only on the users' first use).
- In editing mode, import a multimedia (e.g., movie or picture) from the library in iOS devices and/or input a URL address of a Web page.
- Touch a Post-It sticker icon with G-Pen Blue to link the multimedia.
- Repeat the two steps above as many times as users want.
- Save all the above procedures.

Just touching a Post-It sticker icon with the G-Pen Blue pen can replay the linked multimedia on an iPad or iPhone screen. This GCV software being available for iOS is invaluable, since almost all the schoolteachers now use iPads in their classrooms. This software has not yet been put on the market, but the users may ask Ikuta to try it; this software will be uploaded to Apple's App Store soon.

Schoolteachers create many self-made teaching materials and conduct school activities to help students with disabilities communicate with others and learn how to live in society. Further, these self-made contents are widely used to promote children's learning at general schools, nursery schools, and kindergartens. For example, a student of Otsuma Women's University, Honami Nakano, created a multiplication table (Figure 2-c) for second-grade students in collaboration with a teacher at Aiwa Elementary School, Tokyo. The content includes each multiplication from the 1-times table to the 9-times table and times table for each together with the corresponding song, placed at the lower right. Second-grade students are still using the multiplication table in both math lessons and breaks, to learn them by heart. They enjoy the content very much, since the voices were recorded by the ten-month-long volunteer student, Honami Nakao, and their teacher. Especially the original song together with each times table is very attractive to the students, since the songs sung by a homeroom teacher are very rhythmical, and the content helps the students recite the multiplications from 1 times 1 to 9 times 9 very nicely. This content is now used at several schools, including a special-needs school.

The teachers at Fuchu Keyakinomori Gakuen Tokyo Metropolitan School for The Physically Disabled and The Intellectually Disabled created a standalone application on iPad with GCV software. Just touching with the G-Pen Blue with Bluetooth functionality the Post-It sticker icon pasted on several animal-model figures reproduces the movies well on the iPad screen. This content was created for the school festival and exhibited for the attendees on that day. Many participants came as a big surprise and enjoyed touching animal-model figures with the G-Pen Blue pen to reproduce their movies. Similar contents created with the GCV software to learn the mat and basketball exercises, with the model performance videos by the schoolteachers, were used for senior-high-school students with light disabilities. The students could carry out their own performances nicely while checking the model ones with the iPad. On the same festival day, several school activities like morning and farewell meetings, social-skill learning, a manual paper-making, required Foreign Language Studies (mainly English), and others conducted on a daily basis by the schoolteachers for the students in their classes were also demonstrated (with movies) to the attendees, by using the corresponding GCV contents with the G-Pen Blue pen with Bluetooth functionality on the iPad screen.

Another content, *Let's Learn Tama Zoo*, was created by students of Otsuma Women's University for lower-grade students at elementary schools, and nursery and kindergarten students. The younger students located in the Tama region have a whole-day excursion to the Tama Zoo, Tokyo. Every guest visiting the Tama Zoo can get a zoo map at the main entrance; more than 60 animals' or birds' silhouettes are printed on the map. With the zoo map, the university students created a quiz for younger students to learn animals and birds at the Tama Zoo; they first put the dot codes over each silhouette with specially designed software, GM Authoring Tool, and two hints and the name of each animal or bird were linked to the corresponding silhouette. In the quiz activity, with a G-Speak pen, after the younger students listened to two hints like (1) the place where the animal or bird lives and (2) kind of foods the animal or bird eats, they must answer with the animal's or bird's name and confirm it with the G-Speak pen. Two hints and its answer for each animal or bird were described and recorded with university students' voices; the recorded voices were edited to delete noises and adjust the volume with audio-editing software, Audacity, and finally linked to the dot codes overlaid on the corresponding silhouette with specially designed software, Sound Linker. (Three audios, two hints and its answer, were linked to each animal's or bird's silhouette on the zoo map.) This quiz content was very much welcomed at both general and special needs schools, and nursery schools and kindergartens, and is still used in pre- and post-learning about characteristics of animals and birds and their living environments.

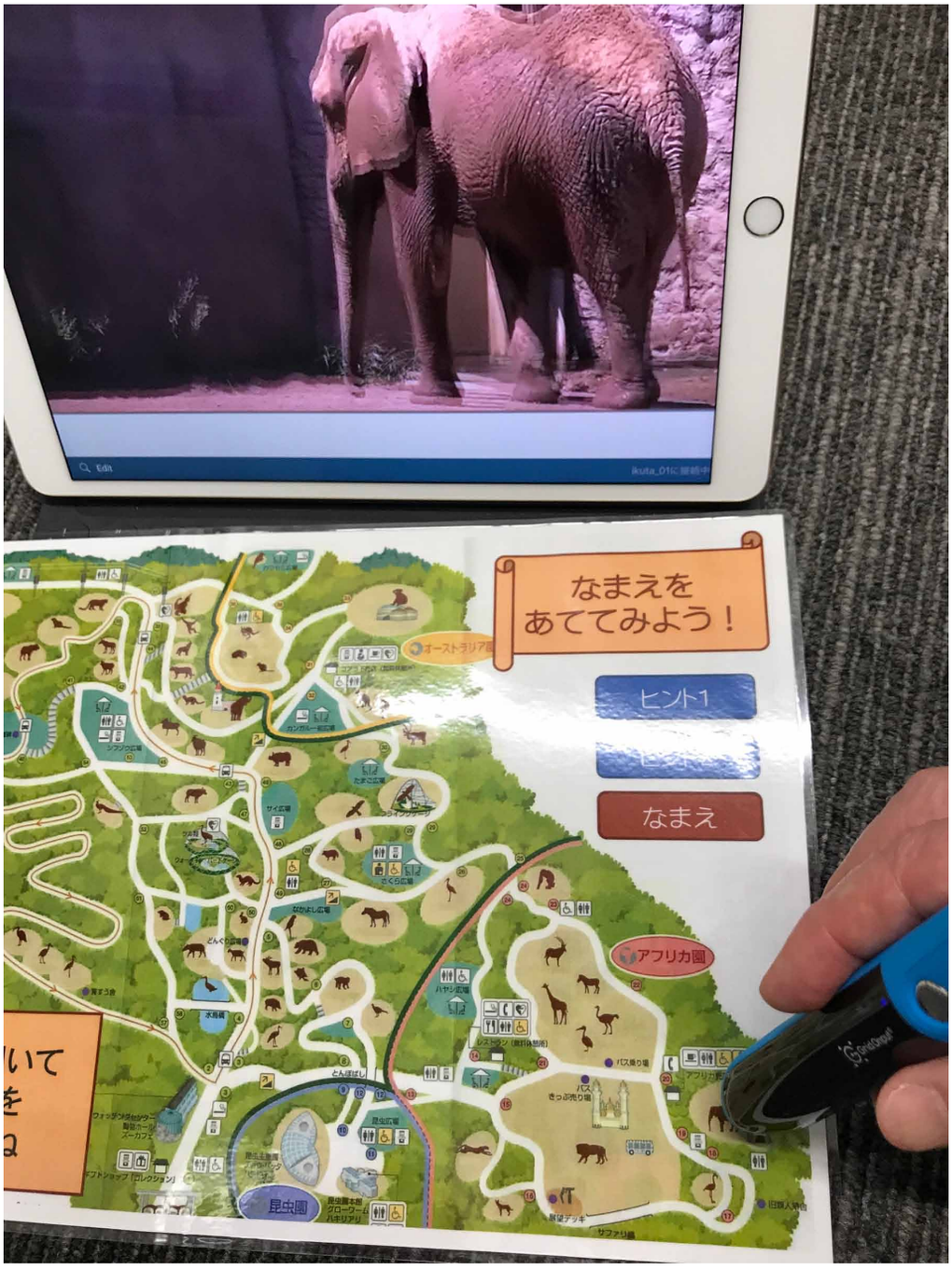
Three years later, other students of Otsuma Women's University upgraded the Tama Zoo content with newly developed software, GCV, and a dot-code reader G-Pen Blue with a Bluetooth functionality. They first went to the Tama Zoo to take video clips of all the animals and birds. Unfortunately, they had to visit there several times—taking videos of all the animals was not so easy, since each time, some of the animals were caged at the zoo. The university students edited the recorded video clips, and the title (each animal's or bird's name) was added. All the audio volumes were adjusted with movie editing software iMovie.

All the edited movies were moved into the internal memory of an iPad. With GCV on iOS, specially designed software, each video clip was linked to the corresponding dot codes overlaid on the animal or bird silhouette. Just touching the dot codes with a dot-code reader (G-Pen Blue) with Bluetooth functionality nicely reproduced the video clip linked to each animal or bird silhouette. Younger students can now learn about each animal's or bird's life at the Tama Zoo with movies. This new Tama Zoo content was used at the pre and post activities in the class by the younger students with great joy, using iOS devices like iPad and iPhone.

At the School for the Mentally Challenged at Otsuka, University of Tsukuba, the teachers placed sheets with Post-It sticker icons at the polling station of the student council chairman. Three students stood as candidates in the 2017 election. Each sticker icon was pasted just near each student's photo-sheet. The teachers (Ishitobi et al., 2019) first recorded the expressed determinations of the three students in their campaign speeches as movies and linked them to the corresponding sticker icon with the new software GCV. By just touching the Post-It sticker icon on the sheet with the new G-Pen Blue with Bluetooth functionality, their campaign speeches were reproduced nicely on their iPad screen; all the students could easily check each candidate' s campaign and vote accordingly.

These self-made contents and tools created with newly advanced technologies really help the students upgrade their learning and activities at school and at home, whether they have disabilities or not.

Figure 3. Self-made content of "Tama Zoo" and G-Pen Blue with Bluetooth functionality.



FUTURE RESEARCH DIRECTIONS

With the help of the staff of Gridmark Inc., Ikuta created original self-made contents with newly developed software and conducted many activities at both general and special-needs schools, in collaboration with schoolteachers not only in Japan, but also in the United States, the United Arab Emirates, China, Korea, Saudi Arabia, Myanmar, and Oman. Teachers often wish to create original materials for each student in their class; however, it is difficult for schoolteachers to obtain the funds to buy costly software and hardware to do so. Collaboration with university professors is crucial to start and then continue these activities. Even the less expensive tools that the authors presented in this chapter, such as G-Speak, G-Pen BT, and G-Pen Blue, for replaying audio clips and multimedia files like movies, cost approximately US$50 each; thus, schoolteachers cannot buy them easily. The software to create self-made contents, Sound Linker and File Linker, is now distributed for free, and users can ask Ikuta for opportunities to try them.

In collaboration with the research project organized with Ikuta, Gridmark Inc. is now developing new software, GM Authoring Tool and GCV. Some of the members of Ikuta's research project now use this software on a trial basis, and the authors are rushing to complete it. Gridmark, Inc. is also developing several pens with Bluetooth functionality, which users can use without connecting to their PCs and/or tablets. Schoolteachers are asking Gridmark Inc. to consider reducing the price of the speaking-pens (G-Speak and G-Talk) and the dot-code readers with Bluetooth functionality (G-Pen Blue and G-Pen BT), so that these hardware tools are more accessible to teachers.

During many school activities performed at general and special needs-schools, the authors noticed that the speaking-pen G-Speak requires some changes. The positions of the power and audio-volume buttons on the new speaking-pen G-Speak are located at the pen center, and students with disabilities and in lower grades often make errors. For this reason and on the basis of Ikuta's suggestions, Gridmark Inc. has already revised the design of the power on/off button.

The help of university students is also crucial for developing original self-made contents, since schoolteachers, especially in Japan, always have too much to do in their daily jobs. Collaboration with schoolteachers is very important and attractive for university students, especially those who wish to become teachers; these university students can learn much from current schoolteachers.

CONCLUSION

The authors have been developing several new software packages that can manage the dot-codes-handling multimedia (e.g., audios, movies, photos, and Web page). In collaboration with schoolteachers, one of the authors, Ikuta, has been creating a variety of original self-made content and conducting various activities at both general and special-needs schools. Ikuta has created specially designed sheets with "Post-It" symbol icons overlaid with dot codes, provided with speaking-pens and software to collaborating schoolteachers free of charge, so that they can create self-made content for students in their classrooms without purchasing anything.

The project asked schoolteachers to create original self-made content for students in their own classes, instead of purchasing teaching materials already on the market, since each student has his/her own needs, desires, and history of learning. Perfect teaching materials and tools for one student do not always perform well with other students. Schoolteachers require easy-to-handle and cheaper software and hardware if they are to proceed with these voluntary activities.

Support given by the Japan Society for the Promotion of Science (JSPS) and the Institute of Human Culture Studies, Otsuma Women's University, is also important for ensuring the continuation of larger collaborations with schoolteachers worldwide. The help of university students is also a strong motivation for schoolteachers who wish to develop individual content for each of their students. Collaborations with foreign schoolteachers in the United States, United Arab Emirates, China, Korea, Saudi Arabia, Myanmar, and Oman are also very important to extending and assessing present school activities performed in the classroom, with new information and communication technologies.

INSTITUTIONAL REVIEW

The study was approved by the Ethics Committee of Otsuma Women's University. Before the study, the schoolteachers received permission from their principals to conduct the current school-based activities. The study purpose and methods were explained orally, and informed consent was obtained from the students and their parents.

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KEY TERMS AND DEFINITIONS

Assistive Technology: Assistive technology (AT) devices range from no-tech to high-tech and help to properly assess the correct systems for students with various difficulties.

Communication Aid: Communication aids based on augmentative and alternative communication (AAC) technologies have been widely used to provide students with severe speech, language, and communication difficulties the opportunity to achieve successful communication and relationships with others.

Dot Code: Invisible dot codes developed by Gridmark Inc. are a novel two-dimensional code technology consisting of extremely small dots, which are practically imperceptible to the human eye. Each symbol icon can be linked to up to four audio clips. Multimedia such as movies can also be linked very simply to the same symbol icon with newly developed software. A simple touch by speaking-pen and dot-code reader pen on the symbol icon enables links between paper and digital content.

Dot-Code Reader: Dot-code readers, such as new G-Pen Blue with Bluetooth functionality, can read dot codes printed on paper and then play back multimedia (such as movies) on the screen of a tablet or personal computer without connection to it.

Magical Sheet: This specially designed sheet with Post-It sticker icons has the order for each dot code imprinted on each symbol icon. The sheet has additional symbol icons with audio-recording functionality, mode changing, and more. The icons can then be taken off and pasted onto a target object and touched with speaking-pen and dot-code reader. The "Magical sheet" enables the costly Grid Onput system to be used at any school at a low cost.

School Activity: School activities at both general and special-needs schools can be improved through the use of original and individual self-made teaching materials and aids suitable for each student, whether he/she has any kinds of difficulties.

Self-Made Content: Original self-made teaching content plays a key role in learning, as each student has different thoughts, feelings, needs, and desires. Independent teaching material should be prepared and used for each individual, especially in preschool and special-needs classrooms.

Speaking-Pen: Speaking-pens, such as G-Speak, reproduce original voices and sounds by simply touching the dot-coded symbol icons or the dot codes directly overlaid on the paper.

Chapter 21
An Overview of the Technological Options for Promoting Communication Skills of Children With Cerebral Palsy

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ABSTRACT

This chapter provides the reader with a selective overview of the empirical contributions available in literature on the use of assistive technology-based interventions for promoting communication skills of children with cerebral palsy. Four categories were selected regarding (1) microswitches and computers, (2) aided-alternative and augmentative communication devices, (3) eye tracking, and (4) robots. Overall, 18 studies were retained, and 47 participants were included. Results were largely positive although a few failures occurred. Clinical, psychological, and rehabilitative implications for research and practice were critically discussed.

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INTRODUCTION

Cerebral Palsy (CP) refers to a group of non permanent postural defects or movement abnormalities as a consequence of fetal problems and/or an immature brain. It is frequently described as one of the basic cause of extensive motor disabilities, closely linked to intellectual delays, sensorial impairments, perception disturbances, and associated with behavioral difficulties, epilepsy, seizures, or muscular alterations (Anaby et al., 2017).

A critical issue for children with CP is represented by their communication inabilities. Thus, due to lack of speech, tracheotomy, and both upper and lower limbs spasticity, children with CP may be unable to adequately and sufficiently communicate their needs to the outside environment (Perrin, Gnanasekaran, & Delahaye, 2012). Accordingly, they might be quite isolated and passive with negative outcomes on their quality of life (Stasolla & Perilli, 2015). To overcome this crucial matter, one may envisage the use of assistive technology-based rehabilitative interventions (AT) (De Pace & Stasolla, 2013).

1. BACKGROUND

AT defines any electronic tool, piece, equipment, or device aimed at promoting self-determination, independence, constructive engagement, and/or positive occupation of an individual with severe to profound multiple disabilities towards the social environment. Consequently, children's isolation and passivity on one side, and caregivers' burden on the other, should be relevantly prevented. Additionally, the quality of life should be improved (Weinstein, Lloyd, Finch, & Laszacs, 2018).

Based upon learning principles (i.e., causal association between behavioral responses and environmental consequences), a child with severe to profound developmental/multiple disabilities, and/or extensive motor impairments should be motivated to an adaptive responding, once exposed to an AT-based intervention, for getting the independent access to positive stimulation contingently to such responding. Thus, the AT-based program should mediate and fill the gap between the behavioral responses and the environmental events (LoPresti, Bodine, & Lewis, 2008). Among populations with developmental and intellectual disabilities, children with CP might greatly benefit of an AT-based strategy.

Microswitches (i.e., electronic tools aimed at providing brief periods of positive stimulation contingently to performing an adaptive responding, through a technological control system), aided-alternative and augmentative communication systems (AAC) (e.g., speech generating devices, computer-based interventions), eye tracking, and robots may be very useful for supporting a child with CP to profitably communicate his/her needs, and/or requesting/choosing desired items. For example, through a combined microswitch/computer-based program, a child with cerebral palsy may be enabled to independently access to preferred environmental events such as beverages, foods, and/or leisure activities. Else, with AAC aided-systems such as PECS (*Picture Exchange Communication System*) and VOCA (*Vocal Output Communication Aid*) a child with CP may choose between two different communication strategies.

Basically, two groups of users may be targeted for the aforementioned programs, namely (a) children with CP who present extensive motor disabilities and are considered within the normal range of the intellectual functioning, and (b) children with CP who have severe to profound intellectual disabilities and motor impairments. Irrespective of the adopted intervention strategy (i.e., see the options listed above), for the former group, one may envisage the access to the literacy process, while for the latter group the rehabilitative program may be aimed at promoting occupational activities and/or constructive engage-

ment (Collins & O'Mahony, 2015). As mentioned above, next to favorably enhancing the participants' active role and positive occupation, the rehabilitative programs may accordingly have beneficial effects on the participants' quality of life (Lancioni, Singh, O'Reilly, Oliva, & Basili, 2005).

The critical construct of quality of life is happiness, which includes fulfillment, pleasure, satisfaction, and well-being, not easily detectable among populations with severe to profound developmental disabilities. To tackle this issue, researchers refer to behavioral indices of happiness (e.g., energized body, arms, and legs movements with or without vocalizations) labeling them *indices of happiness* (Brown, Shalock, & Brown, 2009). Thus, an increased active role, independence, and self-determination should have positive outcomes on participants' quality of life and the indices of happiness should consequently increase (Stasolla & Perilli, 2015).

This chapter presents a selective overview of the empirical evidences available in the last decade (i.e., 2005-2018 time interval) on the use of AT-based programs for promoting communications skills of children with CP. Specifically, the contribution provides the reader with some illustrative examples of (a) microswitches alone or combined with a computer, (b) aided-AAC systems (e.g., PECS and VOCA or SGD), (c) eye tracking, and (d) robots. For each category, the chapter emphasizes a selection of studies, and underlines strengths and weaknesses. Social validation assessments (i.e., standard procedures aimed at formally endorse the intervention strategies by external experts), and indices of happiness as sign of positive mood, whenever available, will be discussed. Finally, some useful guidelines for future research and practice, within the specific framework, will be outlined.

2. METHOD

A computerized search in Scopus (i.e., the largest abstract and citation database of peer-reviewed literature) was performed. Cerebral palsy, assistive technology, communication skills, developmental and intellectual disabilities, motor impairments, quality of life, indices of happiness, social validation, eye tracking, robots, and alternative and augmentative communication were used as keywords. Additionally, a manual search was carried out as completion. Four main categories were selected, namely (a) microswitches-based interventions, (b) AAC-based programs, (c) eye tracking strategies, and (d) the use of robots. The eligibility criteria were (a) at least a child with CP (i.e., 3-19 years old as age range interval) involved as participant, (b) an AT-based empirical intervention, and (c) communication skills as targeted behavior (i.e., dependent variable). Overall, 18 studies were reviewed and 47 participants were recruited. For practical reasons, a study was concisely described for each categorized group.

3. MICROSWITCHES AND COMPUTERS

Microswitches alone and combined with computers have been adopted for (a) enabling children with CP and severe to profound intellectual disabilities to choosing among pleasant stimuli, (b) promoting an adaptive responding and simultaneously reducing a challenging behavior, using a cluster technology (c) helping children with extensive motor impairments to perform an adaptive responding, using them as a supplement, (d) promoting the child's independent access to either personal needs or academic and leisure activities, and (e) fostering ambulation and/or locomotion fluency (Stasolla et al., 2019). Overall,

three studies were reviewed in this section with 14 participants involved (Lancioni, Antonucci, et al., 2007; Lancioni, Singh, et al., 2007; Stasolla et al., 2019).

For instance, Stasolla et al. (2019) recently exposed 10 children with CP and different levels of both intellectual and motor functioning to an intensive microswitch-based program aimed at (a) enhancing academic performance, (b) ensuring leisure activities, (c) getting the independent access to literacy process, and (d) supporting ambulation responses. Three studies were assessed. Study I involved 5 children with CP, who were estimated between the mild and the moderate range of intellectual disabilities, presented lack of speech, basic forms of initial ambulation responses, and extensive motor impairments (i.e., they were unable to correctly manage neither a traditional mouse nor a pencil). Their ages ranged between 7.5 and 9.6 years old. The technological system, which included a circular pressure sensor (i.e., a microswitch), optic sensors (i.e., photocells), and a laptop with an adaptive software, allowed the participants to (a) autonomously accessing to a request and choice process among desired items (i.e., to be selected between personal needs and/or academic activities), (b) independently improving their locomotion fluency (i.e., four forward steps to be performed between 3 sec time interval), (c) increasing their positive participation. Study II, which included a similar technology, involved 5 new participants with CP who were aged between 7.8 and 10.5, and who were estimated between the normal range of intellectual functioning. However, they presented severe to profound motor impairments. The technology enabled the participants to (a) access to the literacy process, (b) make single ambulation responses (rather than locomotion fluency), and (c) positively participate to both proposed activities. Study III recruited 60 external experts, equally divided in three groups (i.e., parents, physiotherapists, and teachers), for a social validation assessment. Results evidenced an increased performance for all the targeted behaviors. Participants consolidated and generalized the learning process during both 6 month follow-up and generalization phases. Social raters favorably endorsed the use of such technology for promoting self-determination and constructive engagement of children with CP.

4. AAC PROGRAMS

The aided-AAC intervention strategies are finalized to ensuring the communication skills of children with CP. Regardless if equipped with a low-technology system (e.g., PECS), a middle technological system (e.g., VOCA or SGD), or a high technology system (e.g., tablet or IPAD), a participant with CP will have the opportunity to communicate and receive his preferred environmental events (e.g., 7-10 sec of positive stimulation) by selecting manually a pictogram (i.e., PECS), or a sensitive area through a touch screen (i.e., tablet). Different option may be included in the technological system, depending on both economical and human resources, and based upon both residual intellectual and motor participant's functioning. Overall, 8 studies were retained in this section with 8 participants involved (Adams & Cook, 2014a, 2016, 2017; Clarke &Wilkinson, 2008; Hynan, Goldbart, & Murray, 2015; Mathisen, Arthur-Kelly, Kidd, & Nissen, 2009; Noren, Svensson, & Telford, 2013; van der Meer et al., 2014).

For example, van der Meer et al. (2014) described the case of a 10-year old boy with CP and autism who learned the use of an IPOD-based SGD. The technological system was compared to both PECS and manual signs for assessing his functional communication (i.e., requesting items). The child showed difficulties in using the latter traditional strategies (i.e., PECS and manual signs) for spontaneous and socially oriented communication functions. His incapacity reflected the social communication delays typically observed in individuals with autism. Furthermore, the traditional programs did not allow for

the development of more sophisticated and advanced communication skills. Results showed a significant increasing of the participant's spontaneous requesting once the IPOD was implemented. A preference check phase revealed that the child favorably selected the technological system once presented alternatively to both aforementioned traditional forms of communication. Thus, opportunities for social interactions and spontaneous communication were created using highly motivated and rewarded activities through behavioral interventions.

5. EYE TRACKING

Eye tracking technology (ETT) represent a class of device for assessing and measuring eye positions (i.e., where eyes are focused) and eye movement. Three basic modalities or types of ETT may be considered, namely (a) eye-attached tracking (i.e., a special contact lens), (b) optical tracking, without contact to the eye, and (c) electric potential measurement, using electrodes placed around the eye.

The first modality relies on a device attached to the eye (e.g., special lens with an embedded mirror or a magnetic field sensor). The movement of the attachment does not slip significantly as the eye rotates. So, this method allows to record horizontal, vertical, and torsion directions of the eye. The second modality is based on non-contact optical strategy for measuring eye movement. Typically, the eye reflects an infrared light that is captured by a video camera or some specific optic sensor. The information extracted by the technology are the changes in reflections, indicative of eye rotation. Both corneal reflection and the center of the pupil are normally used as features to track. The third modality uses electric potentials measured with electrodes placed around the eyes, that create an electric potential field. It is generated by a dipole with its positive pole at the cornea and its negative pole at the retina. The electric signal can be measured by using two pairs of contact electrodes placed on the skin around the eye (i.e., Electrooculogram, EOG). If the eye moves from the center to the periphery, the retina approaches one electrode and the cornea the opposite one. The change in the orientation of the dipole and the electric potential field reflects in a change of the measured EOG signal. By analyzing these changes in eye, movements can be tracked. Two distinct movements (i.e., horizontal and vertical) can be identified. Finally, EOG may be considered a robust technique for measuring eye saccades closely linked with gaze shifts and can be capable of detecting eye blinks. Overall, 3 studies were reviewed with 12 participants involved (Clarke, Loganathan, & Swettenham, 2012; Federici et al., 2015; Machado et al., 2013).

An illustrative example is represented by Clarke et al. (2012) who carried out a pilot study for assessing true and false beliefs (i.e., theory of mind abilities) of 4 children with CP through anticipatory gaze behaviors. The participants were aged between 4 and 5 years old, presented quadriplegic CP, had a limited use of speech, and were assessed between the third and the fourth level of the Gross Motor Function Classification System. The crucial aim of the study was to evaluate the effectiveness of a new action anticipation task (i.e., the children were requested to anticipate the outcomes of different presented scenarios as true and false belief) through gaze oriented, measured using a webcam (i.e., second option of the three modalities described above) mounted on the monitor fixed in front of the participants and an adaptive software. All children consistently demonstrated an anticipatory gaze behavior which indicated their awareness of discriminating false and true beliefs.

6. ROBOTS

Robots may represent a valid alternative for rehabilitative purposes of children with CP. Robotic assistive technology may be very helpful for demonstrating how to execute requested exercises, provides an attractive to children, and should be able to communicate with participants and caregivers. A critically beneficial outcome of robots is to support the therapist to profitably carry out specific activities. Additionally, the literature corroborates the hypothesis of an affective engagement (i.e., empathy) between the child, the therapist and the robot. Rehabilitation for children with CP emphasizes the effectiveness, feasibility, and suitability of robots for promoting adaptive behaviors. A favorable way to manage the triad robot, child, and therapist is to combine working sessions with play. Researchers outline the relevance of involving the child in performing actions that enhance the rehabilitative process. The empirical evidence available up to date underline that the *Social Assistive Robotics* positively increase social interactions between the child, the robot, and the caregiver. Motivation and communication of children with CP significantly improve once the robot is introduced. Robotic toys have been favorably implemented for promoting constructive engagement of children with CP in imitation based play. Overall, 4 studies were included in this section with 13 participants involved (Adams & Cook, 2013, 2014b; Encarnacao et al., 2017; Ferm, Claesson, Ottesjo, & Ericsson, 2015).

A representative example is provided by Adams and Cook (2013) who involved a 12 year old student with cerebral palsy in programming robots in the classroom by using her SGD. The rehabilitative objective of the study was to assess the effectiveness of adopting a two-switch scanning mode on the SGD for programming robot. The participant tested classmates' robot programs, following infrared on her SGD, and she accessed the programming software via a customized manipulation page. Her positive participation to the academic activities was measured with *Goal Attainment Scaling*, descriptive observations, and measure of effectiveness and efficiency. Results demonstrated that the participant actively progressed from observing classmates to autonomously testing robots programs in the classroom. In fact she wrote a simple program with support during individualized sessions.

7. DISCUSSION, SOLUTIONS, AND RECOMMENDATIONS

Data of the reviewed studies confirmed the effectiveness, the feasibility, and the suitability of AT-based interventions for promoting communication skills of children with CP and severe to profound developmental disabilities. Once exposed to the aforementioned programs, children with CP significantly increased their communication capacities and their adaptive responding with beneficial outcome on their indices of happiness, and/or positive participation. The participants were constructively engaged, positively occupied, and played an active role towards their environment, with positive effects on their quality of life. The participants consolidated the learning process during follow-up, maintenance, and/or generalization phases. The use of the technology was favorably assessed by participants involved (i.e., during preference check phases), and/or external experts who positively rated it once recruited for social validation assessments. The findings were widely supported by previous contributions (Davies, Mudge, Ameratunga, & Stott, 2010; Stasolla, Perilli, & Boccasini, 2018) and suggested the following considerations.

First, AT-based strategies may be considered great educational and rehabilitative resources for helping the independence and self-determination of children with CP and developmental disabilities. Thus,

participants with CP will be able to autonomously (a) communicate their needs, request and choose desired items, (b) access to leisure, academic, and occupational activities. Depending on both economical, human resources, and rehabilitative goals, one could use microswitches, aided-AAC devices, eye tracking, or robots for enhancing mastering and self-management by the participants involved. Accordingly, their active role, social image, and status were relevantly increased with positive outcomes on their quality of life (Brown et al., 2009).

Second, in light of the above, one may argue that caregivers' burden was significantly reduced. Since the participants empowered their independent adaptive responding, parents and caregivers relevantly decreased their assistance towards children with CP with beneficial effects in daily life contexts. Thus, the inclusion of participants with CP in home, school, and/or medical settings was undoubtedly fostered. Consequently, families, teachers, therapists, and practitioners may find AT as a valid and useful way for educational and rehabilitative goals (Nicolson, Moir, & Millsteed, 2012).

Third, data demonstrated that the participants consolidated their learning during post-intervention checks, follow-up, maintenance, and/or generalization phases. That is, even if the intervention was suspended and a rest time interval occurred, children with CP profitably learned the use of AT-based equipments or devices. One may argue that an intensive and regular AT program may be viewed as a clear strength point for child's learning (Catania, 2012).

Fourth, the participants enjoyed the sessions. That is, during the intervention phases the intervals with positive participation and/or happiness significantly increased, closely linked to the participants' performances. The participants' amount of pleasure, fulfillment, and satisfaction was relevantly promoted. One may argue that the improvement of their quality of life is a consequence of their active role, positive occupation, and constructive engagement (Dillon & Carr, 2007).

Fifth, expert external raters favorably considered and formally endorsed the use of AT-based interventions once involved in the social validation assessments. Even if unfamiliar with either the specific rehabilitative programs or the recruited participants, the social raters confirmed the clinical validity of the adopted strategy and corroborated its use for helping individuals with CP and developmental disabilities in daily life settings (Caffò et al., 2014; Perilli et al., 2013a, b).

8. CONCLUSION

The reviewed studies identified four basic categories of AT for children with CP and developmental disabilities. Despite the findings of the contributions were widely positive, caution is mandatory for their interpretation. In fact, questions arose about (a) some of the measures adopted to determine the outcomes of the intervention, and (b) the lack of relevance attributed to the participants' preference checks. Given both criticisms, the extension of research may be warranted. Moreover, it is critical to examine the selected studies in terms of (a) size, (i.e., the quantitative importance of behavior modification observed) and (b) credibility/reliability depending on the methodological conditions of the adopted strategies (Barlow, Nock, & Hersen, 2009; Kennedy, 2005).

With regard to the first point, some studies reported significant modifications in the participants' behavior, measured through groups comparisons, other studies reported modifications only related to behavioral ratings, expressed by professionals or other representative figures involved in the intervention, and/or presented partial, inconclusive or mixed statistical evidence on formal measures. The outcomes of the studies using single-subject designs could be taken as more solid and reliable, because

these designs allow for control over the time (history) variable (Barlow et al., 2009; Kennedy, 2005). Quantitative significance and credibility are the two important criteria on which evaluating the results. A supplementary criterion could be the practical and clinical relevance of changes observed in terms of participants' constructive engagement and interaction involvement. With regard to this criterion, it might be stated that not all the studies code this variable, but it is becoming more frequent.

9. FUTURE RESEARCH

In light of above, future research perspectives should be primarily focused on the following topics. The first may be related to the extension of AT for other children with developmental disabilities (e.g., autism spectrum disorders and rare genetic syndromes). This attempt should analyze (a) the literature on the use of AT-based approach in other rehabilitation fields; (b) the ethical considerations related to the participants' legal representatives right to decide on the use of such approach; and (c) the need for methodological sophistication. Furthermore, rehabilitative interventions through an AT-based program should consider the individual's involvement in the decision making and the positive interaction with the outside world (Lancioni & Singh, 2014).

A further extension may relate to the technologies. One may design new technological options responding to participants' characteristics on the one hand, and to contexts' resources on the other. With respect to participants' characteristics, one may consider new technologies that ensure that participants can interact constructively with minimal effort. With respect to the second point, one should consider the financial resources available to families and to rehabilitative centers (Lancioni, Sigafoos, O'Reilly, & Sigafoos, 2012).

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KEY TERMS AND DEFINITIONS

Alternative and Augmentative Communication: Different methods for helping people with disabilities to communicate with others.

Assistive Technology: Umbrella term including any technological device, tool, or equipment aimed at improving self-determination of individuals with developmental disabilities.

Cerebral Palsy: Neurological disorder caused by a non-progressive brain injury or malformation occurring during brain's development.

Quality of Life: Complex construct including personal well-being, pleasure, fulfillment, and satisfaction.

Self-Determination: Process by which a person controls his/her own life playing an active role towards his/her environment.

Section 3

Knowledge Sharing, Collaboration, and Professional Development

Chapter 22
Designing Schools as Learning Centers

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ABSTRACT

There are several variables that need to be considered when rethinking education delivery for the 21st century. Designing schools as learning centers is more than just about restructuring the physical space of schools. Effective education leadership and administration must successfully align several often-competing goals. These goals include guiding a human-centered organization, consisting primarily of young, evolving learners while continually managing knowledge and information delivery and balancing the needs of students and teachers with the education policy requirements set by federal and state legislation and subsequently interpreted by school districts. This chapter explores the 'rethinking education delivery' theme through several topics such as learner's comfort levels, teacher- training and professional development, and school district leadership. A case study looks at a six-year research project focused on the effect of district and school leadership styles on teaching and learning.

INTRODUCTION

There are many variables which need to be considered when rethinking education delivery for the 21st century. Goldberg, in 1991, documented the role of environmental variables in motivating and assessing improved student performance. "This position is not a new or revolutionary claim, but a message that seems to need to be repeated because (schools) seem to just keep constructing buildings that merely reinforce an obsolete paradigm that will not prepare students for real world challenges. (Nair, 2011). However, designing schools as learning centers is more than just about restructuring the physical space of schools (Ripple, 2014; Nair, 2011; Rosenblum, S & Spark, B, 2002; Sabo, 1998; Goldberg, 1991; Chan, 1981).

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Reevaluating education delivery will incorporate a range of topics as:

- **Learner's comfort level**- physically, mentally, and emotionally
- **Teacher-training courses** in colleges and universities (C/U)
- Teacher and school counselor **professional development**
- School district **administration's attitudes** towards delivery
- School **auxiliary personnel** understanding of the importance of their roles
- **Community** support and buy-in

Instead of centering focus on the actual purpose of education, the learner and learning, states and school districts seem to be fixed on the idea of learning requiring following a fixed pattern of education delivery, which occurs only in particular spaces and is delivered in a specific way. These are outmoded ideas of the industrial revolution. Spaces that allow for personalization, collaborative learning, self-directed learning, are environmentally conscious and connected to the broader community surrounding the school will be the schools of the future (Nair, 2011).

This chapter, focused on the educational system in the United States of America, considers how the educational process in America might be reconstructed to ensure the minds, hearts and bodies of learners are involved, and engaged, in the process of learning. According to David Gamberg, the superintendent of both the Southold Union Free School District and the Greenport Union Free School District, on Long Island, N.Y., school districts must do more than 'efficiently manage the system or pits stakeholders against one another' (Gamberg, 2012). Teachers must be effectively trained and supported in the classroom.

In response to an editorial, *What Defines a Good School?* (Gamberg, 2016), a teacher posted this comment: 'we definitely need to watch our words and avoid infusing a "standardization" in the definition of "what makes a good school" for it is the students who ultimately define their school, not the adults who often strive to classify and define the culture and components' to the detriment of the learners'. Following this student leadership theme, Chiquita Hall, an ISTE Student Technology Leadership Symposium member states, 'I've been a student for almost thirteen years, and never did anyone ask me how I wanted a school to be.' -- (Armstrong, 2002).

This chapter will describe how, in the American K through 14 education system, effective leadership and administration successfully aligns several often-competing goals (Leithwood, K., Seashore Louis, K., Anderson, S. & Wahlstrom, K, 2004). These goals include:

- Guiding a human-centered organization, consisting primarily of young, evolving learners while
- Continually managing knowledge and information delivery and also
- Balancing the needs of students with the education policy requirements set by federal and state legislation

Partnerships created for restructuring school institutions and their classrooms while reshaping teaching and learning initiatives in the classroom are examined below. These partnerships will include deliver supportive tools and practices, including needs assessments and community input while being guided by evidence-based redesign projects already in place.

Topics explored and discussed include

- Why the need for re-thinking education delivery in America?

- Re-shaping the learning landscape,
- STEM is not enough
- Career readiness
- Teacher Professional development
- Evaluation of teachers seen as a 'whole organization' issue

The Focus of the chapter asks the question: what does re-thinking education mean at the school leadership level? A joint research study from the University of Toronto's Ontario Institute for Studies in Education, the University of Minnesota's Centre for Applied Research and Educational Improvement and the Wallace Foundation, conducted a multi-year study on the importance of school leadership in improving student learning. With the purpose of identifying and exploring district and school leadership styles necessary for improving student learning, the study, *Investigating the Links to Improved Student Learning,* examined supplementary contributors to effective school leadership practices at the school, community, and district level.

A significant feature of this study is the sizeable data base which incorporated 9 states, 43 school districts and 180 elementary, middle, and secondary schools.

BACKGROUND

The current model of education. Bailey, Jaggers, and Jenkins ask the question, 'What is the current model of education in their research focused on community colleges. Synthesizing findings from research which began in 2009, the study by Community College's Research Center, was conducted with the goal of identifying ways of completing graduation rates. 'Improving developmental education, instruction, student supports, and the overall student experience is necessary but not sufficient; targeted reforms must be implemented as part of a broader institutional restructuring (Bailey et al 2015a).

While Bailey, Jaggers and Jenkins' research was focused on community colleges, the following figure is adapted by this author for use with the K-12 school system. Describing a set of research-based design principles and strategies to help achieve the goal of reorganization (Bailey et al., 2015b, p. 2), Table 1 shows a comparison between what the authors call the 'self-service cafeteria style of education or a guided pathway to success'.

Why rethinking education delivery?

Table 1. Education Delivery Comparison

Mandated Style or Self-service cafeteria style	Engaged Pathways or Guided Pathways
Checking off state and federal mandates	Building up to clearly-defined learning outcomes
Competencies are defined on the course-level	Students build skills across curriculum
Assessment used to sort students	Assessment used to diagnose areas needing support
Pre-requisite courses cover general content	Basic skills are integrated and contextualized
Students receive limited feedback on their progress	Proactive progress feedback and support

By 2018, if today's college graduation rates hold as steady as they have for decades, the U.S. will be short at least 3 million college-educated workers for the projected 101 million jobs that will require a degree. We must give our teachers and students the breakthrough tools they need so that the next generation of Americans will be better prepared to take advantage of those jobs and contribute to a stronger economy (Childress, 2012).

The question of why it is necessary to rethink education delivery is currently a predominant focus for with all K-12 stakeholders: learners, teachers, school administrations, district school offices, parents, colleges and universities, businesses, and neighborhood communities Us Dept of Ed, 2018; Unwin & Yandell, 2016; Collins and Halverson, 2009). Through the exploration and outlining of the characteristics of what learners, parents, teachers and others all think makes a good school, certain themes can be discovered. The Transforming Croydon Schools team, London, England sponsored a rethinking education delivery workshop for invested stakeholders in the Croydon School District The workshop focused on eight themes which the team suggested as defining a good school (Atkinson, 2010). Table 2 describes these eight themes.

Reshaping Our Learning Landscape

The longstanding operating models for higher ed and K-12 are both in a state of flux, and while demands for innovation probably won't create an all-new landscape, the resulting product of ongoing changes is likely to be unrecognizable compared to that of the last several decades (Liddell, 2015).

In 2015, the Organization for Economic Co-operation and Development (OECD) published its global education rankings. The report by the OECD was based on test scores in math and science from 15-year-olds in 76 nations. The U.S. placed 28th in math and science. Low standing in international rankings have been a chief concern leading to calls for innovation and reform in America's K-12 schools (Lidell).

STEM is not enough. David Gamberg, previously, a classroom teacher, an elementary school principal, and an assistant superintendent, is now the superintendent of both the Southold Union Free School District and the Greenport Union Free School District, on Long Island, N.Y. Regarding the call for 'college- and career-readiness, Gamberg states:

'The call to have children as young as 8 or 9 years old "college- and career-ready" does not create the same narrative as building a sound foundation in childhood filled with play and creativity. Among the many other more important ways to engage the hearts and minds of our youngest students, we must promote the childhood experience in all its wonder (Gamberg, 2016).'

Despite the additional critical thinking components accounted for with STEM, concerns regarding the need for an expanded focus to a more well-rounded education which includes the arts are prominent in most discussions on 21st education requirements (Davis McGaw, 2016 and 2019). It's an issue that some schools and districts have already addressed by expanding the STEM acronym to STEAM, emphasizing the connections as well between the arts and science and math. This move by school districts was directed by the myriad of companies who articulated requirements of hire workers who can think creatively, in addition to being technically skilled (Adecco, 2019; Cass, 2018; Castellon, 2019; Davis McGaw 2016 & 2019; Lynch, 2015).

In *Skills Gap: A Big Challenge for Employers,* Brenda Budke, executive director of Sierra HR Partners in Fresno, notes that in the January 2019 National Skills Gap Survey issued by Addeco, a global staffing

Table 2. Themes answering the question: What makes a good school

1. **Learning Experience**	Investigating how the learning experience might change to best meet the needs of learners which includes: • Establishing a personalized, adaptive learning experience • Creating collaborative, project based, enquiry and skills-based learning
2. Teaching Experience	Involves looking at how pedagogy and the teaching profession has changed: • Reviewing new models of leadership; • Revisiting teacher's role in the classroom, • Revisiting across the school • Researching collaborative practice.
3. Social Experience	Specifically, questioning the learner social experience in school: • the role of informal learning • the power of developing the social and emotional aspects of learning.
4. Dining Experience	**E**nquiring into the validity of: • regular, whole school lunchtimes
5. Professional Working	Explore the nature of working spaces for adults in schools: • Staff room, offices, meeting spaces are often poorly planned • Consider how space might support new ways of working, specifically collaborative work.
6. Extended Learning	Considerable thought has been given to how a school might offer a wider range of learning services: • During school hours and • Beyond the school day. As a resource, a • Schools have vast potential for acting as a hub for o Community learning and o Engaging local young people.
7. Accelerating Progress	Extensive conversation continues about • Challenges associated with assessment, o Formatively, in respect to the changing frequency and scale of examinations and o Formatively, in respect to assessment for learning. • Testing focused on o Ideas associated with ▪ peer mentoring and ▪ coaching.
8. Relationships and Partnerships	Because of the multi-disciplinary teams we have formed to transform our schools: • we are working more cooperatively o Some of these relationships are formal and have governance changes connected to them. • Others capitalize on o common areas of development and o strengths of schools.

company, the lack of 'soft' skills: communication, creativity, critical thinking and collaboration, was the biggest problem for employers in hiring skilled workers. The survey of more 500 senior business executives across the country, identified this skills gap in the American workforce as a major concern (Castellon, 2019). According to the study:

- 92 percent of business leaders don't think American workers are as skilled as they need to be.
- 44 percent of the executives surveyed said American workers lacking soft skills is their top concern,

Accountability for Career Readiness

It is also clear that our current strategies are not sufficient to ensure that, indeed, every child will be enabled to learn the higher-order skills that they need to acquire to succeed in today's world. The fuller array of deeper learning outcomes students need to acquire include the knowledge, skills, and dispositions needed to foster critical and creative thinking, problem solving, collaboration, multiple modes of communication, uses of new technologies, the capacity to learn to learn, and the social-emotional intelligence that fosters a growth mindset and supports resilience and resourcefulness. (Darling-Hammond, Wilhoilt, Pettinger, 2014)

The relevant measure of a high school's performance is not how many ninth-grade students receive diplomas four years later or even how many of them enroll in a college or university—especially in the era of open ad-missions at many universities. It is how many of their graduates earn a college degree or are working full-time six years later (Cass, 2018).

School-to-prison pipeline. Another significant problem which can to be addressed by school redesign is one which is a result of disciplinary actions that push many students into the juvenile justice system. The loss of class time these punitive measures cause contributes to too many learners dropping out of school, too often ending up in the criminal justice system.

Suspension Stories, a youth-led participatory action research project initiative is the result of a collaboration between the Rogers Park Young Women's Action Team (www.rogersparkywat.org) and Project NIA, notes on its website, 'Schools indirectly push students towards the criminal justice system by excluding them from school through suspension, expulsion, discouragement and high stakes testing requirements'.

Recent studies show suspensions have a disproportionate impact on minority and special education students (Cregor, M., Harper, 2017; Hewitt, D., 2017; Lidell, 2015; Balfanz, 2003).

Kristen Harper, a Senior Policy Specialist for Child Trends, a national research institute, states in her testimony before the United States Commission on Civil Rights:

During the 2013–2014 school year, six percent of all public-school children experienced at least one out-of-school suspension. This figure doubles (to 12 percent) among children with disabilities. Worse still, the figure doubles again, to approximately one-quarter of children, for black, Hispanic, multiracial, and American Indian/Alaskan Native boys with disabilities. Further, we know that exclusionary discipline practices are associated with poor academic outcomes. (2017).

The U.S. Department of Education Office for Civil Rights Disparities highlights in the publication, *Data Snapshot: School Discipline (2014)*, the disproportionately high suspension/expulsion rates for African American (AA) students. AA students are suspended and expelled at a rate three times greater than white students. On average, 5% of white students are suspended, compared to 16% of black students. Latino students are 1.5 times as likely to be suspended and twice as likely to be expelled as their white peers.

Re-thinking teacher professional development. School district leaders realize the need for more effective professional development (PD), however, the ability to fund PD programs may impede implementation (Gulamhussein, 2013). Nevertheless, research suggests restructuring of current spending may provide the funding needed for school districts to provide effective PD for teachers (Colorado Dept. of Education, 2019; Darling-Hammond et al., 2013; Gulamhussein, 2013; Sawchuk, 2010).

According to the National School Boards Association's Center for Public Education (CPE) report, *Teaching the Teachers: Effective Professional Development,* most professional development today is ineffective because it neither changes teaching practices nor improves student learning (2013). According to CPE.org, current research recommends that PD for teachers, to be effective, needs to be focused on content relevant to the subject the teacher teaches. Teachers don't find professional development on generic topics useful. When educators are responsible for taking an active role in selecting and constructing learning designs that facilitate their own and others' learning PD is more effective (learningforward.org; Illinois State Board of Education; nea.org)..

Shirnetha Stinson, an assistant principal at Clinton Elementary School in Lancaster, S.C., discusses the PD program at her school:

Previously 'a "spray-and-pray" model -- spray it out there and pray the teachers go back in the classroom and implement it -- to professional development on campus involving everyone in our school. Now, we purposefully plan and execute professional development. We have eliminated faculty meetings. If we meet, we meet for a learning purpose. …We have shifted our professional development to work more with one another.' (learningforward.org., date unknown)

Student voice in teacher professional development. The power of collaboration is one of the best ways to empower greater teacher effectiveness (Brooke, p.4) In a unique joint student-teacher professional-development session at Roosevelt High, participating students are central players. Pupils are helping shape the redesign of the school's mission and vision statement and its adoption of a less-punitive approach to behavioral infractions (Superville, 2019). Brent Wooters, a social studies teacher at Roosevelt says, 'We've got 20 million books out there on how to be the best teacher, but none of them were written by a 14-year-old. And that's what we miss out on in staff development."

Asantee, a 16-year-old junior offered suggestions to her business teacher on his résumé-writing lesson. Asantee collaborated with her business teacher on his plans for a résumé-writing lesson She advised shorter introductory remarks and a visual presentation of résumés examples other students had created. Asantee also recommended he walk around the class to seek out students who might need help but are reluctant to ask for it. Expressing surprise that the teacher would be open to her to her ideas, Asantee states, 'He seemed really interested in what I had to say about his lesson plan," she said, "and he was just real open to change' (Superville).

In their policy paper, *No Panacea: Diagnosing What Ails Teacher Professional Development Before Reaching for Remedies*, Tooley and Connally (2016) identified 4 predominant barriers to effective PD implementation. 'Even in the case of well-designed PD, these obstacles can impede the effectiveness of professional learning and hinder its impact on student learning and achievement. The challenges with implementing and scaling evidence-based practices underscore that translating promising PD research into practice remains one area ripe for improvement.' Table 3 describes improvement needed and barriers to change.

Teacher growth and development. In a research study conducted by Parlar, Cansoy, Kılınç (2017), a positive and significant relationship between administrator's support and teacher professionalism was found. 254 primary and secondary school teachers in the 2016-2017 academic year constituted the participants of the study. 'School administrator's support emphasizes the sharing of leadership, encouraging participation at school and providing teachers with opportunities for leadership roles (Demir, 2014 in

Table 3. Effective Teacher Professional Development with Identified Barriers

Areas of improvement opportunities	Barriers to successful change
1. Identifying PD needs	• Teacher PD is often determined without understanding what teachers need. • Lack of shared vision around what excellent teaching entails. • Preparation and training for principals and instructional leaders often fail to address how leaders identify and organize needs-based PD. • Without systems in place ensuring teachers' needs are being identified and met, PD will not be effective
2. Choosing effective approaches	• Strong consensus exists about the kind of professional learning opportunities likely to yield student achievement • Often PD is implemented that does not meet these standards. • "One-off" workshops are easily scheduled, require less time and human capital to implement than evidence-based approaches.
3. Implementing approaches with quality and fidelity	• PD needs more than designating coaches and having them available for teachers • Many other variables affect coaches' effectiveness, involving coach's expertise in the teachers' o grade span, o subject, o school context; o the depth of observation, feedback, and suggestions • The authority of a coach to recommend next steps; • Time and accountability for teachers to follow through with recommended next steps • Lack of an integrated, coherent approach to instruction
4. Assessing PD outcomes	Difficult to adopt and implement evidence-based professional learning addressesing potential obstacles due to: • Ineffective tracking of PD, • Ineffective system for analyzing the quality and impact of PD.

Parlar, Cansoy, Kilinc). The development of teacher professionalism is associated with teachers' attempts to bring student learning to a higher level at school (Parlar, Cansoy, Kilinc, p.20

Evaluation as organizational problem. Efforts to improve the technical quality of evaluation systems over the past two decades have not produced evidence of improved teaching and increased student achievement. Thus, newer thinking treats teacher evaluation as an organizational problem that includes improving school climate, having the principal become an instructional leader, and building links between school improvement, professional development, teacher evaluation and student learning (Marx, 2007)

Organizational change. The foundation of creating a strong and effective culture at school is based on compromising on common objectives, a confident vision and the carrying out of assigned tasks in a peaceful working environment and in harmony (Marzano, Waters and McNulty, 2005 in Parlar, Cansoy & Kulonic)). It can be said that school culture proceeds within the framework of the values, beliefs, and norms shared by teachers (Parlar, H., Cansoy, R., Cagatay Kulonic, A., 2017, p. 14).

A cultural change may be required to achieve a significant and sustainable improvement in the whole school environment. This may mean changes in assumptions, beliefs, values and habits (Demir, 2015, p. 623). Other organizational changes may be necessary for reasons which include enrollment increases or declines, facility conditions, or changes in a school's programming (www.philasd.org/greatschools/schoolorganizationalchanges/).

However, one of the most common obstacles to teacher effectiveness is constant organizational change. Far too often, schools change instructional methodologies and programs every few years. Teachers, to be effective, need time and the opportunity to master the instructional process (Walcott, 1994). A school's

assessment framework, data team process, and instructional routines all take time to understand, develop and adopt. (Brooke, 2017, page 7).

FOCUS OF THE CHAPTER

What does re-thinking education mean at the school leadership level? Batagiannis suggested a decade ago, that educational leaders are working in a society that seeks immediate and perfect solutions with the result being a tendency for "push-button" leadership that neither trusts nor respects educational judgment (2009). The Center for Comprehensive School Reform and Improvement, in *Role of Principal Leadership in Improving Student Achievement,* underscore the importance of 'direction setting' by effective principals. Effective principals know that 'an investment of time is required to develop a shared understanding of what the school should "look like" and what needs to be done to get it there. When teachers and other staff are included in identifying goals, they are more likely to be motivated to achieve acknowledged goals (2005).'

Business manager or instructional leaders. School leadership studies, those focused on principals and district leaders, have been redirected in the last decade, from administrative management towards instructional leadership, and from a focus on teaching to a focus on learning (Leithwood, Seashore, Anderson & Wahlstrom, 2010; Parsons & Beauchamp, 2012, p 700). Stronge (1988) and Flath (1989) noted that principals' jobs were changing to be less business managers and more "instructional leaders" (in Parsons et al. 2012). According to Leithwood et al., establishing a balance between stability and change, school leaders highlight two significances in the guidance they provide to teachers as well as in the influence they exercise over teachers:

1. School leaders work to develop and support people to do their best, and
2. School leaders work to redesign their organization to improve effectiveness.

Case Study: Effect of District and School Leadership Styles on Teaching and Learning

Improving student learning. The case study, *Learning from Leadership,* was a six year, joint research project between the University of Toronto's Ontario Institute for Studies in Education, the University of Minnesota's Centre for Applied Research and Educational Improvement and the Wallace Foundation. In the final report, one over 300 pages long, *Investigating the Links to Improved Student Learning*, researchers noted significant indications of a direct relationship between robust educational leadership and school conditions, as well as the indirect relationship between robust educational leadership and student learning (Canadian School Board Association (CABA), 2010). Leithwood, Seashore, Anderson & Wahlstrom, the main investigators of the multi-year study stressed the importance of leadership in improving student learning. From their preliminary review of research, they found a suggested significant- and underestimated- link between successful district and school leadership roles in improving student learning (2004; 2010, p. 9). Leadership is second only to classroom instruction as an influence on student learning (2010, p. 9). When the research study, began in 2004, was concluded in 2010, the authors noted, 'Five years later, we are even more confident about this claim (CABA, 2010).

'It turns out that leadership not only matters, it is second only to teaching among school-related factors in its impact on student learning, according to the evidence compiled and analyzed by the authors. And, say the authors, the impact of leadership tends to be greatest in schools where the learning needs of students are most acute.' (2010, p. 7).

Looking at the effect of both indirect and direct support systems at state, district, school and classroom levels, the stated purpose (2010, p.7) of the project was to:

- **Identify** leadership practices which support improvement of student learning.
- **Clarify** how successful leadership practices influence the quality of teaching and learning.
- **Determine** the degree to which individuals and groups, possess the will and skill required to improve learning, and the extent to which their work settings allow and encourage action.
- **Describe** the ways and the success with which, individuals and groups help others to acquire the will and skill required.
- **Identify** the leadership and workplace characteristics that encourage values, capacities, and use of practices.

Instructional Leadership Differences and Teaching Quality. The research project, prompted by the question 'Were the principals in High Scoring Schools (HSS) engaged in different instructional leadership practices than those in the Low Scoring Schools (LSS)? The schools studied were selected based on the proportion of teachers who were rated high (HSS) or low (LSS) on Standard 1 of the Newmann scale during classroom observations (Leithwood, et al., 2010, p. 72; Newmann & Wehlage, 1993)). Methods used were surveys, classroom observations, and four rounds of interviews (pp. 317-328).

The Educational Leadership Effect. The lead research team of Louis, Leithwood, Wahlstrom and Anderson, in this segment of the larger *Learning from Leadership* project, wanted to illustrate their understanding of core leadership practices, based on the experience of teachers and principals. . 'Although leadership is widely thought to be a powerful force for school effectiveness, this popular belief needs to be justified by empirical evidence (2010, p. 7).

Evidence collected for this component of the study highlights certain differences, by school level and by level of teachers' instructional expertise, in the values participants assign to the core practices.

Leadership styles. With the purpose of identifying and exploring the essential district and school leadership styles necessary for improving student learning, the study, *Investigating the Links to Improved Student Learning,* examined additional contributors to effective school leadership practices at the school, community, and district level. A broader definition of leadership was explored, identifying and examining three types of leadership and their subsequent effects on student learning.

A significant feature of this study is the data base. The authors collected data from a wide range of respondents (Leithwood, et al., p.12). Table 4 presents details the data base.

The authors acknowledge the 'recent flurry of attention to a broader spectrum or distribution of leadership has begun to sensitize us to the remarkable array of people who exercise formal or informal leadership in schools and districts (p.13). Three types of leadership and their effects on student learning were identified and explored: collective, shared and distributed. Table 5 below highlights key findings.

Implications for policy and practice. Elements and conditions encouraging effective leadership were identified in this longitudinal study, some having a more direct relationship with student learning.

Table 4. Size of research study data base

9 states	43 school districts	180 elementary, middle, and secondary schools	
At the state level,	At the district level	At the school level	survey data collected in the first and fourth years of the study
interviews conducted with: • legislators, • stakeholders, • members of state education agencies	interviews conducted with: • senior district leaders, • elected board members, • representatives of the media, • other informants	interviews conducted with: • teachers and • administrators, • survey instruments were used and • classroom observations were conducted	interviews conducted in districts and schools in three cycles over the five years of the project.
	Interviews conducted in districts in three cycles over the five years of the project.	interviews conducted in schools in three cycles over the five years of the project.	
	Survey data collected from 471 school administrators	survey data collected from 8,391 teachers	
Interview data from 124 state personnel	Interview data from 304 district level informants	interview data from 581 teachers and administrators	observational data from 312 classrooms

Principal - teacher relationships, district leaders‘ interactions with principals, and policy decisions at the state level all are intertwined in a complex and changing environment (p. 282).

Table 6 includes some of the most important implications for policy and best practices researchers reported in *Investigating the Links to Improved Student Learning*.

SOLUTIONS AND RECOMMENDATIONS

Table 7 highlights refocusing structural reform in education in three areas (Cass, 2018, pp. 15-16)

FUTURE RESEARCH DIRECTIONS

The increased involvement of all “employees” as stakeholders in organizational decision-making has become a globally accepted practice over the past 20 years (Parsons and Beauchamp).

CONCLUSION

Among all stakeholders- parents, teachers, policy makers- who work to improve education, educators in leadership positions are best situated to ensure the necessary synergy (Leithwood, et. al, p. 9). ‘Administrators in five highly effective elementary schools were studied. Leadership is becoming less hierarchical and more horizontal (Parsons & Beauchamp, p. 702). State initiatives matter. States, for all the variability in their approaches to policy making, are firmly focused on standards and accountability (Leithwood, Seashore, Anderson & Wahlstrom, p. 283).

Table 5. Key findings from Investigating the Links to Improved Student Learning

Type of Leadership	Definition	Key findings
1. **Collective** (p. 19)	• refers to the extent of influence that organizational members and stakeholders exert on decisions in their schools • the influence of collective leadership on students operates indirectly, through its influence on teacher motivation and work setting (p. 29, 36)	• Collective leadership has a stronger influence on student achievement than individual leadership. • Principals and district leaders have the most influence on decisions in all schools; however, they do not lose influence as others gain influence. • Schools leaders have an impact on student achievement primarily through their influence on teachers‘ motivation and working conditions; • their influence on teachers‘ knowledge and skills produce less impact on student achievement
2. Shared (p. 37)	• teachers‘ influence over, and their participation in, school-wide decisions with principals. • distinguishes our approach from the approach of scholars who blend the concept of shared leadership with instructional leadership (p. 41)	• When principals and teachers share leadership, teachers‘ working relationships are stronger and student achievement is higher. • Leadership practices targeted directly at improving instruction have significant effects on teachers‘ working relationships and, indirectly, on student achievement • The link between professional community and student achievement may be explained by reference to a school climate that encourages levels of student effort above and beyond the levels encouraged in individual classrooms. • Shared leadership and instructional leadership are important variables, but they are indirectly related to student achievement (p. 51)
3. Distributed (p. 54)	Distributed leadership: • The individuals or groups identified as providing leadership included a mix of principals, assistant principals, teachers in formal leadership roles (p. 57) • teachers with specialist positions - literacy specialists, technology specialists, counselors etc.	• While there are many sources of leadership in schools, principals remain the central source. • No single pattern of leadership distribution is consistently linked to student learning • More complex and coordinated patterns of distributed leadership appear when school improvement initiatives focus directly on student learning goals, as distinct from the implementation of specific programs.

Reforming the U.S educational system is both crucial and central to the development of the U. S. education system. Education leaders' contributions to improving student learning are indispensable.

Principal - teacher relationships, district leaders‘ interactions with principals, policy decisions at the state level all are intertwined in a complex, changing environment. Links were found between all these elements, with some having a more direct relationship with student learning (Leithwood et al, p. 281).

Redesigned School Districts. If schools are to thrive, school districts need to redesign themselves. Giving schools autonomy over key aspects of their programs, such as budgets, staffing, curriculum and assessment, leadership and governance, school policies, and school calendar and schedule, holding schools accountable for results is a necessary second step. While this kind of "autonomy in exchange for accountability" arrangement is often associated with charter schools, small redesigned schools do not necessarily have to be charters. (Darling-Hamond et al., p. 58)

A sense of urgency is needed to fuel the difficult but necessary work of creating schools that can provide both nurturing and learning as well as a sense of individual worth (Davis McGaw, 2016 & 2019; Darling-Hammond, L., Wilhoit, G., & Pittenger, L., 2014).

Table 6. Investigating the Links to Improved Student Learning: Implications for policy and practice include:

Implications for Policy
1. School leaders can utilize the influence they have on classroom practice by motivating their teachers, exerting effort to align teachers‘ work settings with effective instructional practice (p. 35).
2. Evidence about the effects of leadership distribution on school improvement initiatives or student learning is modest. Principals working in similar organizational structures may enact their leadership roles and engage in distributed leadership in different ways (p.64).
3. District leaders must effectively define and pursue local goals and priorities when they shape local understanding of state policies, and incorporate this understanding into local education priorities, policies and services (p. 275)
4. State leaders should acknowledge the increasingly important role of districts as collaborators in the policy process (p. 279). Data from this report suggests state policy makers rarely incorporate the views of district leaders in the legislative and agenda-setting process (p. 279).
5. Data from this report suggests state policy makers rarely incorporate the views of district leaders in the legislative and agenda-setting process (p. 279).
Implications for Practice
1. School improvement requires the participation of all leaders. Distributed leadership effects on student achievement were among the most significant in the research study (p. 280).
2. Increasing teachers‘ involvement in the task of making good decisions and introducing improved practices must be at the heart of school leadership (p. 53).
3. Higher-performing schools generally ask for more input and engagement from a wider variety of stakeholders and provide more opportunities for influence by teacher teams, parents, and students (p. 282).
4. The extent to which leadership will be distributed, and the forms it may take, are determined predominantly by principals’ beliefs about the following key factors: • external and internal influences on school direction setting, • sources and uses of professional expertise o their own expertise, o teachers‘ expertise, o expertise from external sources • participatory or shared leadership (p. 65).
5. State policy makers and education agencies should find ways to disseminate creative initiatives by local districts to encourage authentic compliance while acknowledging local differences (p. 208-81).
6. State policy makers and education agencies need to be more responsive to legitimate concerns about unforeseen inequities arising from the implementation of well-intended government policies (p. 281).

Table 7. Refocusing the education system: structural reform in three areas

1. Defining Success	a focus on the combination of full-time employment and college completion as coequal goals	•
2. Increasing Flexibility	CTE students show proficiency on standardized tests designed for a college-preparation curriculum makes no sense.	• develop a parallel set of standards and tests for a CTE pathway • classroom-hour requirements designed for college preparation are no more appropriate to a CTE pathway
3. Reallocating Funds	A student pursuing a noncollege track warrants the same level of public support as one pursuing college.	• funding might go toward subsidized employment rather than tuition • allowing students to use federal Pell grants for short-term technical training.

Table 8. Questions guiding future research for designing schools for learning

1. Student Level	What are our students' aspirations?	What needs to be done to achieve these aspirations?
2. Teacher Level	How might teachers, with their domain expertise, become the designers of change?	Do district's current professional development programs align with research about teacher learning?
3. Principal Level	What are the best practices and behaviors associated with identified leadership scope that principals of successful schools demonstrate?	How can educators gain a better understand of the role of school principal in facilitating collaboration? How is this collaboration vital in creating optimal learning opportunities?
4. School District Level		What successful behaviors, actions of administrators of highly effective schools support excellent student learning?

In New York City, some students and teachers have participated in a comprehensive math program called School of One, in which each student receives a unique daily schedule, called a playlist, based on academic strengths and needs. Such programs offer promise, but they are just a start. (Childress, S., 2012).

'By 2018, if today's college graduation rates hold as steady as they have for decades, the U.S. will be short at least 3 million college-educated workers for the projected 101 million jobs that will require a degree. We must give our teachers and students the breakthrough tools they need so that the next generation of Americans will be better prepared to take advantage of those jobs and contribute to a stronger economy.' (Childress, 2012)

All members of a community, from custodians to teachers and principals to kindergartners, are the learners of a true school. A less-than optimum performance from this community will yield neither a school that serves the needs of children nor the globally competitive country that some imagine will arrive when we replace the old with the new (Meador, 2017; Gamberg, 2016; Davis McGaw, 2016; The Wallace Foundation, 2013).

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KEY TERMS AND DEFINITIONS

Co-Created Learning: Student participation in creating lesson plans; learning created jointly.

Collective Leadership: Influence organizational members and stakeholders exert on decisions in their schools.

Distributed Leadership: Individuals or groups identified as providing leadership; a combination of principals, assistant principals, and teachers.

Effective Teacher Development: Action research to gain better understanding of what's working or not working in academic programs; using findings to improve educational quality and results.

Instructional Leaders: Involved in curricular and instructional issues that directly affect student achievement.

Rethinking Education: Reforms that impact elementary, middle, and high school programs; district-wide or statewide reforms seeking to make changes throughout a defined system.

School Redesign: Anything politicians, policy makers, government agencies, school leaders, teachers, educational reformers, experts, are doing, effectively or ineffectively, to improve school performance, teaching effectiveness, or educational results for students.

Shared Leadership: Separate from instructional leadership, the practice of governing schools by expanding the number of people involved in making important decisions related to school's organization.

Chapter 23
Generalizable Models for Online Professional Learning Communities for America's K-12 Teachers

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ABSTRACT

America's teachers are burning out. The emergence of teacher-centered online professional learning communities (PLCs) is a relatively new phenomenon with unestablished boundaries. The questions to be answered are: (1) What are the opportunities, issues, and challenges associated with online PLCs for K-12 teachers? (2) What are generalizable models for designing, implementing, and managing online PLCs for K-12 teachers? An exhaustive review gathered, organized, evaluated, coded, analyzed, and synthesized 45 relevant studies, dissertations, articles, and reports that examined online teacher PLCs. The goal was to identify and highlight conflicts, contradictory ideas among findings. The intent was to bridge gaps between theories and principles to create a common framework and generalizable models. This study was relevant because it sought to identify opportunities, issues, and challenges associated with online teacher PLCs and successful evidence-based micro-level, meso-level, and macro-level replicable practices for broader generalization.

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INTRODUCTION

What would America be without qualified K-12 teachers? While this question might sound rhetorical, Garcia and Weiss (2019) warn education administrators, policymakers, and parents should turn an increased focus toward a coming perfect storm. America's teachers are burning out from teacher shortages, stressful working conditions, and a perceived lack of support. After examing a stratified sampling of 60,000 teachers that responded to the 2017-2018 National Teacher and Principal Survey (NTPS), Garcia & Weiss found 48.7 percent of respondents expressed some levels of dissatisfaction with being a teacher, 27.4 percent admitted thoughts they would leave the teaching profession at some point, and a disturbing 57.5 percent felt they would not return to teaching if they went back to college at some point. The primary reasons cited were teachers felt they lacked influence over what they teach (71.3 percent) and the instructional materials they use (74.5 percent). Garcia & Weiss attributed these factors to why America faced a 100,000-teacher shortage during the 2017-2018 school year and described the phenomenon as a recognized but poorly understood national crisis (Garcia & Weiss, 2019a). In subsequent studies, the researchers mapped the strong correlations between on-the-job training and professional development and teacher job satisfaction. Garcia & Weiss recommends improvements in the types and usefulness of the professional supports offered to teachers. They found such efforts should include efforts to help them stay abreast of advances in research on effective teaching practices, strategies for facing challenges, and advocacy (Garcia & Weiss, 2019b).

One particularly promising and emerging trend is the increasing number of online teacher professional learning communities (PLCs). PLCs are usually teams of teachers engaged through social media (e.g., Twitter, Facebook, LinkedIn) in e-learning communities where they share and learn from each other (Beach, 2012). However, the rapid growth and prevalence of online teacher-focused PLCs beg the questions: Is the excitement about PLCs as an alternative to traditional teacher professional development approaches justified? What types of PLC peer-directed and self-regulated learning practices work best? Which PLCs are designed to accommodate particular learning styles and learning needs? What types of learning tools are available to PLCs participants that might not otherwise be available? Are investments in administrative-supported PLCs socially and economically smart (Fabio & Antonietti, 2012)?

A plethora of empirical studies have found online PLCs help teachers share teaching tips and techniques, promote collaborative and social learning, and provide guidance emotional support for teachers within a virtual community of peers (Ahmad et al., 2013; Ahmad & Tasir, 2013;Azevedo & Cromley, 2004; Darmadi, 2018; Dascalu et al., 2015; Lo, 2012; McManus, 2000; Ozyurt & Ozyurt, 2014; Scheiter, 2009; Švarcová & Jelínková, 2016; Taub et al., 2014; Truong, 2016; Wells, 2011). Research also points toward the potential of PLCs to create a paradigm shift in professional development approaches for K-12 teachers and the value of collaborative problem-solving with like-minded peers (Chappuis, Chappuis, & Stiggins, 2009; DuFour, Eaker, & DuFour, 2005). Teachers themselves have claimed benefits from engaged learning within collaborative e-learning environments that enabled them to share resources and knowledge with other K-12 teachers (Anwauddin, 2015; Ballenger, 2001). Nevertheless, critics have claimed the evidence is inclusive that online PLCs actually improve K-12 teachers' learning experiences compared to traditional professional learning approaches. Others claim online PLCs approaches are too simple and that the benefits of participation are not shared equally among all participants (Akbulut & Cardak, 2012; Gerjets, 2009; Hamid, 2015). Researchers have also noted that online PLC administration is often sloppy and disorganized with little learning taking place among its members (Lang & Fitzgerald, 2005, Verborgh & Dumontier, 2018). Other studies have identified the need to review the literature to

shed additional light on this rapidly growing phenomenon (Webster & Watson, 2002). Implications are the literature should be synthesized to identify generalizable models and theoretical frameworks. Such efforts should also seek to determine if gaps exist within the body of knowledge related to how to effectively implement and manage teacher-focused and managed online PLCs (Webster & Watson, 2002).

Yet, it has been suggested that any efforts toward adult distance learner should incorporate an understanding about how and why adults learn (Dwye & Walsh, 2019). Inferences are that heutagogy, a form of self-determined lifelong learning, should be considered for teacher-focused online PLCs because of its associated continuum from andragogy or adult education (Blaschke, 2012). Heutagogy is described as distinctive because of the increased emphasis on self-directed, self-directed, and self-regulated autonomous adult learning (Blaschke, 2012; Buckley, 2019). Similar to Mezirow's (1997) disorienting dilemma decoding, transformative learning theory, heutagogy stresses the importance of learner maturity through critical reflections that document adjustments in self-perception, beliefs, and lifestyles. In educational research, it has been accepted that increased knowledge and understanding of life experiences (Merzirow, 1997) enrich and deepen the learning experiences of adults. Research has shown heutagogy-influenced teaching and e-learning environments progressively develop learners' competencies, capabilities, and competencies through self-assessments usually under the direction of peer coaches (Ashton & Newman, 2006, Bhoryrub et al., 2010; Kamenetz, 2010). Research has attributed the strength of self-directed e-learning environments to the promotion of emancipatory learning through collaborative social action (Carr et al., 2013; Garden & Garden-Ross, 2018). Research shows heutagogy is most useful for adult education when learning occurs within environments that offer continuous self-reflection, collaborative learning spaces that help decode prior knowledge, peer-driven constructive feedback, competency applications and demonstrations, positive role-modeling, and emotional support (Baker, 2006; Blaschke, 2012; Persaud, 2016; Stiglitz & Greenwald, 2014). Over the last decade, both teachers and school administrators have been bombarded with books and programs that promote heutagogy-influenced PLCs as an attractive option for K-12 teacher professional learning (Hargreaves, 2007; Talbert, 2010). The challenge is that most of the literature was written by practitioners or university researchers—not the teachers themselves (McLaughlin, 2001). By comparison, a new and emerging trend is the advent of the teacher-driven, teacher-centered, and teacher-created online PLC society. The opportunity is that collaborative online personalized learning communities (PLCs) appear to be the best platform for creating such real-time and interactive peer-driven e-learning environments (Blaschke, 2018; Narayan, Herrington, & Cochrane, 2019).

The purpose of this study was to employ Cooper's Taxonomy for literature reviews gather, analyze, and synthesize existing research concerning online teacher professional learning communities. The goal was to summarize the findings, identify ambiguities or conflicts in the literature, and outline areas for further research.

BACKGROUND: THE STRUCTURE OF AN INTEGRATIVE LITERATURE REVIEW

This study sought to answer two questions: *(1) What are the opportunities, issues, and challenges associated with online PLCs for K-12 teachers? (2) What are the generalizable models for designing, implementing, and managing online PLCs for K-12 teachers??*

Cooper's Taxonomy of Literature was used to focus attention on this fast-growing phenomenon; synthesize literature from prior studies of the topic; provide perspectives from the literature regarding

the generalizability of successful models using a structured approach to ensure diversity of findings; organize the literature by attributes; and disseminate findings for future research (Sipe & Stalling, 1996). The researchers took a neutral perspective while conducting the study, evaluating, coding and categorizing the works by research method, participant effect size, and theoretical underpinning. The intended audience is scholars, administrators, and policymakers tasked with evaluating online, adult education, and professional learning community frameworks. Cooper's taxonomy methodology was used because the approach is commonly accepted conducting social science and behavioral literature reviews (Cooper, 2017)

An exhaustive coverage of literature, with selective criteria of focus on American K-12 teachers, was used to gathered, reviewed, and analyzed for both large-scale and small-scale quantitative and qualitative studies. Seminal and theoretical literature was gathered and examined to establish conceptual frameworks and boundaries. An economic report was gathered and analyzed to assess the ramifications influencing the phenomena from the administrative and budgetary perspectives (See *Figure 1).*

Google was used to access a University of North Texas EBSCOHost account. Six unique keyword phrase searchers for English studies were conducted November 5 through November 10, 2018. Keyword phrases searched were: personalized learning communities; e-learning in America; teacher e-learning, online teacher communities; teacher online professional learning, and teacher e-learning. *Table 1* identifies the 550 works identified by phrase. <Table 1 here>

The University of North Texas EBSCOHost account was used to search for and find four seminar study searchers by title and author during separate searches.

Based on the thorough search and exhaustive keyword searches, 145 English works published and unpublished in peer-reviewed scholarly journals, conference papers, proceedings, dissertations, theses, and working papers written between 1980 and 2018. Abstracts were screened for operational characteristics, independent and dependent variables, participant eligibility criteria, research design methods, study timeframes, and stated geographical restrictions. Forty-one works were selected for coding and systematic review, and 104 were excluded. *Table 2* provides the number of works excluded because the literature as duplications, being off-topic, or not focused on American teachers.

The inclusion of theoretical seminal studies and theoretical works was necessary because the classic works were of central importance to the topic and provided the conceptual framework for this study and literature syntheses. Seminal studies and theoretical works are of central importance to the topic were exempted from the exclusion criteria based on their accepted validity within the scholarly community and indicated by scholarly their number of citations. A study limitation was that ERIC works not accessible through the University of North Texas' EBSCOHost were also excluded, which included three book titles. <Insert Table 2. Here>

The principal investigator, a University of North Texas doctoral student with a master's degree in Learning Technologies, gathered and selected the 41 different studies, theoretical works, and economic report. The student was qualified to make the selections based on her knowledge and experience related to the topic. Microsoft Office 2016 Access was used to organize literature by title, authors, year of publication, participant population, sample size, primary findings, and limitations. A co-investigator agreed with the literature selections (See *Figure 2.).*

Relevant data samples were extracted and synthesized to create statements by weight and quality and were combined into a summative account. Narratives were written to describe the syntheses; and tables were included to display study designs, variables, outcomes, and context.

Figure 1.

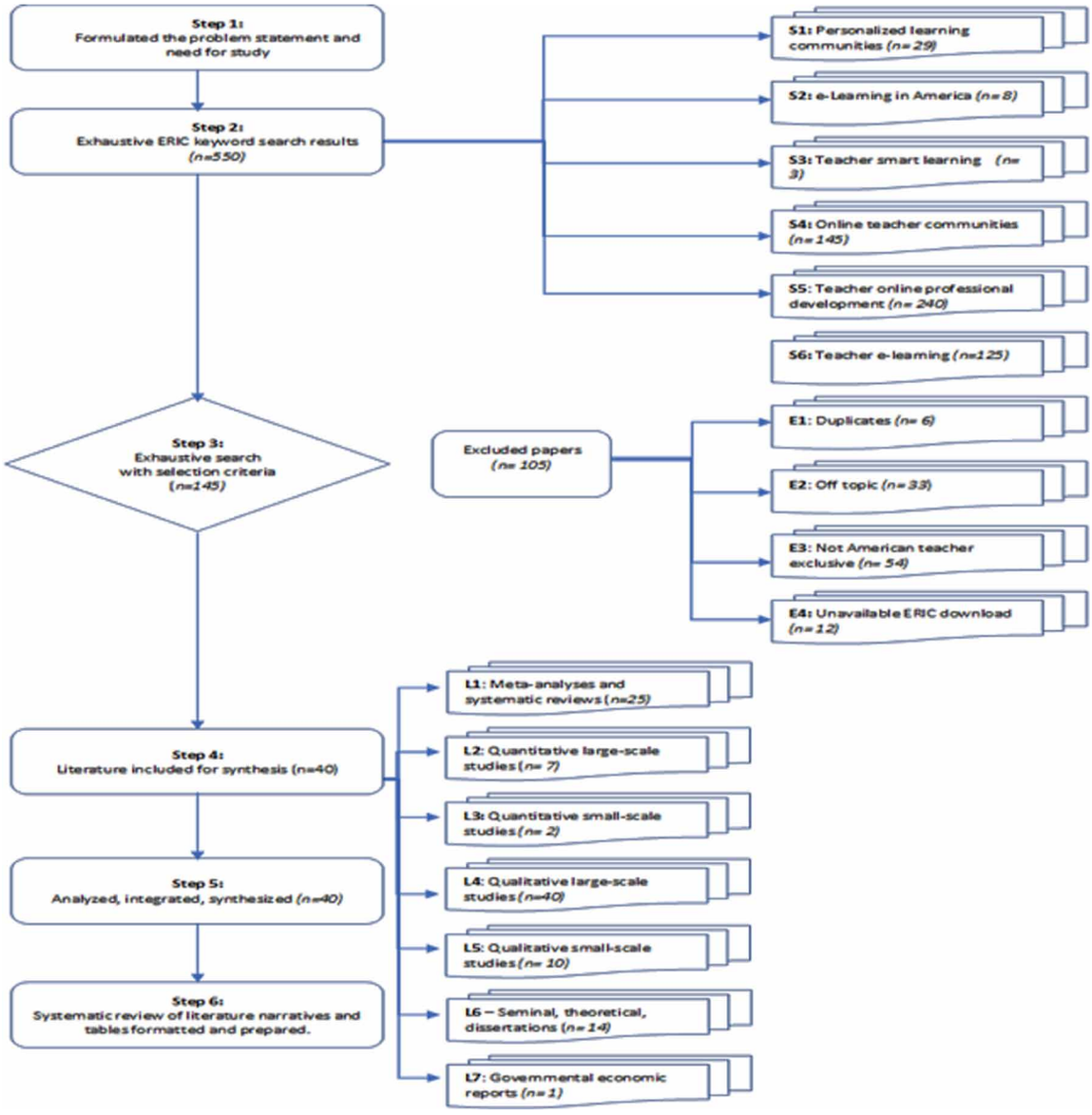


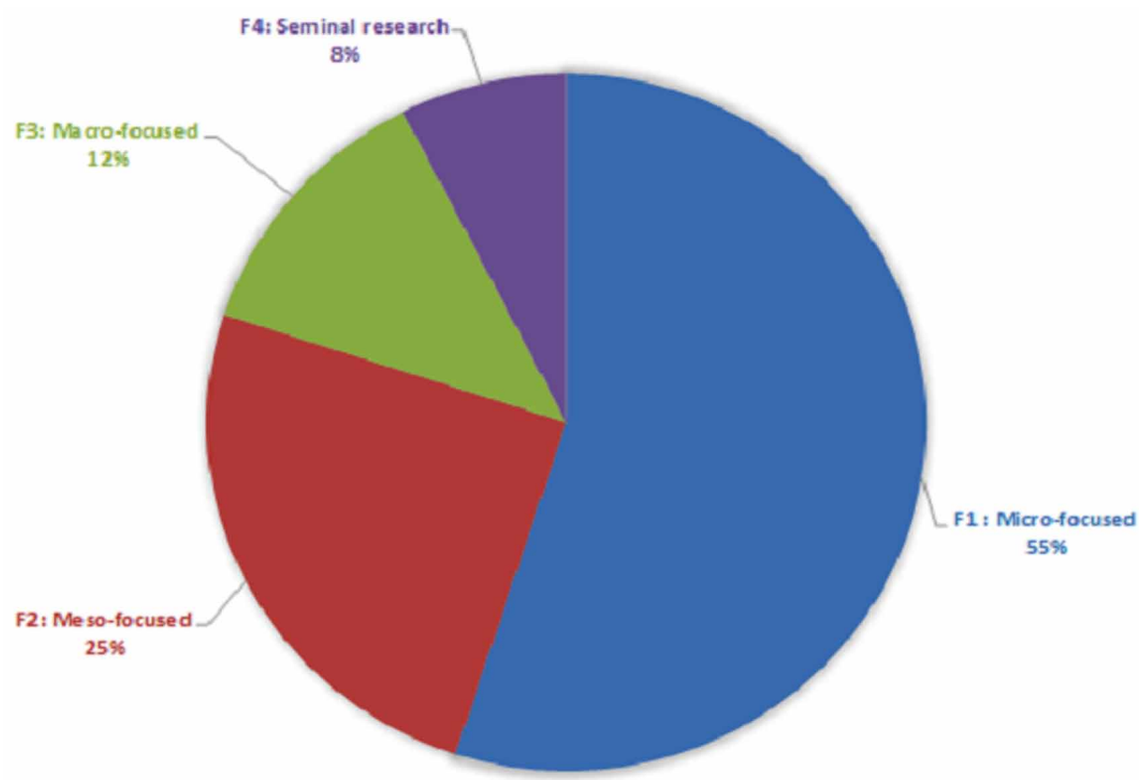
Table 1. ERIC database keyword search terms and results

Search Terms	Results
S1: Personalized learning communities	29
S2: e-Learning in America	8
S3: Teacher e-learning	3
S4: Online teacher communities	145
S5: Teacher online professional learning	240
S6: Teacher e-learning	125
Total Keyword Search Results	**550**

Table 2. Literature exclusions by reason

E1: Duplicates	6
E2: Off-topic	33
E3: Not USA teacher exclusive	54
E4: Unavailable at time of the search	11
Total Literature Exclusions	104

Figure 2.



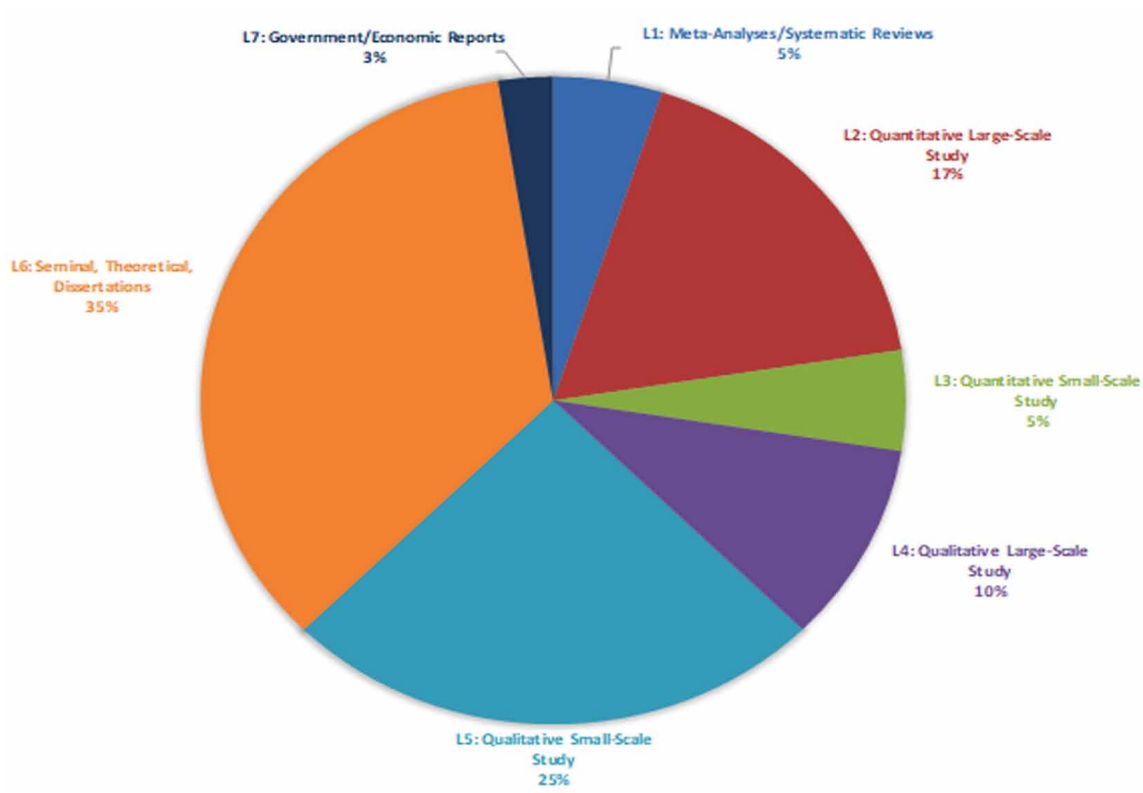
Both published and unpublished literature was coded, weighted, and assigned one of seven values by the principal investigator. A rating level scale (**L**) was created to rank literature from "**L1**" to "**L7**" based on determined evaluated relevance and significance. The highest rating of "**L1**" was coded to literature reviews and meta-analysis based on evaluated reliability and methodology. Large-scale quantitative studies (n=>35) were rated "**L2**" and small-scale studies (n<35) were rated "**L3**" based on reliability, internal and external validity, sample effect size, and generalizability. Qualitative studies were coded and weighted based on reliability, internal and external validity, and sample size with large-scale qualitative studies (n=>35) being rated "**L4**" and small-scale studies (n<35) rated at "**L5**". Seminal works and academic articles were generally coded, weighted, and rated at "**L6**". The government economic report was evaluated and weighted at "**L7**".

Table 3. Literature coding and weights by classification

Search Terms	Results
L1: Systematic literature reviews	2
L2: Quantitative large studies *(n=>35 sample size)*	7
L3: Quantitative small studies *(n=<35 sample size)*	2
L4: Qualitative large studies *(n=>35 sample size)*	4
L5: Qualitative small studies *(n=<35 sample size)*	10
L6: Seminal, theoretical, dissertation works	15
L7: Governmental/economic reports	1
Total Literature Exclusions	41

Relevant data samples were extracted and synthesized to create statements by weight and quality, then were combined into a summative account. Narratives were written to describe the syntheses; and tables were included to display study designs, variables, outcomes, and context. To ensure sufficient literature was gathered and synthesized across the micro, meso, and macro domains, a wide variety of studies were selected and grouped into subsets (See *Figure 3).*

Figure 3.



Relevant data samples were extracted and synthesized to create statements by weight and quality and were combined into a summative account. Narratives were written to describe the syntheses; and tables were included to display study designs, variables, outcomes, and context.

FINDINGS

The summarized finding is that research defines personalized learning communities as communities of like-minded professionals engaged in a partnership that enables them to learn collaboratively by sharing knowledge, methods, tools, stories, cases, and documents (Smith, Hayes, & Shea, 2017).

Online Personalized Learning Communities Literature Reviews

Two meso-focused peer-reviewed works were examined that focused on PLC infrastructure and learning environments. Smith et al. (2017) described the connections between professional learning network logic, social constructivism (Bandura, 2001; Vygotsky, 1978), and the Wenger-Trayner (2002) Communities of Practice (CoP) theoretical frameworks. The premise was that humans learn best within communities engaged in collaborative learning activities (Wenger-Trayner, 2002). However, Smith et al. also argued that theories, such as Wenger-Trayner's CoP theory when taken at face value lacked the due diligence generally required for rigor, reliability, and validity quantitative analysis. Smith, Hayes, & Shea found that of the 41 studies about CoP conducted between 2000 and 2014, 9.8% used a reliable and generalizable quantitative approach. The observation led Smith et al. to argue that future CoP research studies should go beyond verifications of theory and to perform statistically valid measures of learning impacts among participants that engage in PLCs. Smith et al. were not the first to question the quality of research related to the effectiveness of online teacher PLCs (Smith, Hayes, & Shea, 2017). In like manner, a scientific review of online PLCs (Blitz, 2013) found that, while there is evidence that PLCs can help teachers develop professionally, further exploration is required into the moderators and mediators that enhance learning in these online communities. The need for additional research that examines diversity, group leadership, and flexibility among these groups was also inferred (Blitz, 2013). In summary, the two meso-level students that focused on online teach PLC infrastructures and environments infer the need at the meso-level to provide guidance for administrators on how teacher PLCs should be organized, managed and sustained.

Quantitative Analysis of Online Personalized Learning Communities

Seven large-scale *(n^3 35)* and two small-scale *($n < 35$)* quantitative experiments that investigated teacher learning, adult learning and professional development, and participant engagement within online PLCs were examined. All quantitative studies focused on micro-level teaching and learning aspects within online PLC environments. The composite sampling size for the large-scale studies represented 868 American K-12 teachers (Baratta, 2012; Lauer, Stoutemyer & Van Buhler, 2005; Strycker, 2012: Tsai, 2011; Vavasseur & MacGregor, 2008; Mintz, 2017; Snider, 2009). Five of the studies cited ANOVA statistics, acceptable Cronbach alpha scores, and statistically significant P-values in order to support their reliability measures. The effect indicates the results were generalizable (Baratta, 2012, p. 69; Lauer et

al., 2005, p. 16; Snider, 2009, p. 33). The total sampling for the small-scale studies represented 53 K-12 teachers. In summary, like the large-scale studies, the small-scale quantitative experiments also implied that teachers benefitted from participation in the online PLCs (Frumin et al., 2018; Matranga, 2017). Noted, however, was a study that questioned the sustainability for peer-driven online PLC and questions related to the effectiveness of the shared practices as being generalizable for diverse mathematics instruction (Matranga, 2017, p. 29).

Qualitative Analysis of Online Personalized Learning Communities

Four large-scale *(n ³ 35)* and eleven small-scale *(n < 35)* qualitative works that examined teacher learning, adult learning, professional development, and engagement within online PLCs. All but one of the quantitative studies focused on micro-level teaching and learning aspects. The composite sampling for the large-scale studies represented 1,464 sample size of American K-12 teachers (Hodes et al., 2011; Hur & Brush, 2009; Linton, 2017; Schrum, Burbank & Capps, 2007). Evaluations of observations, surveys, and interviews from large-scale studies indicated the teachers generally felt they benefited from engagement with peers during interactions within their online PLCs. However, the large-scale qualitative studies differed from quantitative experiments in that several mediators and moderators were identified and analyzed. For instance, researchers suggested mediators and moderators, including the need for structure that encourage administrators to support participants interactions (Hodes et al., p. 315; Schrum et al., p. 210); stringent participant eligibility criteria (p. 316); and training durations influence learning, levels of engagement, and retention (p. 317). One study denoted that factors that contributed to levels of participant engagement (4%–10% of participants produced 50–80% of the messages and resources shared0 should be studied further (Hur & Brush, 2009). Evaluations of small-scale qualitative studies (Boyd, Gorham, Justice, & Anderson, 2013; Gore et al., 2013; deNoyelles & Raider-Roth, 2016; Kulavuz-Onal, 2013; Moore & Chae, 2007; Reich, Levinson & Johnson, 2011; Restivo, 2012; Sayre & Wetterlund, 2002; Sciuto, 2017; Scurr, 2017; West, Jones & Semon, 2012; Yates, 2014) also differed from the quantitative studies. Despite self-reported favorable impressions of online learning, a sampling of 158 American K-12 teachers enabled researchers to observe some teachers shared unfavorable reflections on their online PLCs engagement experiences including one group of participants reporting they did not learn anything "new" about teaching during interactions within an online PLC (Moore & Chae, p. 221). Also, as was reported by some large-scale qualitative studies, moderators and mediators influence the effectiveness of online PLC engagement, participation, and interactions (Sciuto p. 3, 25, 28; Reich et al., p. 392). For instance, one small-scale qualitative study observed teachers engaged in online PLCs to combat feelings of isolation and to get emotional support from their peers, something not noted by studies with larger effect sizes (Scurr, 2017, p. 156; West et al., 2012, p. 109); Kulavuz-Onal, p. 127). Another small-scale qualitative study differed in its meso-exploration of the distinction between asynchronous and synchronous PLC spaces (deNoyelles & Raider-Roth, p. 349). Sample sizes for several small qualitative studies were insufficient to be considered as generalizable (Boyd et al., p. 8; Moore & Chae, p.218; Reich, Levinson & Johnson, p. 5; Restivo, p. 6; Scurr, p. 117; West et al.; Jones & Semon, p. 109) which negatively impacts their value to the body of knowledge. Exceptions were the controls and rigor of one large-scale qualitative study whose findings were generalized to further research with a 700-participant effect size with consistent outcomes (Sayre & Wetterlund, p. 5, 20). But, the moderator was that "all" teachers at the project site were required to participate (deNoyelles & Raider-Roth, p.

338). In summary, findings from examinations of qualitative literature infer gaps in rigorous research of sufficient sample size at all three research domains (micro-level, meso-level, and macro-level) which are needed to resolve conflicts and inconsistences among the works.

Seminal, Theoretical, and Dissertation Works

Twelve seminal, theoretical, and dissertation works were examined to provide the analytical and conceptual frameworks for the literature reviews (Bandura, 2001; Blaschke, 2017, Blaschke, 2018; Guri-Rosenblit & Gros, 2011; McLaughlin, 2001; Vygotsky, 1978). Four works focused on the meso level and discussed management, organization, and the technological aspects of online PLCs. Seminal works supported the collaborative learning premise that grounds the expectations for online PLCs. For instance, theories that humans learning is augmented within socio-structural environments (Bandura, p. 5, 23, Singer & Zeni, p. 45) and that cognitive development and higher-order thinking skills obtained through imitation (Vygotsky, p. 34) have been accepted as valid. However, macro researchers identified moderators that tempered expectations. For instance, the works inferred the role that administrator support, access, and accountability play in the success of a PLC (Gutierrez & Bryan, p. 46; Laferriere, Breuleux & Bracewell, p. 3; McLaughlin & Talbert, p. 38). The inference was the self-reported data analyzed during studies of some online teacher PLCs may contain inaccuracies or misconceptions (Colgan, Higginson & Sinclair, p. 4; Guri-Rosenblit & Gross, para. 3, Talbert, p. 569) that led to Type I and Type II research errors. For instance, one research participants self-reported that teachers often feel pressured to conform to general opinions during research studies rather than express their subjective truths about their experiences while engaged in online PLC learning environments (Anwaruddin, p. 817). Another research study participant, while critiquing a book written by a researcher that studied online teacher PLCs, wrote what teachers "say" amongst themselves is often "so much more critical" than what teachers are willing to say publicly (Ballenger, p. 76). Considering the critical role teachers play in confirming online PLC effectiveness, even the most well-accepted theories should be challenged through replication and generalization (Smith et al., p. 224). Succinctly, the inference was that scholarly examinations of the fast-growing teacher-center online PLCs is in its infancy and that the need exists for researchers to further study an emerging phenomenon that appears to be proliferating unchecked. At this point, a review of the literature infers ambiguities and inconsistencies regarding online American K-12 teacher online learning communities leaves questions regarding what is actually going in among these groups, how the groups are organized and managed, and what factors administrators and policymakers should consider while trying to determine if teacher-focused online learning communities are an effective and cost-efficient alternative to traditional face-to-face seminars.

FUTURE RESEARCH DIRECTIONS

Implications from this integrated are that the ambiguities and conflicts in the literature require further rigorous study of teacher-driven and peer-managed online PLCs targeted toward American K-12 teachers is needed. Future research should examine the phenomenon across all three main research domains, micro-level, meso-level, and macro-level, to close gaps and resolve inconsistencies, conflicting theories, and methodological errors. Future quantitative and qualitative studies should seek to establish broad

conceptual frameworks for this growing segment of online learning communities to identify generalizable models and best practices for the management, organization, and financing of these learning groups provide guidance for administrators and policymakers and test the approach's sustainability.

CONCLUSIONS

Our literature review sought to answer two research questions: *(1) What are the opportunities, issues, and challenges associated with online PLCs for K-12 teachers? (2) What are the generalizable models for designing, implementing, and managing online PLCs for K-12 teachers?*

Heutagogy was studied as well because the emancipatory and autonomous adult learning environment heutagogy promotes appears best suited for real-time and interactive online PLC learning environments. We found inconsistencies, conflicting theories, and methodological errors in both quantitative and qualitative studies after gathering, selecting, analyzing, and synthesizing literature that examined online learning communities for K-12 American teachers. We found gaps in rigorous research at the micro, meso, and macro levels, inconsistencies in findings, and confusing and conflicting terminologies.

Our literature review was relevant because research in 2016, the median earnings for young Americans with a bachelor's degree was $50,000, 57 percent higher than median wages for young Americans with a high school diploma ($31,800) and 49 percent higher than the median earnings for young Americans who did not complete high school (McFarland et al., 2018, p. xxxvi). This creates the need for dominant economic powers, such as the American economy, to find measures to better educate its future workforce. Our study indicates rigorous research of online professional learning communities that effectively address the professional development of K-12 teachers may be a viable strategy for addressing growing global income inequalities.

Limitations included the decision to limit search results to the ERIC database. Another limit was to focus on one keyword phrase to the exclusion of others. The final limitation is related to the time available to complete this systematic review.

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KEY TERMS AND DEFINITIONS

Adult Education: A practice in which adults engage in systematic and sustained self-educating activities in order to gain new forms of knowledge, skills, attitudes, or values.[1] It can mean any form of learning adults engage in beyond traditional schooling, encompassing basic literacy to personal fulfillment as a lifelong learner.

Andragogy: The science of understanding (theory) and supporting (practice) lifelong education of adults.

E-Learning: The use of both physical hardware, software, and educational theoretic to facilitate learning and improving performance by creating, using, and managing appropriate technological processes and resources.

Heutagogy: Self-directed education without the guidance of masters (such as teachers and professors) or institutions (such as schools).

Learning Environment: An educational approach, cultural context, or physical setting in which teaching and learning occur.

Pedagogy: The study of how knowledge and skills are imparted in an educational context, and it considers the interactions that take place during learning.

Professional Learning Communities: A method to foster collaborative learning among colleagues within a particular work environment or field.

Self-Regulated Learning: A process of taking control of and evaluating one's own learning and behavior.

Chapter 24
Professional Development and Training Needs for Administrators in an Islamic University Malaysia

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ABSTRACT

There have been several studies that have been conducted on employee training and development, both in educational institutions and companies, such as the study conducted by Oktavianus, namely training and development of employees at schools in Indonesia. This study found that in order to help the process of education services, each existing unit must be equipped with competent administrative staff to help teachers and students, even parents for the purpose of the educational service process. Therefore, training and development must be given to these administrative staff so that they can do their jobs properly and correctly. Hence, the purpose of this chapter is to highlight the professional development needs for administrative staff at the Islamic University in Malaysia. Researchers explore the trainings that were provided by the university not only for self-development but also for the benefit of the university to reach its goals.

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INTRODUCTION

Training and development are commonly practiced in the work settings, whether in educational settings or none. For the efficiency of administrative work, there is no doubt that training and development are important for administrators to understand and master the fields of work that are being carried out now or in the future. There have been several studies that have been conducted on employee training and development, both in educational institutions and companies such as the study conducted by Oktavianus (2018), namely training and development of employees at schools in Indonesia. This study found that in order to help the process of education services, each existing unit must be equipped with competent administrative staff to help teachers and students, even parents for the purpose of the educational service process. Therefore, training and development must be given to these administrative staff so that they can do their jobs properly and correctly.

Hence, the purpose of this paper is to highlight the professional development needs for administrative staff at the Islamic University in Malaysia. Researchers explore the trainings that were provided by the university is not only for self-development but also for the benefit of the university to reach its goals. The sample frame consisted of five administrative staff from various departments and the interviews were conducted around 20-30 minutes for each participant. Participants were asked about their perceptions of the training given to them and how these trainings have helped them in developing new skills.

This paper provides original information on a topic that is not previously well studied at the Islamic University in Malaysia context. It identifies professional development needs for administrative staff of the Islamic University Malaysia and this study provides practical insights and uses an empirical approach to better understand the aspect of professional development in the individual. The issues explored are related to the impact of the training, the effectiveness of the training on staff, Islamic practice in workplace settings and improvement of soft skills as well as job scope.

BACKGROUND

In today's business world, competition at the marketplaces is very high among companies, organizations and institutions. For the organization to survive, remain relevant and productive, top administrators must continue to provide trainings and skills to their administrative personnel or staff to withstand the competition and challenges. Good products that will satisfy customers' needs are what every organization aimed for, but to win the customers' satisfaction and loyalty, it lies on the organization plan and strategies. Attending trainings and workshops benefits not only the organization, but the staff to contribute and improve the services. In developing creativity in educational organizations, better decision-making, the continuous improvement of human, resources, job satisfaction and participative in the decision process practices, it involves educational units and their workers (Anastasiou, Valkanos and Brinia, 2012). Educational leaders take the responsibility of developing opportunities to strengthen and improve, not only the academic staff but the administrative staff's' professional capacity.

In the context of Islamic University, Management Services Division (MSD) plays a role in developing the staff through organizing training per year. Besides professional development, staff in the Islamic University in Malaysia are required to go through spiritual development. As a normal practice and Islamic and Qur'anic practice that emphasize on seeking knowledge and human development, the Islamic University in Malaysia walks the same path by emphasizing on the importance of talent development

to improve the work quality of staff at the university by providing them with advanced knowledge and encouraging to obtain new skills. As such, every staff of the Islamic University in Malaysia is well-aware that they must attend and complete a religious and spiritual being activity such as Ibadah camp which is approved by the university. On top of that, the staff are required to fulfill a minimum of 7 days' work related training per year with 42 CTD points (Point of Competency Talent Development). The types of training and development programs are:

1. Induction Course: Introduction training for new staff for them to do their work in their new job role.
2. Industrial Attachment: The application of learned skills in an organization related to the staffs' job scope.
3. Ibadah Camp: Spiritual, religious course/training/talk
4. Centralized Training Programs: Basic courses that are compulsory for all staff to attend from all departments.
   4.1. Safety & Health Courses
   4.2. English Proficiency Classes
   4.3. Soft Skills Classes
   4.4. IT Courses
   4.5. Islamic Courses
   4.6. NLP, Professional Development Centralized Training
   4.7. Professional Development Courses
5. Allocation to attend relevant external courses and seminars: Staff are required to attend external training by the university. This is usually attended by higher management staff.
6. Allocation for study leave/study loan: Staff are granted to take study leave while their job position remains until they graduate and in certain situations, they are given study loan.
7. Part Time studies for the Islamic University in Malaysia Administrative & Technical Staff: Staff have the opportunity or allowed to attend part-time studies and working in the management at the same time.
8. Professional training such as training attachments: Training attachments that are given to staff that have at least more than 5 years of working experience.
9. External training applications organized by outside organizations (local or overseas): External organizations that organize the training of certain departments and invite them to do their training in their organization subject to application approval and sponsor.
10. Training Consultation and advice: Each staff can seek consultation and advice on the training that they are required to go and whether this training would benefit them in their roles or they can choose which training is suitable for them for their learning needs.

Staff members are more likely to be more committed to work when given a proper professional training. This includes enhancing learning skills that are relevant to individual career development, and lifelong learning. Such training may fail to tackle problems related to the staff's organizational needs. In particular, the practice of the theoretical part in the workplace settings is often the hardest part of the post-training.

Moreover, staff members are reluctant to go to the same training every year, despite having to fulfill 42 CTD points as a requirement for every staff. Hence, new trainings need to be offered to motivate all

the staff to acquire new knowledge at a higher level and gain their interest to attend. However, due to budget constraints, most of the staff that hoped to attend specific training needs to wait a longer time to get an approval and only selected staff is required to go for external training. Besides that, there are several researches that have been done in other countries on a similar topic, such as Professional School Principals Development in Tonga and Training Needs of by Vete, (1990). Other researchers, such as Jung, (2017) study on In-Service Professional Development Training Opportunities for Principals in Early Childhood Education. Unfortunately, all these studies and other studies on professional development in educational institutions, either on teacher professional development or academic staff at higher institutions. It is interesting and worthy for this chapter focusing on the professional training and development needs among administrators, not in an ordinary organization, but religious. The purpose of the present phenomenological qualitative study was to explore the perceptions, level of professional training and its impact in the context of Islamic University in Malaysia.

The outcomes of the results send a strong message to the university management of the improvement of their administrative staff for quality work and services. Again, the findings help voice out the concerns and challenges faced by the administrative staff at this university on the issue related to their professional growth and satisfaction. This chapter contributes also to the research literature in the area of professional development of administrators in an organization. The main objective of this study is to explore the professional development training and the needs among administrators at the Islamic University in Malaysia. Hence, this study sets to address these objectives in specific:

1. To explore the level of administrative staff's professional development and training at the Islamic University in Malaysia.
2. To identify the perceived professional development and training needs for administrative staff of the Islamic University in Malaysia.
3. To know the effect of professional development training program on administrative staff's' work performance.

LITERATURE REVIEW

Organizational Role on Professional Development and Training Needs

Leaders in any organization are responsible to send their employees to participate in any training program that are related to their job scope in order for the staff to perform well, to become more effective and to replace their outdated work habits. In addition, by providing regular training to the administrator there will high the tendency to reduce turnover, as stated by Egan, Yang, and Bartlett (2004) that organization that provide frequent and regular training for their employees are able to increase commitment and decrease turnover among their employees. Moreover, professional training programs are useful and it functions as the primary training tools for reaching the organizational goals. According to Dirani (2011), organizations should design their training programs to increase the likelihood that the staff would contribute their trainings to their job scope when they understand how to apply the newly learned knowledge and skills at work. Furthermore, it can be seen in Brazil, in a study of 1150 organizations (public, private, and third sector), the study identified that 42% of organizations invested their budget on training actions

within or outside their organization. These outcomes allow an association between the development of the organization and the level of investment in the professional development of the employees.

The Aim of Training and Development

The main purpose of training and development is to improve the abilities, skills, and competencies that are available to these employees and ultimately can increase employee productivity and help increase job satisfaction so as to increase employee support for turnover (Huselid, 1995). Regarding Mulang (2015), Latham, and Dello 2008), the term of training and development are refer "to planned efforts or designed to facilitate the acquisition of relevant skills, knowledge, and attitudes by members of the organization" (p 1). Another view the term of training and development from Mulang, Wexley and Yulk stated that "development focuses more on improving the decision making and human relation skills of middle and upper level management, while training involves lower level employees and the presentation of more factual and narrow subject matter" (p.1). Based on the point of view that, it clearly showed that training actually gives more opportunity for the administrative staff in helping them to expand their knowledge and understand on their job scope for organizational better performance. Furthermore, training also helps administrative staff to acquire new skills, sharpen existing ones; perform better; increase productivity and be a better staff for the organization. Training also involves a change in attitude, skills or knowledge of a person with the resultant improvement in the behaviour. There are so many types of training offered by organizations to their employees such as management training or soft skill training, which are important in an organization. It is known that training and development is the method of the organization to improve their staff' knowledge, skills and competence. Training and development are two of the same concepts which is to improve knowledge, soft skills and behaviour. Nevertheless, concerning on the objectives, these two concepts about training and development are distinguishable. This can be seen from the results of research conducted by Mulang (2015), where she found that training focuses more on the improvement of capability for current specific purposes, the development focuses more on improvement of knowledge for future job while the process is carried out to integrate other activities for an organization better work behavior.

Training and Development as Human Capital

The one that distinguishes the organization from the competitors is the Human Resource (HR). Human Resource departments play an important role in organizations, particularly in the competitive world where there are fierce competitions at every corner of the industry. Employees are the main support system of any organization and its functions as human assets which is much more important than financial assets. An organization should invest money in training and development of their employees to produce human capital. When employees are well equipped with extensive technical skills and knowledge, they have become an asset of the organization and therefore, it is easier for the organization to achieve the competitive advantage in the market. Previous research has shown that training and development stimulates employee satisfaction and motivation. Besides helping employees in their career growth, they are given other benefits such as promotion, salary increment, incentives, job security and so forth. With these advantages, it leads employees to stay longer in the organization and increase the overall productivity at work (Ahmed, Ahmad and Channar 2016).

Islamic Aspect of Training and Development

From the Islamic view of training and development, it focuses more on the human development of both spiritual and human uprightness. In fact, Islam positions the human condition between two extremes, a perfection which strives to be closer to Allah and lowest level, which is the reflection of the clay which is the origin of human. Training and development in Islam encompass the intellectual, moral; spiritual; physical development (Hashim, 2010). Although individuals vary in terms of their capacities, they are not burdened by the works which are beyond their capabilities. As the Qur'an mentions: "No soul shall have a burden laid on it greater than it can bear." (2:233). As a Khalifah of the earth, individuals are able to make a difference, take responsibility and contribute to society. Training is part of learning process whereby the more people learn, the more knowledgeable they get and they are able to distinguish between right and wrong. It requires a reflection on how important it is to reach the ideal work practice. When an individual keeps correcting his/her work due the impact of the training, they work better as a Muslim and as a worker. As a result of improvement in work, and knowledge, he/she is a step closer to Allah and towards the paradise.

METHODS

Research Design

This research is qualitative in nature, using a phenomenological approach. The design is properly classified as qualitative, as it sought to examine people in their natural setting in an attempt to make sense of or interpret the meaning that they create from their experiences within the context of phenomenon (Denzin & Lincoln, 2005); phenomenological, as it sought to understand and construct meaning of lived experience from the perspective of the participants. A semi-structured interview with open-ended questions was used to collect data in order to gain a better insight among administrator experiences and exposure on training.

Creswell (2007) suggested that a qualitative research method provides the framework to explore, define, and assist in understanding a phenomenon and the experiences people meet within the context of that phenomenon. Qualitative research, rather than quantitative, according to Creswell (2007), is more appropriate when the study requires in-depth and detailed understanding of a phenomenon and it can only be achieved by interviewing or observing people in their natural environment. The aim is to hear their stories and real experiences from the participants about their professional development needs. For the purpose of this research, a qualitative approach, rather than a quantitative approach, was appropriate for understanding the experiences of administrative staff to identify those influences and priorities, which affect these experiences and work performances.

Population of the Study

This study covers Islamic University in Malaysia. The population of the study consists of five administrative staff at the Islamic University in Malaysia. All candidates were administrative staff from various departments at the Islamic University in Malaysia.

Sampling

In this study, purposeful sampling technique was used and purposeful sampling is used when the researchers are quite familiar with the research location and environment. Participants were consulted on their willingness to be interviewed and their readiness to participate actively. Thus, after the participants expressed their intent to take part in this study, they were given a date based on their availability. The interviews were conducted, from 10 April to 30 April 2019, using semi-structured interview. A total of five participants were interviewed and one of them was male, while the rest were females. The number of years they have worked in this university is varied starting from 2 years to 29 years.

Data Collection

This study required information on professional development training needs for administrators at the Islamic University in Malaysia. Participants were approached first, through messaging (WhatsApp), asking their permission and volunteerism before being interviewed. The participants were asked five questions. "How does your training help you to develop professionally and personally? To what extent it has contributed to Islamic workplace practice?", "In your opinion, Do you think that the training you received leads to the improvement of the management? Can you give an example of the improvement that has been made in your department?", "To what extent your training has helped you in your job scope?", "To what extent the professional development training has helped you in your current situation? Do you think the level of training provided by the Islamic University in Malaysia to all the staff are same?" and "What kind of professional training/needs would you like to be offered to at the Islamic University in Malaysia? And why?". These questions were designed to get full and meaningful answers using the participant's own personal descriptions of professional development and training needs for administrators at Islamic University in Malaysia. The interviews lasted, around 15 to 20 minutes, which conducted, using a face to face method. The audio was recorded using a phone recorder with the consent of participation and notes were taken describing for any cues and clues which presented additional context for the verbal data. In order to explore the meaningful and precise cues in expressions and answering questions, a researcher or interviewer must listen closely and carefully (Leedy and Ormrod, 2004).

Data Analysis

The data analysis takes place in a number of steps. First, recorded interviews were transcribed immediately after the conversation has taken place. It is to assure thoughts, verbal and non-verbal information was grabbed and kept as best as possible. These immediate and detailed transcriptions enable the underlying meaning to be better kept. Creswell (2002) suggested focusing on meaning first before going to the substance. This step helps to understand the personalities and experiences of participants, including their subjective view and voices. Coded names were used and the story of each interviewed participant was written in detailed.

The next step was to look for themes and subthemes from the conversations and information provided. Merriam (2001) discovered one of the objectives of qualitative study as developing a "thick description" of the phenomenon being investigated. The thick description in need for researchers to understand the respondents very well in order to identify multiple contexts, themes and subthemes. To achieve this objective, the text obtained is examined for the presence of recurrent ideas that helped to identify

general themes. Then, coding and sub coding themes were developed. The encoding process helped to generate a description of each theme. The coding was then analyzed in order to assist understanding of professional development and training needs of administrators at the Islamic University in Malaysia and its effect to them. The themes generated were analyzed for additional division of topic or sub themes information. The coding and description of additional sub themes were also generated. The research questions and related literature help in directing the finding of patterns within themes and subthemes. The data interpretation process contributed to the development of theoretical structures which may help in determining the significance of conclusion built.

Ethical Consideration

In this study, it is important to note that the central ethical issues have been considered with the highest level of respect and appreciation, including integrity, informed consent, confidentiality, anonymity, data storage, accurate representation of the research study to the participants, and achieving objectivity in obtaining the results (Lahlafi, and Diane, (2013). All of the essential information has been provided to respondents with a clear understanding of the nature of the research that was being undertaken. The participants were informed that they had the right to withdraw from the study at any time and that their data would only be used for research purposes.

As noted, the study sampling consisted of administrative staff from Islamic University in Malaysia. However, to maintain a high level of anonymity, we labeled them as follows: Participant 1, Participant 2, Participant 3, Participant 4 and Participant 5. The name of their division they worked never been mentioned. All of the participants were told about this method in order to give them more confidence in addressing their attitudes and share their ideas. During the interview sessions, the audio was recorded using the recorder from the researcher's phone. These recorded materials were kept on the researcher's personal laptop and is secured with a password. The participants' names also have been coded using numbers to represent each participant in analyzing and presenting the data. Creswell (2002) explained that masking the names of the participants in the data is helpful for providing Anonymity.

Validity and Reliability

The concern for validity was a final consideration in this approach as well as in qualitative research which has a common question because qualitative research does not follow the same scientific procedures as those used in quantitative research (Cho & Trent, 2006). Although validity was debated, Silverman (2011) stated that validity as one of two essential concepts used to ensure the research credibility. Also stated that, another tradition describes validity as "the strength and soundness of statement; in the social sciences validity can mean whether a method investigates what it proposes to investigate" (Kvale & Brinkmann, 2009, p. 372). As this is a semi-structured interview, researchers developed the questions based on the reflection of the research objectives, experiences, observation, knowledge and collecting ideas from other researchers. Literature review also played a part in developing the questions. Interview questions were analyzed for reliability. The reliability test was carried out on questions related to training that help develop professionally and personally that has contributed to Islamic workplace practices, the effectiveness of trainings that received lead to the improvement of the management and job scope. The importance of this test is to find out which interview question items are provided with high reliability. Once the questions are analyzed, the researchers consulted with the professor of Human Resources sub-

ject to vet whether it is acceptable to be interviewed. After making some improvements and maintaining the integrity of the information, the researchers set an appointment prior before the interview day with the respondent because at the time of this study the mostly all the administrator was very busy with the enrollment for the new students, then researchers give them the consent letter with the question.

The validity of a study, according to Silverman (2011) is dependent on the data to be collected and interpreted in a way that conclude, "... accurately reflect and represent the real world that was studied" (Yin, 2010, p.78). This study followed all the recommendations steps in phenomenological methods. Besides that, this study presented transcript of the interview to the participants, allowing them to check for accuracy in order to assure validity. In terms of transferability, this study included significant part of participants' views so that readers can compare our statements with their own experiences and make their own naturalistic generalizations. Any changes or deletions of codes and contents in this study were recorded to make this research as transparent as possible.

INTERVIEW REPORTS

After completing abstractions, the researchers explained the results, which in this result, there are five themes emerged, based on the objective of this study, namely to explore the level of administrative staff's professional development and training at the Islamic University in Malaysia, to identify the perceived professional development and training needs for administrative staff at the Islamic University in Malaysia. Besides, to know the effect of professional development training program on their work performance.

THEME 1: PROFESSIONAL DEVELOPMENT TRAINING AS A PART OF IMPROVEMENT

In this study, the researchers discovered that the most given answers by administrators on their professional development training and needs are usually improved in terms of their job scope and their soft skills that help themselves to improve it. Not only that, they also claimed that professional development training and needs can be one of their sources of improvement which helps them to understand more deeply and benefit in terms of knowledge in their workplace. One of the participants says that:

"As a staff we need training and looking forward for training because training this is one way to develop yourself, improve your skills in terms of your job skills or soft skills ..."

Sub-Theme 1: Improvement on Job Scope

All participants commonly attended the training provided by the MSD. Attending recommended training, inside or outside of the university will equip the administrative staff with new skills to perform well in their job scope. It can be seen from all the transcribed information that almost all the participants agreed and stated that how training helps them in their job scope. **Participant 1** said that:

"Job related training is the most important thing that needs to be done. There used to be training and test for administrator, English for officer level. The Rectors wants to see because some languages of the

letters are ridden. Will be divided into groups based on the result. Will be taught what kind of paper, or proposal …"

Through professional and development training, the administrative staff are learning and gaining knowledge that could help them to apply and deliver at their workplaces or departments. For example, **participant 2** learns how to use the database for citation and references to teach the others in the library session. **Participant 2** said:

"... if the database is just like how to use the databases .. for example medley, zickok, zotero ... do you know? references tools ..so we need to learn it first before we teach others aaa..like that .. like Google scholar it also …"

Participant 3: *"... not only soft skills there also have professional such as that related with their job. For example admin, we do the minute meeting. Other than that, if they are accountant we will invite finance to come, staff from finance will come and talk about the things that related with account, if auditor we will invite the thing that related with audit…"*

Participant 4: *"I have to audit all the kulliyah and all the staff. I am the internal auditor. For that I took training for one week which helps me a lot."*

Participant 5: *"Definitely yes... it really helps in improving your skills, our knowledge, skills and knowledge but again over here we don't have a specific training. I mean they have training but like myself I am in charge of International Affairs where the university does not provide training like eerr.. how to deal with international. For example international students but it's more on general training like communication skills but it definitely helps a lot ..."*

Sub-Theme 2: Improvement on Soft Skills

Most of the trainings that were provided, not only to improve work, but to improve their soft skills. Participants said that:

Participant 1: *"… soft skill for certain criteria and then quality part and then there is a supervisor for staff also we have to know how to be a boss, supervisor, how to monitoring, and various skills. How to handle stress, how to manage your/ handle the situation or organize program …"*

Participant 2: *"... one more slide presentation.. how sometimes we like to own the slides for this kind of modern slides you need to use even he 10 times .. he looks like a je like flash pretty ... beautiful .. beautiful..haaa ohh like this while we do not know any pound it's selfie make slide ... aaa tu slide .. technically we learn to edit pictures .. poster ... aaaa another one where we can manage the person below us, to handle the older ones .. because he eats more salt from us aaa so we want to make it like that aaa .. to face the angry people like the smiling…"*

One of the participants from HR department stated that:

Participant 3: *"...what are the HR do? the latest, what we have done, we do .. aaa .. image consultant like grooming.. there are also excel, Microsoft as usual .. we also provide training for Photoshop, ai, administer…"*

Participant 4: *"PowerPoint presentation and leadership are the main kinds of professional training need for Islamic University in Malaysia"*

Sub-Theme 3: Training on Islamic Knowledge

As a university that applies Islamic value, Management Service Division is responsible to provide training to all staff and some added-values training on further development in Islamic religion knowledge, Islamic Funeral & Death Rites Course, Tazkirah, and others. It can be seen from the statement of the participants:

Participant 1: *"Training that more to Islamic, depends on who want to join. Examples of training for hadith or workshop courses a day. I need to attend Hadis training enroll on Wednesday and Thursday ..."*

Similarly, with participant 2 that explained her experiences of professional development trainings that she joined that related to Islamic knowledge:

Participant 2: *"… sometimes there have courses for public to all people whether there are professional staff or support staffs… aaa… all The Islamic University in Malaysia can join.. like hadith aaa.. course on health .. usrah .. usrah also was already decided by them..."*

Participant 3: *"… two months or three months later, we will have training on hibah, faraid, aaa event even though zakat also did not related with faraid or hibah but this thing is for the whole. Everyone can join this training…"*

Participant 5: *"... we are also offered training like jenazah course. They provide us tazkirah every Friday, there is a talk below here where it is conducted but that one is only called upon invitation. But for me, hmm which should be balanced just that what I see, I am so sorry to say, I can see some of my.. my observation for the support staff they are more into religious matter …"*

THEME 2: CHALLENGES FACED IN PROFESSIONAL DEVELOPMENT TRAINING

There are some challenges that the participants faced in terms of professional development training and the challenges are varied:

Sub-Theme 1: Offering more trainings to Academic Staff

Training that is provided by MSD, as it stated in the policy or paper are given to both administrative staff and academic staff. However, from this study, researchers discovered that, based on the participant 1 claim, most of the training that provide by the MSD are given to the academic staff.

Participant 1: *"Admin's training is less than adequate. For instance mobility just for academic and for admin is limited chance is likely to exist but not open to all. More advantage for Academic …"*

Participant 4: *"... university gives more attention on academic staff rather than administrative staff for their professional development."*

Sub-Theme 2: Lack of Financial Resources

As it is well-known, providing or sending staff for training seemed to be costly for involving or inviting expertise. The participant 1 mentioned: "Because we need specific training and that training are not offer because of limited cost and always offer the same training …"

Participant 3: *"... I take the example of external training, we are not given the external training but the staff by themselves are looking for that and will apply to us.. and that is my specific job scope that indeed an external training .. so if they want to go for training, for example safety course that are needed fairly high cost..."*

Participant 4: *"To compare other university or big company like Telekom Malaysia they are much better than The Islamic University in Malaysia because it depends on budget"*

Participant 5: *"... we are trying very hard to find, in fact under my unit, I'm trying very hard to find that… university partner that can offer training or our admin staff, with overseas scholarship so that we don't have to attend training that is based on talking and talking. We want to be attached to the office like last time I was attached to Turkey international office at a university in Turkey. I learnt how they do everything like benchmarking."*

Sub-Theme 3: Time Consuming

As an administrative staff, there are excessive workloads needed to complete. In addition, most of the training was mostly done during the office hours where the administrative staffs have to choose and eventually, prioritized their main task or job instead of attending training. Participant 2 mentions: "… I cannot apply training outside rather than my university because of due to job queue and my time constraints ..."

Sub-Theme 4: Need New guideline and new content

The revolution of information technology and knowledge development and globalization, are changing the way things are done in organization radically. To cope with the modern development in educational

competition, staffs need new guidelines and new contents in their training programs. Traditional training styles and contents are becoming ineffective and has failed to ensure staff professional development.

Participant 4: *"... every year we are getting the same trainers, same contents and same types of training, which I think need to be changed because the world is changing very fast ..."*

THEME 3: PROFESSIONAL DEVELOPMENT OPPORTUNITIES AVAILABLE TO ADMINISTRATIVE STAFF

Professional development training is more important for the administrative staff to help them especially in their career. All staff, whether they are new or senior staff are required to join any training that provided by the Malaysian Government.

Sub-Theme 1: Promotion

By joining a variety of trainings that are provided by the university, it prepares the potential staff or administrators to handle their own duties and responsibilities. It, thereby, makes the participants eligible for promotion for better positions in their organization. By fulfill the university requirement at least 42 CTD points for every year, it will help them get the promotion. According to statement by:

Participant 1: *"… For university requirement all staff needs to fulfill 42 CTD points. We have to complete at least 42 points for a year. One of the criteria beside you needs to achieve 85% and above appraisal performance annual record (APAR) and recommendation for head department (promotion part) …"*

Participant 2: *"... cause by the employer was decided that you must go to get 46, so rather you need no need you must get and caught any courses that you do not really want to go to the course you need to go for the increasing salary for us a promotion a must have ..."*

Sub-Theme 2: Variation in Administrative Staff' Professional Development Training and Experience

Based on the interview results that the authors reported, four of the participants have worked at this university for more than 10 years, so they have followed various types of trainings offered by the university. The longer that staff work at that place, the more training that they had ever attended.

Participant 2: *"... I've been going to oversee form The Islamic University in Malaysia sponsorship to see other libraries, the way their do.. Is fun but to be fully sponsored ... we are looking for training that is just a ticket sponsor…"*

Sub-Theme 3: Training Must be Free for the Staff

One of the greatest advantages of on the job training is that, trainings are free of charge. There are various professional skill development trainings which are considered expensive to attend by the adminis-

trative staff. Due to the budget constraints, as a result, sometimes university postponed several training programs or workshops that are highly important for staff and could directly affect the development of the staff performance.

Participant 4: *"... staff used to get frequent training programs but due to budget constraints in recent years training programs become limited."*

THEME 4: FUTURE TRAINING PROFESSIONAL DEVELOPMENT NEEDS OF ADMINISTRATIVE STAFF

As said before, staff training is very important for every organization. An increase in the skills usually helps to increase both quantity and quality of output. Based on the interviews, it can be concluded that all participants want a change in the training that was given because, they find that the same training was provided each year. In addition, they want equal opportunity as the academic staff to join the necessary training related to their job scope.

Participant 1: *"Please provide different training next year. Job related to this training because each staff has different course or job scope …"*

Participant 3: *"... excel for me, in one year we do three times or four times are recommended because most of the staff they are gold level, the platinum level did not say that they are older. This platinum level most of them IT blind so when they are using it easy for them to save their document …"*

THEME 5: ADMINISTRATOR STAFF PERCEPTION REGARDING PROFESSIONAL DEVELOPMENT TRAINING AND NEEDS

According to the interview with the participants of this study on professional development and training needs, they have shown their perceptions and opinions regarding the training that they have received from their university.

Participant 1: *"... Because we need specific training and that training are not offer because of limited cost and always offer the same training, so when you already go to the training, you will not go again. For recall purposes it is okay but bad because there's no new thing that you will learn…"*

Participant 5: *"Definitely communication is the main one, definitely on the management, financial part, that one we have to handle, planning, organizing, like every semester I conduct programs for exchange students so yes every.. I think you are familiar with every program we organize, where we face problems but I think the training will only be training if you don't have any experience to go through so no point in going training because in trainings we learn more about theoretical part."*

DISCUSSION

Offering professional development and training programs will allow staff to perform better and also will help them to prepare for future positions with the greater responsibilities. Through training, an administrator can develop or obtain the skills to deal with the constant changes that occur around them. Based on this study, researchers found that administrative staff needs more new training that are related to their job scope and a chance to join any training that can enhance their performance. It is important to send that new or old staff for training on using technologies. For example, the old staff need training that can teach them about how to use Microsoft PowerPoint for the presentation. While the new staff need training to teach them how to do their work efficiently and effectively. Besides that, giving an equal chance to administrative staff to join any training that is beneficial to them, whether inside the university or outside university will show university management curiosity towards the development of the university as a whole. Academic staff are not the only staff that contribute to the development of the university, it is a collective effort and performance that included the administrative staff. The task might be different, but the goals are the same and equal. If the university has budget constraint and unable to send or sponsor their administrative staff to attend trainings outside the campus, they can enroll their staff to join any training that provide by INTAN (Institut Tadbiran Awam Negara) because, the fees charged for training at INTAN are considered lower and avoidable.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

There are three limitations in this study. Firstly and generally, the number of participants that were interviewed for this study might not be enough to represent the whole staff at the Islamic University in Malaysia and departments/divisions. But from the qualitative design perspective, five respondents or small samples are practically enough for qualitative research as qualitative design seeks for saturation and does not aim to generalize the findings like quantitative design. Staffs experience and perspectives on professional development training and needs can vary due to many reasons other than what has been found in our result. According to Dirani (2011) the findings of the study of professional development for administrative staff could be subjected to different interpretations due to the environment surrounding the research as well as the observer subjectivity. Significantly, analysis of the perceptions and experiences of the staff towards training helped researchers develop an understanding of the range of factors that mediate and impact the effectiveness of the training. The second limitation is about this research, focusing on one location or campus, whereas, Malaysian universities tend to have campuses in different states in Malaysia to reach their students. Again, the environment of the surrounding may have impact differently at a different place. Thirdly, the time frame in finding the participant. According to the Islamic University in Malaysia's academic calendar, the periods of the interviews were quite the busiest periods for most staff. Hence, this led to the researchers going from one department to another to find participants and seek their consent in person. Due to their tight schedules, most of them are reluctant to give their time to be interviewed and as a result, they declined the interview invitation. Due to time constraints, researchers managed to get five respondents from different departments for the interview. Notwithstanding, saturation is needed in qualitative as mentioned before. Importantly, if it is not the first research in the world, this is the first research that was done in Malaysia that has studied the professional development of the administrative staff at Islamic University Malaysia. Therefore, based on the

findings of this research, future research is needed to explore other areas of professional development; include other administrative staff at other campuses; by interviewing their respective directors or leaders to examine their options about their administrative staff and perhaps, students' perceptions towards administrative staff' services at Islamic University in Malaysia. As this research is done qualitatively, it is recommended for future research to study a similar topic or objective while using quantitative methods.

CONCLUSION

The findings of this study have given insights to the perception and the effect of professional development and training needs of administrators at the Islamic University in Malaysia. In this study, researchers found that there were some trainings and development programs provided for the administrative staff at every division at the Islamic University to enhance and upgrade the administrative staff skills, but researchers found in this study that the majority of the administrators that participated in this study said that, the training provided by the Islamic University are not related to their specific job scope and trainings that they received were very limited. Besides that and very strangely, the University tends to focus on general training such as Jenazah (funeral) course, seldom English course, stress management and others. Therefore, the researchers found that the administrative staff at the university are in need of trainings that are related to the job scope so that or later on, they can develop their profession, and produce high quality work.

According to the participants, 'once upon a time' there were full training on improving English proficiency and communication among administrative staff as part of the PD, but, due to the budget constraint, the training seems no more provided on a large scale. In addition, the results show that the professional development and training needs that the administrative staff received by the Islamic University are repeated by giving or providing the same training every year. At every university in Malaysia, whether Islamic or none, the administrative staff must fulfil their 42 CTD points every year that is required by the university as Key Performance Indicators (PKI) and for the sake of promotion.

Furthermore, when it comes to training aids and sponsorship, only the selected staff will have the privilege to join the trainings that are provided outside their university or other countries. This is due to the limited budget and in these cases, the academic staff are the 'breadwinners to attend the training. Hence, this is one of the complaints from the participants that, trainings are mostly provided for academic staff. From the findings of this study, the research found that most of the administrative staffs have attended trainings outside their university on their own expenses to increase their professional development and skills. Thus, they mentioned their self-sponsored training at the National Institute of Public Administration (INTAN).

In addition, another problem that affects administrative staff in their professional development is to see the luckier or luckiest administrative staff among them that were selected for advanced professional training hiding the skills or knowledge obtained from the training without the courtesy of sharing them with other administrative staff.

In light of this, it does not make any difference whether the organization is Islamic or none as every organization should keep providing training to improve their works' competency for efficiency. Also, from some literatures cited in this study, the performance of the organization depends on the performance of its workers. Moreover, training and continuous improving workers' skills, whether academic and non-academic is considered as an investment. The outcomes of the investment will yield positive

results by seeing organization improving better and better especially when the training focuses on job scope. Professional development needs are not only meant for academic staff at the university, but, it includes administrative staff in order to produce quality in their administrative work.

Most importantly, this research is one of its kinds in Malaysia and in the Muslim world. There is a scarcity of research that looks into the professional development needs of administrators particularly at the Islamic university. Most of the research at the university level looks into the professional development needs for academicians. Therefore, this study proves that, both academicians and administrators highly need professional training and development activities to involve themselves with, for the sake and betterment of the university especially Islamic university in providing quality services and productions.

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KEY TERMS AND DEFINITIONS

Administrator: Is someone who is responsible for managing and carrying out the administration duties and activities of an organization or institution.

Development: Is a process in which someone or something develops or changes to become better or advanced.

Islamic Human Resources: Are every individual or employee who is a Muslim that works in an Islamic organization that observes and practice Islamic teachings in their organization.

Professional Development: Is a process carried out by the employees in a company, organization or institution to improve and also increasing their abilities by receiving education and training in their workplaces, following training provided by other organizations, or by seeing senior workers do that work.

Professionals: Are staff that are officially recognized by professional organizations for that profession where the staff has completed the training or education needed by them and usually the professional organization has set the standards that must be met by participants.

Training Needs: Is an activity organized by an organization or institution that aims to provide information or instruction to enhance performance or to assist participants in the training to attain the level of knowledge and skills that the employees need.

Chapter 25
Supporting Community Engagement Through Real-World Instructional Learning

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ABSTRACT

The ability to attain knowledge for implementation within real-world environments is a shift in understanding within many instructional environments. Shifting from competency-based understandings wherein a knowledge base is attained as well as implemented towards a capability-based understanding that emphasizes the conceptual framework of information shift towards higher order knowledge creation within novel situations and environments is essential. Lifelong learning within nuanced understandings of new situations and new experiences is essential. Normally, these novel situations and experiences occur within a real-world community environment wherein the learner is critically analyzing new information and opinions from innumerable engaged people within the community. This style of learning is vital to understand within a competency-based learning environment, as well. Therefore, real-world instructional learning embeds the supporting community engagement at distinctly appropriate and impactful points throughout the instructional process, resulting in outstanding conceptual frameworks with the continuous understanding around cognitive engagement.

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INTRODUCTION

The instructional process is an intriguing dance between knowledge and intentional usage, between an instructional environment and the real world implementation of that information. The shift in learner engagement while working with the new knowledge, the information, is a curiously arduous task that defines mere knowledge acquisition and its forward-leaning real world implementation. A question posted by Wenger is simply stated yet powerful in impression and influence: "So, what if we adopted a different perspective, one that placed learning in the context of our lived experience of participation in the world?" (Wenger, 1998, p. 3; Wenger, 2009, p. 210). What if a different question was brought forward, rethinking the instructional world in which traditionalists thrive but subject matter is tied to the four walls of the learning experience instead of embracing the learner's lived experiences as participants in a deeper understanding of the subject matter under study. The question, is how might one successfully move between the classroom learning experience and the real world implementation of the learned information in successful ways? Herein is the focus of this discussion, towards framing an understanding of the learning process that slowly embeds within an assessment of learned knowledge and viable usefulness within a real-world environment. Analyzing the viability of the usefulness of the learned information within a real-world environment necessitates a reflective approach that allows for additional learning progression and framing one's knowledge acquisition a bit more succinctly.

The final question revolves around the competency of the learner, towards using this information in a real-world environment. Throughout this process, the instructional facilitator's efforts are viable, as is the viability of engagement by the learner. Yet perhaps unrecognized throughout the majority of the learning and development process is the community in which the learner embeds the new information; the community engagement. Overlooking this imperative may be viewed as a foolish endeavor, as the community engagement may be defined as defined by the learner's world as a *collegial community*. Each learner's collegial community environment, friends and family, co-workers and supervisors, as well as the co-learners and instructional facilitators directly impacts the learner in an everyday manner, regularly support and impact the learner's knowledge acquisition and understanding, self-efficacy and even evaluative engagement. Embedding each learner's collegial community throughout the learning process is an imperative, worthy of long-term self-efficacy and informational impact.

BACKGROUND

A background understanding of the learning and knowledge acquisition process is a viable consideration. This is important not only towards better understanding the frames of theoretical and modeling reference upon which the concept of supporting community engagement within real world instructional learning efforts are based; thus, but also towards highlighting the undergirding instructional thoughts, advantages and impediments that facilitate the learner's knowledge acquisition and real-world impact, including implementation towards performance improvement and talent development. The primary aspects under consideration are Maslow's hierarchy of needs, Bloom's cognitive taxonomies that includes Anderson and Krathwohl's revised cognitive taxonomies, learning theories framed as pedagogy, andragogy and heutagogy, Vygotsky's conceptual frameworks of understanding, Wittgenstein's social discourse, as well as Wenger-Trayner's learning in landscapes of practice.

MASLOW'S HIERARCHY OF NEEDS

Maslow's work is based within an understanding of learner support that initiates with a base level of physiological needs and ultimately attains levels of self-transcendence (Koltko-Rivera, 2006; Maslow, 1943, 1954, 1961, 1962a, 1962b, 1963, 1964, 1969a, 1969b, 1970, 1971, 1979, 1982, 1987, 1993a, 1993b, 1993c, 1996, 1999a, 1999b, 1999c). Of intrigue within Maslow's work, is the recognition that the learners naturally flow between the hierarchical designations of need attainment as impacted by one's real world daily needs that may occur outside of the classroom as well as inside the classroom instructional environment. A strong understanding of Maslow's hierarchy of needs is framed by Koltko-Rivera (2006), noting the integration of Maslow's later works that add self-transcendence to the top of the hierarchy of needs attainment is recognized through the depiction represented in Table 1:

Table 1. A Rectified Version of Maslow's Hierarchy of Needs

Motivational Level	Description of person at this level
Self-transcendence	Seeks to further a cause beyond the self and to experience a communion beyond the boundaries of the self through peak experience.
Self-actualization	Seeks fulfillment of personal potential.
Esteem needs	Seeks esteem through recognition or achievement.
Belongingness and love needs.	Seeks affiliation with a group.
Safety needs	Seeks security through order and law.
Physiological (survival) needs	Seeks to obtain the basic necessities of life.

(Koltko-Rivera, 2006, p. 303)

Through understanding the needs of the learners, the motivational focus of the learners towards meeting more basic physiological and safety needs before considering needs associated with belonging and self-esteem, and then striving towards self-actualization and self-transcendence. The learner's embedded community engagement rooted within the belongingness and self-esteem needs of the learner sustained through the learner acquisition efforts of supporting community engagement through real world instructional learning.

COGNITIVE TAXONOMIES

The work of Bloom, focused upon cognitive taxonomies, is inherently viable and expediently integral towards understanding the progressive learning and informational engagement of the learner with the subject matter under study (Anderson, 2013; Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths & Wittrock, 2001; Bloom, Englehart, Furst, Hill & Krathwohl, 1956; Krathwohl, Bloom & Masia, 1964). From a simplistic understanding, Bloom's work around designating progressively heightened understandings and usage of knowledge in new and differentiated manners must be clearly articulated, while the work of Anderson and Krathwohl's revisionary understandings of Bloom's original efforts are also worthy of recognition (Table 2):

Table 2. Bloom's Taxonomy of the Cognitive Domain versus Anderson and Krathwohl's Revised Taxonomy

Thinking Skills of Taxonomy	Bloom's Taxonomy	Anderson and Krathwohl's Revised Taxonomy
Lower Order	Knowledge	Remember
	Comprehension	Understand
	Application	Apply
	Analysis	Analyze
	Synthesis	Evaluate
Higher Order	Evaluation	Create

The captivating aspects of Bloom's taxonomic designation is that it is framed through a noun descriptive designation, while Anderson and Krathwohl's revised taxonomy shifted to verb descriptive designations. Another intriguing differentiation is that Bloom's "Evaluation" was considered the ultimate higher order thinking skill that may be reached. Anderson and Krathwohl's revised the two top levels of the cognitive taxonomic designations of higher order thinking skills to designate "Evaluate" as the second highest thinking skill and replaced the ultimate higher order thinking skill that may be reached to "Create" as a reconsideration of Bloom's "Synthesis". Although there is significant differentiation and entrenched understandings within Bloom's taxonomy of the cognitive domain, the articulation of this differentiation continues to emphasize application as an initial step towards an analysis of the newly acquired information that has been tested as applied, with the next step towards understanding being the analytic engagement with the information. The implementation of the application and analytic phases of the cognitive taxonomy within a real world learning environment engrains the support of the community's engagement towards formative and summative evaluative efforts suggested as enhancements that lead towards more creative understandings of the subject matter under study. Returning to the learning environment for purposes of a probing scrutiny or perhaps additional evaluative efforts that may support an inquiry-based exploration of real world implementation and potentials may lead towards re-learning, rethinking the learned information, and/or rethinking one's conceptual framework of understanding within a real-world environment. .

PEDAGOGY, ANDRAGOGY AND HEUTAGOGY

The ability to understand how people learn is necessary and impactful, not only from an understanding of the curricular and instructional design but also towards better understanding the needs of the learners. Of interest is the reconsideration and extension of consideration around the learning theories of pedagogy, andragogy and heutagogy from a teaching and learning, talent development and knowledge acquisition framework. As such, Crawford, Young Wallace and White (2018) have framed a deeper understanding of the 21st century digital impacts of the teaching and learning process through understandings of: learning, focus, power and control; learning; learning design; and, development (p. 16). Towards representing the discussion succinctly, Table 3 offers a constructive layout of the alignment between pedagogy, andragogy and heutagogy's enhanced differentiation towards better understanding the learner's engagement with the subject matter under study.

Table 3. Alignment and Differentiation between Pedagogy, Andragogy and Heutagogy

Differentiated Areas	Pedagogy	Andragogy	Heutagogy
Learning	Instructor-Directed	Self-Directed	Self-Determined
Focus	Knowledge	Content	Process
Power and Control	Instructor-Directed	Instructor-Learner-Coordinated	Learner-Directed
Learning	Single-Loop (goals and rules)	Double-Loop (modification)	Spiral-Loop (transformation)
Learning Design	Linear (modular)	Cyclical (spiral)	Holistic (mastery and trustworthiness)
Development	Knowledge	Competency	Capability

(Crawford, Young Wallace, & White, 2018, pp. 16-18)

Of particular interest is Crawford, Young Wallace and White's work around pedagogy's normally understood implementation as a cognitive development recognition of the younger learner up to approximately the age of 16 years old, suggesting that pedagogy is instead a reflection of "tabula rasa" or a blank slate that must be controlled by the instructor; "Yet what if, instead, pedagogy is merely an epistemological understanding that the learner lacks a knowledge base around specific subject matter. If this were the recognition, then pedagogy may also frame an adult learner's recognition of engagement with new knowledge" (p. 16). Based within this understanding, pedagogical theories are not age-based cognitive development but, instead, merely a lack of the learner's knowledge base. This could shift the understanding of the teaching and learning process significantly. Further, the introduction of a supporting community engagement through real world instructional learning can be more easily recognized as viable and impactful, throughout the deeper informational engagement of the learner with the subject matter.

VYGOTSKY'S CONCEPTUAL FRAMEWORKS OF UNDERSTANDING

Vygotsky's work around how the learner understands new information, by making conceptual frames of reference and understanding within one's own memory is intriguing (1934/1987, 1962, 1978). Simplistically, each time the learner attempts to acquire new information, the information must be placed somewhere in a person's memory; as such, the learner's cognitive efforts attempt to make connections between old information and the new information is readily available to pull up and to use at the learner's will. This process is much like an interconnected database structure that can pull information that appears to be connected into a cohesive and connected understanding. Yet, working with the information in new and different ways, checking and re-learning information supports the learner's developing frame of reference so that appropriate connections between information are created and solidified, with the subsequent recognition that reconnections and additional connections will continue throughout the learner's cognitive life cycle. Vygotsky's work explained the processes around the learner's conceptual frameworks of understanding, how information fits together in each learner's understanding, the importance of knowledge checking towards an assurance that misunderstandings are corrected early, and through a social engagement. This social engagement supports the discussion around inserting the learner's community engagement throughout the real world instructional learning, towards an ability to cognitively engage in learning, performance improvement and talent development understandings within

a larger realm of support systems that clarify, correct, enhance and solidify the learner's understanding of the new subject matter in new and different ways. This in turn further develops the learner's conceptual frameworks of understanding as pertains to the subject matter under study and focus.

WITTGENSTEIN'S SOCIAL DISCOURSE

Wittgenstein's (1922) work around social discourse and understanding subject matter through word choice and the social context in which the words are spoken is impactful to this discussion due to the impact of communicative understanding on the part of the learner. More specifically, the word choices implemented through which to introduce, explain and engage with the subject matter are vitally important towards the learner's understanding and acquisition of thought around the new information (Burr, 2015; Gorski, 2016; Gupta, 2016; Inwood, 2015; Shotter, 2015). While considering the impact of the learner's community upon the knowledge acquisition and enhanced understandings of the subject matter, one must consider that the supporting community engagement embeds a more developed social context of understanding through the social discourse achieved by the community-embedded and engaged approaches, more thoroughly structuring the real world instructional learning and long-term cognitive understanding on the part of the learner.

WENGER-TRAYNER'S LEARNING IN LANDSCAPES OF PRACTICE

The work of Etienne Wenger-Trayner has focused upon social learning theory and practice and social learning capability (Wenger, 2009) over an extended period of time, initiating the constructivist-embedded understanding around communities of learning (Wenger, 2010). This focus changed the face of many learning environments towards embracing differentiated learning approaches, with a next step approach to understanding communities of learning to include an extension designated as *learning in landscapes of practice* (Wenger, 1998, 2009; Wenger-Trayner, Fenton-O'Creevy, Hutchison, Kubiak, & Wenger-Trayner, 2014; Wenger-Trayner & Wenger-Trayner, 2015). As suggested by Crawford, Young Wallace and White (2018), "Embracing a deeper understanding of differentiated learning is a curious task in this digital world, as social media and social learning have embraced concepts around communities of learning and learning in landscapes of practice" (p. 15). Wenger-Trayner reflects upon the theoretical advancement and progressive shift in approach that recognized the larger impact of an understanding defined as learning in landscapes of practice:

- *We focus on* ***landscapes of practice****, rather than single communities or networks as a key locus of social learning capability.*
- *We introduce the concept of* ***knowledgeability*** *as an outcome of learning with respect to a landscape, which includes a lot of practices in which one cannot claim competence. Theoretically knowledgeability is a landscape-level counterpart to the concept of competence, which is defined at the level of communities of practice.*
  (Wenger-Trayner & Wenger-Trayner, n.d., para. 2)

Through this lens, one may recognize the inherent *next step* approach to a recognition of the impact of the supporting community engagement upon the learner's progressive understanding of new information by practical applications within the real world environment, moving beyond theory and knowing, into real world practical understandings and knowledgeability from a practiced and practical point of subject matter analytic discussion.

COMMUNITY ENGAGEMENT AND REAL WORLD LEARNING

The recognition undergirding the theoretical discussions inherent within any teaching and learning, performance improvement and talent development understanding is vitally important towards laying the groundwork for a more inclusive discussion around the *next step* advanced thought processes associated with a new conceptual understanding, such as supporting community engagement through real world instructional learning. As such, an extensive engagement in theoretical underpinnings has been framed. Yet, what is the value, the forward-leaning worth of community engagement throughout the learning acquisition process? To what ends does the learner's need towards implementing new information within a larger community realm offer not only embedded understandings around the subject matter in focus, but a depth of knowing and knowledgeability recognize the worth of the collegial community's engagement in the learner's knowledge acquisition journey? Five aspects of value are considered: competency-based learning; learner engagement; active instructional engagement; community engagement that includes academic, personal and professional support; and, real world instructional learning.

COMPETENCY-BASED LEARNING

Competency-based learning is an approach wherein the learner must demonstrate a level of mastery associated with the subject matter under study. Of interest is that competency-based learning is more often focused upon learning associated with concrete skills that are easily recognized as attained or not attained; however, a shift in thought process towards competency-based learning around more abstract subject matter attainment is developing as viable considerations towards enhancing a real world implementation of the subject matter. Beyond the four walls of the traditional classroom learning environment is one way by which competency-based learning is described, reflecting a recognition of the need to answer the "why" questions behind mandates for subject matter learning acquisition. From a real world consideration, the questions around "why" are viable concerns. The potential disconnect between memorized information and the actual usefulness of this information within a larger scope of understanding is necessary and appropriate to embed within any instructional effort.

Why is this information useful? How does this information connect to other information, especially considering how this information connects to useful real world implementation? These questions are always asked by curious, creative and inquiring learners who want to understand the connections between information more completely than mere knowledge-level memorization skills that may be viable towards completing standardized examinations but are not impactful within the real world of life's journey. The study of competency-based learning is growing in interest (Carraccio, Englander, Van Melle, Ten Cate, Lockyer, Chan, Frank & Snell, 2016; Desy, Reed, & Wolanskyj, 2017; Ellison & Dhuse, 2019; Holmboe, 2015; Lacey & Murray, 2015; Lammerding-Koeppel, Giesler, Gornostayeva, Narciss, Wosnik, Zipfel,

Griewatz, & Fritze, 2017). This focus upon the learner's acquisition of new information that is not merely theoretical or conceptual in nature, but focuses upon the learner's actual demonstration of the learned information, prior to progressing forward to the next or additional learning opportunity. An additional consideration is that the instructional design of the curricular engagement is more fine-tuned as an approach to learning, as competencies are designated as smaller nuggets of informational engagement that ultimately achieve a larger and significant instructional objective and subsequent goal.

This style of instruction within real world environments is impactful, as competency-based learning is significant within a community engagement focus due to the community-based support and real world instructional engagement achieved through tutoring and hands-on assistance endeavors. The real world implementation of skills and knowledge ultimately succeed towards engaging the learner in an imperative linkage between useful learning endeavors of knowledge acquisition, performance improvement and talent development, that highlights the larger understandings around why knowledge is important and the real world connections between *abstract book learning* and the hands-on skills and useful connection of conceptual frameworks of understanding that the learner needs to achieve.

LEARNER ENGAGEMENT

Bandura's work around motivation and self-efficacy (1977, 1986, 1997) is poignant at this point in the discussion, due to the impact of recognition around the need of learners to retain a level of interest in the subject matter under study as well as a sense of self-efficacy, or the recognition by a learner that she or he can successfully accomplish the tasks the learner sets out to accomplish. The perception of attainability is important, not only towards the learner's sense of motivation but also the internalized belief that the achievement can occur. This recognition towards a focused interest in the tasks and activities throughout the learning process must align with the learner's perception of the ability to reach a desired outcome, thus embedding the learner's depth of cognitive engagement in the learning process (Borup, 2016; Gallagher, Bennett, Keen & Muspratt, 2017; Walker & Handley, 2016).

The introduction of the community into this endeavor does emphasize the support structure necessary and appropriate towards the learner's sense of potential achievement and guiding support towards attaining the required learning and instructional objectives or goals. As such, the support of the academic community as well as daily lived community engagement embraces the opportunities towards real world embedded instructional learning approaches that more fully engage the learners in the acquisition of knowledge, skills and talent development as naturally supported by the engagement of the learner.

ACTIVE INSTRUCTIONAL ENGAGEMENT

Active instructional engagement throughout the classroom-based instructional environment is integrally important to the learning process, no matter whether the learning environment is defined as a traditional face to face classroom, a blended style of instructional environment or an online instructional environment; also of consideration is a more recent innovation perceived as micro-learning, being a just in time style of instructional engagement of the learners who are perceptually in a field-based environmental engagement endeavor. Yet how might one consider active instructional engagement? Since as early as

1989 (Moore, 1989), scholars have attempted to understand what the interactive activities are that engage and embed learner activity as critical interactions, occurring in an instructional environment:

- Learner-content (Moore, 1989)
- Learner-interface (Hillman, Willis & Gunawardena, 1994)
- Learner-instructor (Moore, 1989)
- Learner-learner (Moore, 1989)
- Learner-self (Crawford, 2001)
- Learner-community (Burnham & Walden, 1997)
- Instructor-community (Crawford, 2001)
- Instructor-content (Crawford, 2001)
- Instructor-interface (Crawford, 2001)
- Instructor-self (Crawford, 2001;2003)

An intriguing shift that occurred through Crawford's (2001, 2003) work within the realm of interactive activities and learner engagement, brought forward a focus upon the instructor's equal and continued active instructional engagement towards not only supporting the learner's cognitive and competency-based efforts but also towards modeling interactive activity understandings and active instructional engagement.

In the early turn of the century, Burnham and Walden (1997) introduced the concept of the learner's interactions with the community, while Crawford (2001, 2003) introduced the concept of active instructional engagement wherein the instructor explicitly embedded real world instructional learning opportunities within the learner's community environment. Entrenching the learner's opportunity to engage with the subject matter in more real world environments and then bringing back more advanced and enhanced understandings and questions around the subject matter into the instructional environment was an unusual understanding at the time. Special attention was given to online and blended learning approaches that implemented the community-based engagement and interactive activities towards a deeper understanding of the subject matter as well as a sense of multiple points of inquiry, analysis, formative evaluation and constructive criticism. These elements not only came from within the four walls of the classroom environment but also from a real world instructional learning approach as impacted by the supporting community engagement.

COMMUNITY ENGAGEMENT: ACADEMIC, PERSONAL, PROFESSIONAL

An additional consideration is the recently coined collegial community style of engagement (Crawford & Michael, 2017), supported by Wenger's embracing focus upon "experience of participation in the world" (Wenger, 1998, p. 3; Wenger, 2009, p. 210). Crawford and Michael (2017) embraced the conception that collegial communities of learning expand beyond the four walls of instructional influence, into differentiated realms of impact defined as:

- *Professional Community*
  - *Work colleagues*
  - *Work supervisors*
- *Personal Community*

  - *Family*
  - *Friends*
  - *Relations*
- *Academic Community*
  - *Degree program colleagues within our course*
  - *Degree program colleagues from other courses*
  - *Course instructors from other course experiences*
  - *Faculty advisor*
  - *Program faculty (Crawford & Michael, 2017, p. 46)*

More so, active instructional engagement purports to expand the collegial community's influential support towards more fully embracing an engagement with the subject matter, suggested as:

Enhancing professional engagement in landscapes of practice are vital towards the success of the learners, not simply within the formal classroom environment but more importantly as a recognition of the impactful engagement in a larger environment of influence. Further, the self-efficacy necessary for enhancing the learner's potential for success is vital. A quotation of Virgil reflects an understanding of self-efficacy, stated as "They are able who think they are able" (Board of Wisdom, 2014, para. 1), illustrating the potential emphasis of the instructional process upon the larger realm of community. (Crawford & Michael, 2017, p. 49)

A recognition of the strengths of the active instructional engagement throughout the collegial community of the learner not only supports the learner's individual efforts but returning the collegial community's expertise and experience into the instructional realm offers all learners an expanded and differentiated understanding of the subject matter under study. As such, the supporting community engagement through the real world instructional learning embraces nuanced and differentiated approaches to knowledge acquisition, enhancing active instructional engagement while also exponentially expanding and enhancing the learner's understanding.

REAL WORLD INSTRUCTIONAL LEARNING

With the introduction of concepts around learning in landscapes of practice Wenger, 1998, 2009; Wenger-Trayner, Fenton-O'Creevy, Hutchison, Kubiak, & Wenger-Trayner, 2014; Wenger-Trayner & Wenger-Trayner, 2015) and the significant growth of interest in competency-based learning, the natural inclination towards a growing interest in more complex, real world instructional learning opportunities should arise. An intriguing realization, is that rethinking instructional design and curricular impact has been developing within the recognition of the need for supporting community engagement through real world instructional learning events and experiences (Cennamo & Kalk, 2018; Ertmer, Quinn & Glazewski, 2019; Miller & Kastens, 2018; Reigeluth, 2011; Stefaniak, 2015; Tseng, Tang & Morris, 2016; Van Merriënboer & Kirschner, 2017), suggesting that the acknowledgement of the learning in landscapes of practice approach is not only appropriate for knowledge acquisition but also reflects a performance improvement that supports one's talent development.

SOLUTIONS AND RECOMMENDATIONS

Returning to the question posted by Wenger offers a full circle approach to the discussion; "So, what if we adopted a different perspective, one that placed learning in the context of our lived experience of participation in the world?" (Wenger, 1998, p. 3; Wenger, 2009, p. 210). This different perspective appears to be at the burgeoning edge of a tipping point opportunity, slowly shifting instructional endeavors from traditional knowledge acquisition efforts towards a more holistic approach towards learning and understanding, performance improvement, as well as talent development, from the perspective of all ages of learners. The early child efforts towards hands-on manipulatives, social engagement and play are more clearly outlined and embraced within other stages of learning approaches, to the point that a recognition of the early childhood instructional understandings are highlighted as necessary and integrally important throughout all levels of endeavor. The real world, hands-on instructional learning imperatives are journeying from within the traditional four walls of a classroom structure out into the wide open of the real world, towards using, testing and analyzing the information in real world environments that support a connectedness of information unlike previously recognized within classrooms and training events for all ages and areas of subject matter expertise. The connectedness is what matters, the interconnectedness is inherent and recognized as obvious. The days of memorization and regurgitation may slowly be ebbing away, replaced with an acknowledgement of knowledge that is understood through competency-based learning endeavors, learning engagement, community-based engagement and a real world instructional learning endeavor. The supporting collegial community concept introduces the impact of the current day's needs, as collegial, engaging and worthy of real world implementation as a natural engagement of the instructional teaching process and learning endeavor.

FUTURE RESEARCH DIRECTIONS

Supporting community engagement through real world instructional learning is an imperative that is finally recognized as a natural and necessary aspect of the learning process. As quoted from Reigeluth,

One of the few things that practically everyone agrees on in both education and training is that people learn at different rates and have different learning needs. Yet our schools and training programs typically teach a predetermined, fixed amount of content in a set amount of time. (2011, p. 25)

The industrial age approach to learning, wherein all learners must take a lock-step designed and controlled progression through any learning process is being reconsidered. Although the rise of mandatory standardized testing has been decried for a few decades throughout the United States of America, the slow recognition around the standardized testing authority in which learners have been controlled and labeled is now becoming the lens through which the educational system has been studied. The many concerns around industrial age learning processes and procedures are now more so recognized as antiquated and resulting in mandatory standardized testing that removes the basic joys and strengths from the educational system. Wherein is the opportunity for learning to grow, wherein is the scheduled frenzy of a stopwatch thrown out, towards a recognition of a learner's needs to learn and understand information at different speeds and by different pathways towards successful knowledge acquisition attainment and the joy of learning is freely embraced again. With the curiously intriguing shifts in the political landscape that has

left the United State of America educational system in a stranglehold of weakness and vulnerable fault, the landscape has been set to grow a more fertile and supportive engagement with ideas around teaching and learning, performance improvement and talent development.

CONCLUSION

The engagement of the real world community within the teaching and learning process is vital and integral for the success of the learner. The supportive nature of the community's engagement through real world, instructionally appropriate learning endeavors emphasize the potential next steps associated with strengthening instructional practice. The current more desirable intentional approach towards real world knowledge acquisition and understanding learner engagement with the subject matter is essential to differentiation in pedagogy, andragogy, and heutagogy.

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KEY TERMS AND DEFINITIONS

Community: One's community environment can include innumerable groups of people, from personal communities that include friends and relatives to academic communities that include collegial students or coursework or professors, to professional community members that include co-worker colleagues and administrative supervisors.

Community Engagement: This term highlights the level of interaction and support that impacts, encourages and validates a person's efforts in a positive, negative or progressively developmental manner.

Competency: Originally conceived as a style of learning that is focused upon learning more hands-on or concrete skill sets, although more recent understandings suggest that more abstract information can be implemented through hands-on learning and product-oriented outcomes.

Heutagogy: A term related to a style of learning that is self-determined in nature, suggesting a learning who is more advanced in knowledge base and cognitive understanding that allows for self-evaluated and recognized knowledge gaps or areas of interest that desire additional study.

Instruction: The guiding introduction of new information that may successfully lace into prior knowledge, progressive engagement with new information in new and different manners of understanding, towards formative and summative evaluations of understanding and differentiated learning, towards developing a level of competency and associated understanding related to the information under study.

Learning: The process associated with understanding new information and using this information in new and different ways.

Real-World Learning: The implementation of new information within a viable, natural environment so as to not only support the learner's conceptual framework of understanding around the information but also towards developing a deeper understanding of the information newly learned and respond to questions around the viability of the newly acquired knowledge or deeper understanding within a space in which the information will be desirable and naturally implemented.

Chapter 26
Design, New Media, and Human-Computer Interactions

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ABSTRACT

In higher education design-oriented programs, collaborations with industry can be challenging to establish because of the time demands and work priories of professionals working in the field. Education should foster these relationships to enhance the overall educational experience for students. A common form of collaboration is projects in which students are given "real-world" design problems for which they propose a solution. These types of endeavors are very much practice-based and can be especially valuable in digital media and interactive design academic programs. When education partners with industry on such practice-based projects, education can add value and potentially help sustain these collaborations by ensuring that student methods and solutions are rooted in theory and call upon the rich research and theoretical bases of these disciplines. This chapter reviews approaches that educators can use to enhance educational projects with industry partners and ultimately enrich student learning outcomes.

INTRODUCTION

In today's information society, the workforce requires individuals to be adaptive to changing work demands and unforeseen challenges, work collaboratively, think critically, make reasoned decisions, and resolve fluid and ill-defined problems (Huq & Gilbert, 2017; Lee & Hannafin, 2016). In many ways, critical thinking and problem-solving can be manifested in design education's practice-based curricula structured around projects. Nelson (2003), articulating similarities between problem-solving and designing, indicates that engaging students in problem-solving using design-oriented tasks can serve as a model of teaching and learning. Design schools, for example, have a longstanding custom of studio-based learning characterized by work in open-ended design domains, creative thinking about design problems and "real-world problem-solving, creation of design artifacts or prototypes, structured dialogue focused on critique of designs, and a presentation of designed artifacts (Koutsabasis & Vosinakis, 2012, p. 486).

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Many academic programs, such as Digital Media and Interactive design, unaffiliated with traditional schools of design offer design-oriented courses, minors, and even majors in subjects as visual and communication design, digital media design, information design, interactive design, or web design in which the traditions of practiced-based or problem-based learning may not be as strong or do not exist – but are applicable. Because of the applied or professional nature of these disciplines, industry often establishes the standard for practice in terms of processes, technologies, and software, which educational pedagogy attempts to emulate. To prepare students for industry professions, educators generally encourage collaborations between industry and education. Design oriented projects can be a worthwhile form of collaboration in which industry partners give students "real-world" design problems, resulting in positive learning outcomes. At the same time, educators must ensure that they ground these types of projects in research and theory of the disciplines. In programs such as Digital Media and Interactive design, teaching technologies (e.g., software) and modeling industry practices are worthwhile instructional objectives but should be balanced with theory and guiding principles. Pedagogy that focuses on software and the replication of industry designed artifacts potentially reduces design and the complexity of interaction to a minimum. Because of the dynamics of industry, it can be challenging to balance students' need to understand industry practice with underlying research and theory and to ensure that practice compliments but does not suffuse the conceptual. Additionally, educators and students can add much value to these experiences and help foster industry relationships by emphasizing theory and research.

In the sections that follow immediately below, I present several issues facing practice-based courses, the predominant focus of learning software and emulating industry practice over foundational precepts rooted in design theory, digital media, and human-computer interaction.

In the remaining sections, I present an overview of a course project that has been run over several academic semesters. The overview presents three instructional approaches to the project beginning with a focus on software and replicating existing industry designed artifacts to an approach that emphasizes theory and research. I present several advantages of these approaches and discuss their relevance to enhancing education-industry collaborations.

BACKGROUND

Education and Industry: Practice-Based Learning

Traditionally in human-computer interaction and interaction design there has been a great deal of harmony between research and practice. Carroll (2003, p.6) notes that generally ideas originated through research and "…researchers developed concepts, methods, technologies, and prototypes, and practitioners applied and developed them in products." However, this approach has been superseded with "…a more interactive view in which practice plays a more central role in articulating requirements for theory and technology and in evaluating their efficacy in application." (Carroll, 2003, p.6) Correspondingly, in digital media, interactive design and similar academic programs, industry practice informs and in many cases frames classroom pedagogy in terms of what is taught regarding technologies, processes and practices, and software. And there is usually good reason for this. A global retail industry, for instance, might have an interactive design department comprised of professionals who work on long and short term "real-world" interactive design problems, often of much complexity. The scale of these problems and corresponding projects can be quite large requiring extensive resources. Because of the scale, consequences of failed

design are steep, which necessitates work practices that ensure accuracy. These designers work in a culture of design. Their daily experience of interacting with team members, managers, and clients; the language they use; the technology and software with which they work, techniques and processes that guide their work are unique experiences difficult, if not impossible, to replicate in the classroom. Thus, education often gains much by engaging with industry. Students who work on joint projects with companies find them impactful. At the same time, projects can become solely focused on practice ignoring a rich history of theory and research that can add much value to the design of interactive artifacts.

Software Culture

Frequently in digital media and interactive design oriented academic programs, students hold perceptions and expectations, at least initially, that course topics center on software or developing proficiency in coding languages. They may inquire about the applications or languages "taught" and refer to courses based on applications or languages (e.g., "…the Photoshop course"). This certainly depends on the academic program. Engineering oriented programs may be more technical and analysis focused and thus require initial technical competency, fostering different perceptions among students compared to design or arts oriented programs. Student perceptions and expectations about a "culture" of software and coding in courses are in some ways engendered by instructors who see value in student proficiency in software or coding and who themselves are comfortable teaching in these areas. Through other courses or self-learning, students may develop software or coding skills, which they often share with others. When communicating their expertise, they may convey a predisposition that others should learn it. Because of their software or coding skills, students can create more technically difficult designs that other students often value, thus emboldening an aspiration to learn software or coding. Software is pervasive in these types of curricular. A culture of software permeates. For instance, many courses focusing on topics of design, digital media and interaction used the Adobe products, which are an array of advanced software applications for creating and editing digital media. The advertising literature is highly visual, depicting a plethora of creative possibilities. Online communities and tutorials abound that not only offer valuable resources but give credence to the significance these applications hold in the profession. Instructors and students give demonstrations of digital artifacts noting the application(s) used to create them. Employers typically specify the applications and languages in which they expect applicants to show proficiency. Learning any one of these software applications in-depth can be time consuming and comprise a substantial portion of a course. Instructors can often feel pressure to spend a great deal of time teaching software operations and techniques, with insufficient time left for conceptual topics.

The Interface

A predominance of software or a "culture" of software in courses may contribute to there being a focus on making digital artifacts (i.e., interfaces) at the expense of design processes, methods, theory and research. This may be indicative of a fragmentation of the field. Instructors in digital media and interactive design programs have diverse experiences and interests that enrich the field in many ways. However, their expertise may not originate from a design or human-computer interaction background and therefore related topics can become deemphasized. One pedagogical solution some instructors choose is to look for industry models and to recreate those models using software.

In a course in interactive or interface design, instructors usually assign students projects that require them to design an artifact or system with which humans interact. Typically, the most prominent characteristic of a designed artifact or system is the interface, which is comprised of visual objects including interface controls (buttons, switches), images, video, etc. For example, a student might design a website that acts as an interface to an online music store. Because the interface elements are visually dominant, students tend to focus on creating the interface, without much thought of user goals, designing the service features, or how users will interactive with it. The more proficient one is in software or coding, the more advanced features they can include in their finished design. They may look at other websites and replicate features. This often translates into an instructional process whereby the students is using a prototyping tool or coding language to replicate the features that they observe in other websites or applications. Moreover, there a countless books and tutorials that provide step-by-strep instructions for creating digital artifacts (e.g., websites), which are helpful to an extent. This provides students a model and then allows them to enhance their software or coding skills in replicating the model. However, from a design, digital media, and interactive design perspective, this instructional approach is limited. It centers on making an artifact as the end product. Thus, the development of software or coding skill and one's ability to use them to re-create an existing interface become paramount over theory, design process, studying human behavior and activity, and research.

PEDAGOGICAL APPROACHES TO AN INTERFACE DESIGN

Overview

In the following section, I discuss three pedagogical approaches to an interface design course project and their relevance to practice-based learning, instructional management, and student learning. Each approach has been tried over several semesters. They may provide an example for how education can effectively contribute when participating with industry on collaborative projects to sustain these relationships as well as to enhance students learning outcomes.

The Department of Media offers an interface design course through its digital media area of concentration. The course focuses on introductory topics in user-interfaces. During the academic semester, students typically receive a project that allows them to interact with a User Experience (UX) design team at a regional industry. They engage with the UX team, exploring current and emerging technologies that may be used at the interface (website and app) to enhance their customers' (online and in-store) experience. The project usually involves a prototype of some sort, although the companies typically give students "free range" for what they choose to design or assess. Working in teams, students approach these projects from a user-centered design perspective, a philosophy in which the design is centered on the human user of a product or application (Pratt & Nunes, 2012). The needs and interests of the user are central and dictate design decisions. Students follow what may be referred to as a user experience (UX) design process model, an iterative process that endeavors to account for the entire process or experience a human user has with a product or application. There are various process models (e.g., Preece, Rogers, & Sharp, 2015) that typically encompass four major phases, each of which is comprised of multiple activities. The models are iterative in nature so that design teams often repeat phases or activities in a phase as needed.

Phase 1- Design Research: Using various research methods (e.g., contextual interviewers, observation, etc.) the design team attempts to understand the design problem, context of use, users and their goals and needs, stakeholder needs and based on data gather at this stage ascertain a set of requirements.

Phase II – Design Alternatives: This phase usually entails further synthesis of data collected in phase I and using them to generate alternative design ideas.

Phase III – Prototyping: Based on the design ideas generated in phase II, the team builds and tests prototypes. A prototype might be a model of an application interface with which the team conducts user testing to assess the extent it accomplishes the goal for which it was designed. Guidelines (e.g., Shneiderman & Plaisant, 2010; Nielsen, 1994, etc.) are used to assess interfaces. For instance, the guidelines proposed by Shneiderman and Plaisant (2010) focus on: a) interface consistency, b) universal usability, c) informative feedback; d) task-flows that move toward closure, e) error prevention, f) reversal of actions, g) user control, and h) minimizing demand on users' working memory. Designers use them frequently in heuristic evaluations in which expert evaluators check and compare an interface against them. Johnson (2014) indicates that fundamental characteristics of human perception and cognition are of important concern to interface designers. He points out that there are commonalities across guidelines because they ultimately derive from basic attributes of perception and cognition. For example, humans seek and use visual structure. It is not surprising then that most guidelines include recommendations for interface structure or consistency. Moreover, human perception is biased toward goals. When using an interface, people tend to see only those things associated with their goals. It is important then to conduct research early in the design process (i.e., Phase I - Design research) to learn about users' need and goals. By doing so, designers are better able to design interfaces consistent with user intentions and therefore provide them a positive user experience.

Phase IV – Evaluation: The last phase involves evaluating the propose design solutions based on the initial set of requirements identified earlier in the process.

The duration of projects vary depending on the focus but it usually last between three and four weeks. The project is practice-based in that students engage with professionals to analyze the interactive design approaches common in industry websites and applications. The following is a summary depiction of a project involving a large retail clothing company (client) in which students designed a prototype mobile application to enhance the customer shopping experience. I present three pedagogical approaches used to undertake the project, each of which was implemented during separate academic semesters.

Approach I: Practice-Based Learning - Skill Development Focus

The major components of this approach consist of the following: a) UX team's overview of user experience challenges that shoppers encounter during online and in-store shopping; b) analysis of the client's website and mobile application in terms of interaction design, features, and functionality; c) analysis of competitor retailer websites and mobile applications; d) contrast of features and functions; e) identification of features and functions students find unique and useful not offered at the client's website or app; f) identification of usability concerns with the client's website or app; g) design of prototype - students use a prototyping tool (Adobe XD, Axure, etc.) to recreate specific features or enhance existing features. Students employ several rounds of iteration of analysis and design critique to refine the project. Students present the completed design and analysis to the UX team and team members critique and provide feedback.

Instructional Management

This approach entails roughly 10% invest of time evaluating websites and apps, 75% of time in recreating a prototype, and 5% of the time assessing the usability of the prototype.

Its advantages include: a) students gain experience with a prototyping tool, b) students evaluate professional designs, features and functionality; c) students begin working on the interface prototype quickly; d) the approach is popular among students especially those in introductory courses because they can see results quickly.

Its disadvantages include: a) teaching software or coding language is a focal point and, as a result, the instructor should be technically proficient; b) it deemphasizes learning about design or interaction; c) it is limited in exposing students to design process, methods, research and theory; d) the intent of the project centers on recreating (based on existing designs) an artifact (website or app) – it often does not result in new design, as the end product is a replication of an existing design.

Learning

Students learn about interactive design from the perspective of existing designs, which is useful. However, the rationale and context for solving design problems may become overshadowed as students focus on creating a prototype.

Approach II: Practice-Based Learning - Process Focus

In this approach, students participate in a design-oriented process that includes design, user-research, analysis, ideation, prototyping, implementation and evaluation. The major components of this approach consist of the UX team's overview of user experience challenges that shoppers encounter during online and in-store shopping. Following the overview, students generally follow the process approach outlined by Preece, Rogers, and Sharp (2015): a) Phase 1- Design research, b) Phase II – Design alternatives, c) Phase III – Prototyping, d) Phase IV – Evaluation. Design research allows students to investigate the design problem. This may entail, methods such as surveying and interviewing shoppers about shopping practices, making observations, and performing competitor analyses. Upon collecting these data, analyzing and synthesizing them, students begin to generate possible design ideas. This ideation often involves sketching, low and high fidelity prototyping as well as user testing with prototypes. Students attempt to involve users in the design process, which is meant to expose them to participatory design and user-center design approaches.

In the early stages of this process, students investigate shopper behavior or analyze their journey in purchasing a product. Suppose, for instance, that from interviews and observations, a few key goals and corresponding behaviors get identified that translated to interface features. For example, users may express that they would like the system to be familiar with their unique shopping preferences so that incentives, rewards, and payment information is streamlined. They also state that they want to delay purchases, saving them in some form for later checkout. The student team may create several scenarios to explore how customers create profiles and, as they shop, how the system captures their shopping history and unique preferences. Scenarios are descriptions of activities or tasks intended to facilitate discussions of the context in which tasks are carried out and the requirements necessary to support users' goals (Preece, Rogers, & Sharp, 2015). They are a useful method to stimulate feedback to refine and validate a design

(Sutcliffe, 2009). In doing so, the students will likely examine the customer journey, identifying each step in the process from the initial point of contact with the website or app to the final checkout. It is important to understand the goals, tasks, and subtask that comprise each goal. Additionally, it is also vital to understand task sequences and their relatedness to "making a profile" and capturing "shopping history/preferences" and how and when a shopper would use these features.

Instructional Management

This approach entails roughly 30-40% investment of time evaluating the websites and apps, 45% of time in recreating the interface, and roughly 15% of the time assessing the usability of the prototype.

The advantages of this approach include: a) it engages students in a design-oriented process; b) it demonstrates the value of iteration in design, user-centeredness, and participatory design; c) it potentially helps students better understand the design problem and likely creates a more robust design solution; d) it introduces students to a design process causing them to conceive of design as something more than visual aesthetics; e) from an interaction perspective, students can potentially get better understanding of user activity and thinking and how that translates to features and functions at the interface; f) the approach engages students in commonly used industry practices.

The disadvantages of this approach include: a) the artifact (prototype) is the primary intent of the process – instead of understanding the design problem and human activity; b) it requires understanding of design process, research methods, data collection and analysis that may be beyond the expertise of some instructors who do not have experience in these areas; c) it requires instructors to be specialized (i.e., in design, design research, prototyping, and usability), which may not always be possible given the diverse backgrounds of faculty in digital media and interactive design oriented programs; d) the approach is not as popular (compare to the earlier described approach) among students as they often find it challenging to see the relationship between an adherence to sound research methods and the design of a prototype. It is labor intensive. When done well, students spend a significant amount of time in research prior to prototyping. Due to the time between research and prototyping, the relationship between the data collection and analysis and design can appear, at least initially, remote.

This approach in many ways models industry practices. It has some potential benefits for the client. While the client actively engages in extensive research, students, through their research, may ascertain aspects of the design problem that the client had previously not uncovered. The interface artifact is the primary focus - the project is envisioned in the context of making a prototype and not in the context of understanding human motive and activity.

Approach III: Practice-Based Learning - Theory and Process Focus

A third approach is similar to the Approach II: Process focus but differs if two primary ways. First, theory and principles inform design and methods. Second, students envision the design problem not solely in the context of producing an interface artifact but rather in the larger context of human activity – the interface is not an end in itself but it is rather something through which people interact to pursue a broader range of activities and goals (Bødker, 1987).

Theoretical Grounding

With projects such as the one presented here, the relationship between industry and education is asymmetrical. The UX team provides a model for students to analyze and strive to replicate. The team assesses student work and gives them constructive feedback. Industry affords an experience from which students benefit. However, given the time and cost constraints under which many industries operate, it behooves educators to explore ways to engender these relationships and to ensure they are mutually beneficial. In essence, we should continually assess ways to add value or increase incentives for industry to participate with us in these educational endeavors. Generally, projects of this type center on practices such as user research, design approaches, usability, and prototyping. These are areas in which students benefit greatly from engaging with industry to learn current practices. Given the emphasis on practice, there is often less attention to how foundational precepts and theory informed research and design, for example. Education might add much value in these types of projects by examination and illumination of relevant theory. Grounding design and interaction projects in theory can be useful by providing: a) a theoretically-based rationale for design decisions; b) an alternative perspective with which to frame design problems; c) resources for practitioners to gain new insights about interactive design or to examine design problems in unique ways - thus giving incentive for why industry should participate with education in projects of this type. It is in the interests of educators to identify how they may contribute so that the relationship is more symmetrical. One way in which this might be achieved is through an increased focus on research, theory and principles.

Digital media, design, human factors, and human-computer interaction each have a rich research and theory base. Given that the extent of this project, like many interactive design projects, focuses on users interacting with an interface, I confined this brief mention of theory and principles to areas of human-computer interaction. In the following section, I briefly explicate cognitive theory of information processing and activity theory. These perspectives seek to explain mental processes, which has important implications for interactive design.

Cognitive Theory of Information Process

The study of human cognition greatly influenced the field of human-computer interaction. Churchill (2007, p. 236) notes that understanding of cognitive information processing aided in the design of interfaces, instructional materials, and programming languages. Cognitive science posits a representational theory of mind, "… that human behavior and experience can be explained by explicit mental structures and operations." (Carroll, 2003, p.3) Cognitive information processing is described by a transformation of information from stimuli in the environment, to internal mental processes, to a response by the individual. Processing begins as an individual receives information through the senses from the environment, a minute fraction of which is selectively attended to and processed to Short-Term Memory (STM). STM has limited storage capacity. In it new information becomes encoded with existing knowledge and stored in Long-Term Memory (LTM), which provides massive long term information storage. During these transformations, the individual is actively engaged in mental processes of attending to, perceiving, and encoding information from the environment. The individual is not simply responding to external stimuli but actively attending to and making sense of them.

Cognitive information theory has important implications for designers who are trying to understand how human attention, perception, and memory, among other things, influence the design of interfaces

and interactive products. Understanding the stages of information processing can help designers arrange external conditions (e.g., interface components) to support internal mental operations at each stage of processing. Human-computer interaction entails an "…interplay between the humans' information processing and the system's information processing. For this interaction to be efficient, it needs to be compatible with the perceptual, cognitive, and motoric properties of human information processing." (Proctor & Vu, 2016, p. 2).

When interacting with an interface, users get bombard with external stimuli. During information processing, humans selectively attend to specific stimuli over all competing stimuli. For instance, when an individual is in a large crowd of people talking, they are able to attend to a friend's voice over all other voices competing for their attention. Attention or how humans select things at the interface on which to concentrate is important at the initial stages of information processing. The interface should help users attend to important information and functionality at appropriate times. It should help users focus. So techniques such as grouping content and highlighting features are valuable at this stage of processing. As Proctor and Vu (2016, p 5) point out, "In HCI, one goal of designers is to come up with interfaces that are the most compatible with human information processing."

Preece, Rogers and Sharp (2015) point out that interfaces with complex functionality or task procedures can cause users to experience cognitive overload. When possible, designers should design interfaces for information recognition instead of recall, as information recall demands more processing resources. "Beyond a point, individuals' limited cognitive resources are likely to be overloaded, resulting in poor performance and negative outcomes." (Sundar, et al., 2014, p. 117). One does not have to look far to find examples of interface designs that are more taxing on cognitive recourse than necessary. Proctor & Vu (2016) discuss Stimulus-Response (SR) capability noting that relations among sensory inputs and responses to those inputs, some combinations afford easier processing than others. They point out, for example, the Simon effect in interface displays where a user is to make a response to a stimulus and where the stimulus location may or may not correspond with the response. Reaction times and errors increase when the response and stimulus location do not correspond. Mapping is the relationship between a control, its functions, and the results it produces in the world (Norman, 2002). Consider the mapping of controls for burners on a stove depicted in Figure 1. It is more difficult to ascertain the controls that operate each burner in S-R Mapping A than it is in Mappings B and C. In Mapping C the controls directly map to the burners whereas in Mapping A they do not. A primary advantage to S-R combinations that correspond such as in Mapping C is that they reduce the user's memory load for performing specific tasks. The user controlling the burners depicted in Mapping C will likely operate the control more quickly and make fewer errors compared to the controls depicted in Mapping A.

Discussing mobile applications and responsive website design, Budiu (2014) points out the capacity of the communication channel is determined by the screen size. There is a greater channel capacity with larger screens. The communication channel is also determined by users' working memory and the amount to which attention is diverted. During interactions such as navigating the interface, users incur interaction costs and increased memory load, as they must remember content on changing displays, the location of navigation items, among other things. Today it is common for many organizations' websites to be used on an array of devices and, as a result, content responds to accommodate the device size. For example, figure 2 depicts a typical desktop website layout pattern. Utilities are located in the upper right corner of the display (e.g., shopping cart, search, account sign-in, etc.). Navigation occupies a prominent portion of the display. Additional navigation or secondary-navigation gets revealed when users touch or hover a mouse pointer over a main navigation item. When users view the page on a mobile device

Figure 1. Mappings of oven controls

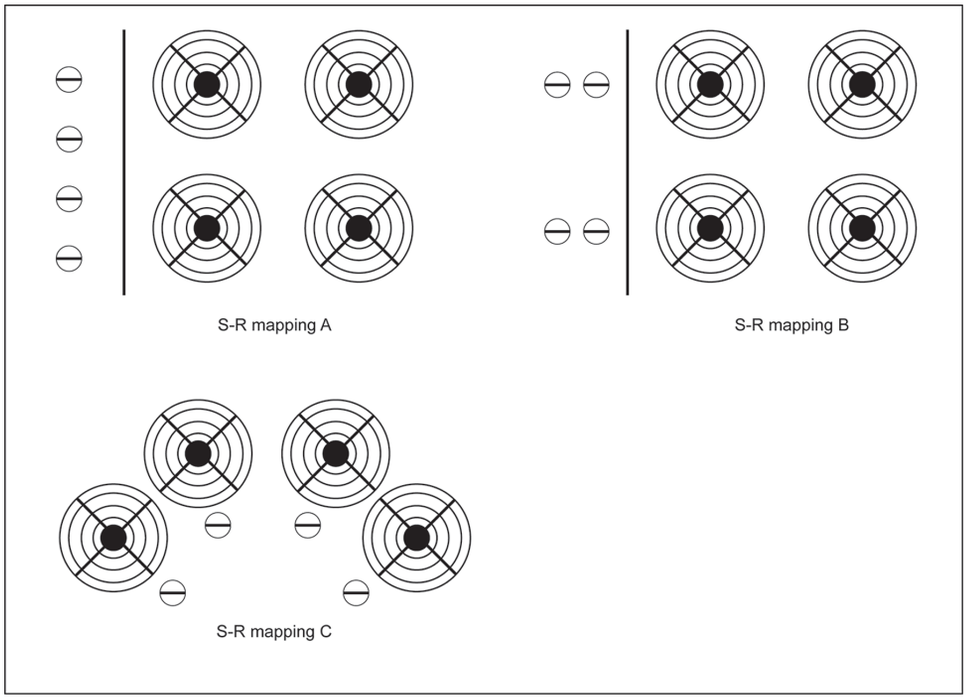
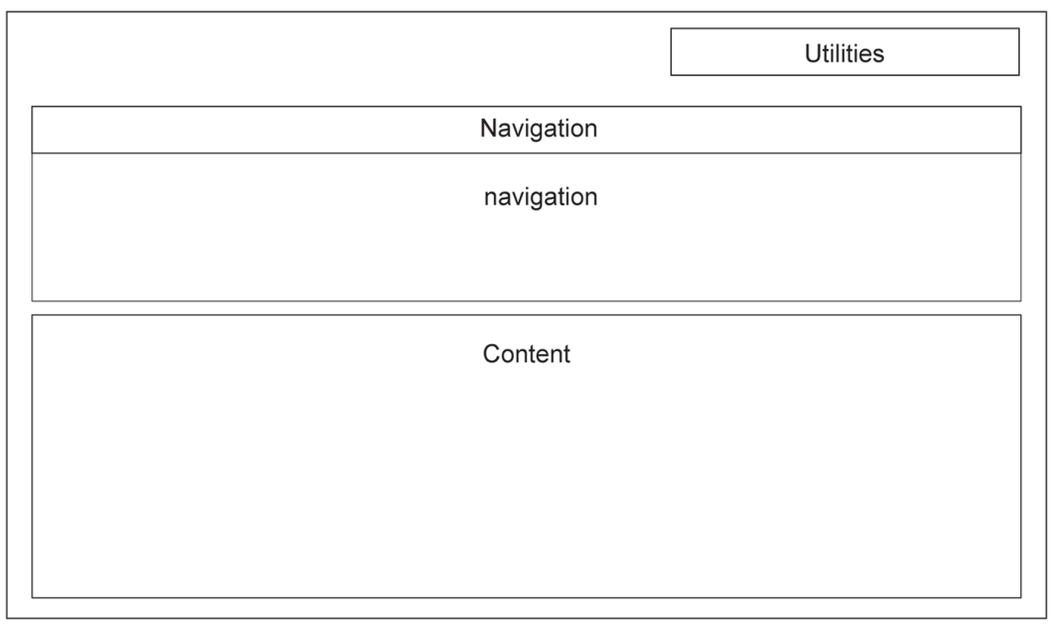
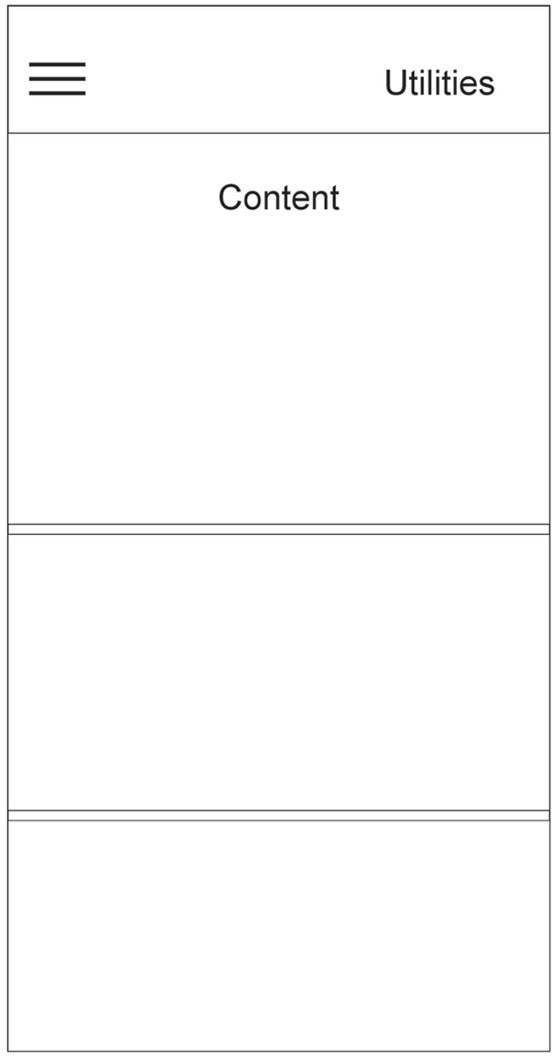


Figure 2. Desktop website layout pattern



(see Figure 3), the location and orientation of certain features (e.g., navigation) change and visibility of

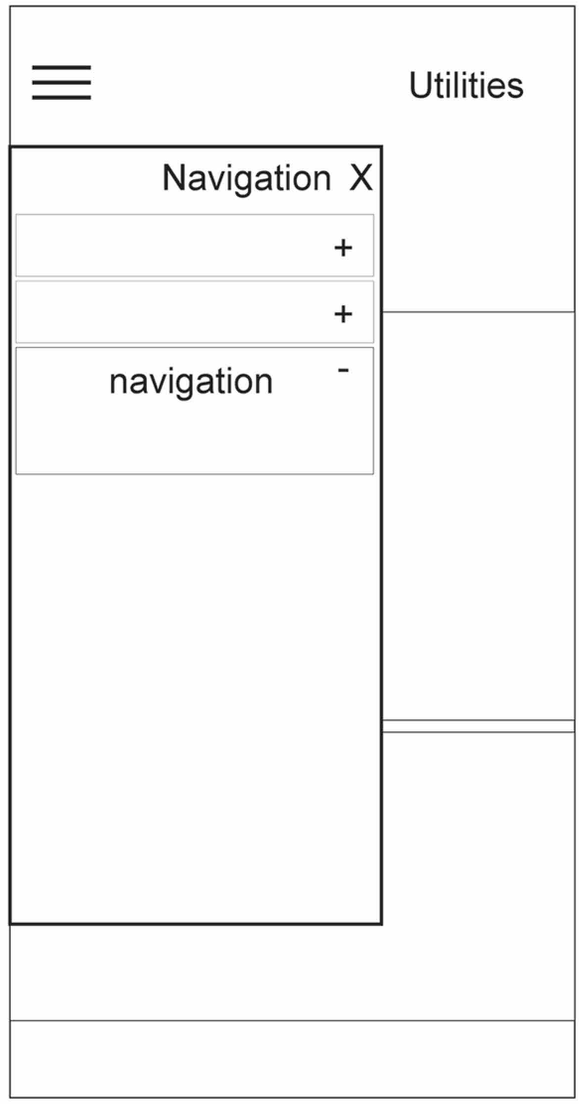
Figure 3. Mobile layout pattern



navigational items becomes hidden. Navigation is accessible by selecting a symbol ("hamburger" icon), which reveals navigational items vertically with secondary-navigation exposed by an accordion-type component (see Figure 4). Interaction costs and memory load (Budiu, 2014) are likely to be recurrent issues in these types of designs.

In client projects such as the one discuss here, students could add much value by providing the rational for design using precepts of cognitive information processing and its importance for human attention, perception, and memory. It might be useful to provide metrics of the interaction costs (e.g. time) and memory load (e.g., ability to recall) aspects of the interface for the industry professional to consider.

Figure 4. Mobile layout pattern: Navigation options



Activity Theory

Suppose, for example, students study online shopping with intentions to improve the experience. Much like in the Processing approach (Practice-based learning approach II) mentioned earlier, they analyze competitor applications, noting design conventions, features, and functionality, among other things. Usability tests help them assess efficiency and identify shortcoming in competitor apps. To more fully understand the shopping experience, they survey and interview shoppers in an attempt to improve the experience, understand how shoppers perceive it, and determine features that might aid in shopping. They identify several goals that shoppers want to achieve when shopping and more specifically with the smartphone application. With these goals in mind, they analyze the shopping experience first from the

moment a shopper enters a store to checkout and secondly from the moment a user opens the application through checkout. In so doing, they identifying tasks and sub-task to reach each goal. Based on the data collected, students design a prototype that includes several new features. They test their design and measure how efficiently users accomplish each of the identified goals – and ultimately how well the interface supports shopper goals. While this is an abbreviated description of the design process, it in some ways reflects a common approach to interactive design – focused largely on user goals. Another approach to this same situation is to frame the problem from an Activity Theory (AT) perspective, which holds that fundamental to activity is human motive and humans act with tools to achieve motives. Kaptelinin, Nardi, and Foot (2006, p. 35) define Activity Theory as:

…an approach in psychology and other social sciences that aims to understand individual human beings, as well as the social entities they compose, in their natural everyday life circumstances, through an analysis of the genesis, structure, and processes of their activities.

In terms of interaction design, it accords with recent trends to understand human-technology interaction, beyond just the computer, and within the boarder context of human activity. AT stresses the importance of human agency and motivation, and social context (Clemmensena, Kaptelininb & Nardic, 2016, p. 610). Analysis extends beyond tasks "...to a meaningful context of a subject's interaction with the world, including the social context. The boundary of the 'objective world' is not limited by the user interface." (Kaptelinin, Nardi, & Foot, 2006, p. 35) Meaningful interaction exists beyond interacting with an interface. As Bødker (1987, p. 1) notes, the interface "…is not something that the user operates on but something that the user operates through on other objects or subjects."

A key precept in AT is human motive and understanding activity through motives. AT holds that the components of activity are actions and the objectives to which actions are directed constitute goals. According to Kaptelinin, Nardi and Foot (2006) goals are conscious, as individuals are usually aware of the goals they want to achieve. However, they are not immediately aware of their motives, which are ''…revealed to consciousness only objectively by means of analysis of activity and its dynamics." (p. 63)

While AT is a comprehensive theory requiring detailed study, the aforementioned precepts offer a perspective, admittedly at a cursory level, with which to view the project presented here. For example, returning to our course project example, imagine during user research interviews about the online shopping experience, shoppers report that they want to purchase clothing (e.g., shoes) using a smartphone application. This would constitute a goal. In doing so, they want to select colors, sizes, among other things with the app. However, from an AT perspective, the interviewer may probed individual shoppers a bit deeper and ask each one about their motives for purchasing clothing items. After some thinking, shoppers may reveal that their motive for buying a particular clothing items is "… to look nice". Such a motive is quite distinct from the goal (i.e., purchasing clothing) and it has significant implications for the interface design. Suppose a customer in a clothing retail store asked a sales associate to help them purchase an item. Later, a second shopper asks the associate to help them look nice. If we studied the activities of the associate assisting both shoppers we would likely observe very distinct activities. Correspondingly, features and functions at the interface would be quite different depending on whether the interface was supporting a user purchasing a pair of shoes versus helping shoppers to look nice. For example, an interface that helps shoppers look nice might enable shoppers to see themselves wearing the shoes (i.e., virtually) while also trying on complete outfits. By framing the design problem from an AT perspective, it may be possible to identify a more realistic and comprehensive set of requirements –

and, at the same time, shift the focus on solving the design problem rather than making an artifact (i.e., interface).

Instructional Management

This approach entails roughly 30-40% investment of time in research, discerning relevant theory as it pertains to the design problem and discovery; roughly 10% investment of time evaluating the websites and apps; 30% of time in creating the interface, and roughly 30% of the time assessing the usability of the prototype and the extent to which it addresses the design problems.

The advantages of this approach include: a) it engages students in a design and research-oriented process; b) it potentially helps students better comprehend how understanding human activity provides an important context for creating a design solution; d) it helps convey to industry partners the value of in-depth study of activity when designing interfaces; and e) it potentially demonstrates that value and insights educational partners can provide industry.

The disadvantages of this approach include: a) it requires deep study and understanding of human activity, which can be challenging and time consuming especially in introductory courses; b) often the results of studying human activity are not readily forthcoming and sometimes only over time do students see returns on their work investments and the relevance to interface design problem.

FUTURE RESEARCH DIRECTIONS

In our lives we increasingly interact with and experience digital "things" – they are everywhere. And we interact with them through all possible means – vision, movement, voice, touch, spatial and temporal. According to (Murray, 2012, p. 2), digital artifacts permeate society, and "the design decisions that shape them affect the way we think, act, understand the world, and communicate with one another". As such, there are seemingly endless practice-based learning project collaborations that can be done with a plethora of industries. Further research in these areas should be guided by the rich history of theory and research in digital media, design, human factors and human-computer interaction. Additional inquiry should explore the extent to which robust investigation into human perception, cognition, activity and behavior enhances these project-based learning activities and student learning as well as the collaborative experience between education and industry – and the extent to which this approach is perceived as valuable to industry and thus is likely to engender ongoing collaboration.

CONCLUSION

Collaborations with industry can be challenging to establish because of the time demands and work priories of professionals working the field. Education should foster these relationships to enhance the overall educational experience for students. A common form of collaboration is projects in which students are given "real-world" design problems for which they propose and often design a solution. These types of endeavors are very much practice based with industry partners usually directing the purpose and parameters. An asset of education is its reliance on and grounding in theory and principles, which can be diminished in heavily practice-based projects. In these projects, education can add value and

enhance these collaborations by ensuring that student methods and solutions are rooted in the theory and call upon the rich research and theoretical bases of these disciplines.

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KEY TERMS AND DEFINITIONS

Digital Interface: A digital interface is the medium through which humans interact with computers. Interfaces represent an amalgamation of visual, auditory, and functional components that people see, hear, touch, or talk to as they interact with computers (digital devices).

Human-Computer Interaction and Learning: Refers to interactional processes between learners and computational devices and the extent to which that interaction supports or impedes learning.

Interface: A mechanism that mediates the conversation between a person and a product or system. An interface is a means to make the conversation between the human and machine or product easier.

Interface Design: The process of designing the visual, metaphorical, functional aspects of a product or system. The process of interface design begins with understanding people, the tasks they perform, and the goals they are trying to reach. Based on this information, interface designers create the medium to help users interact with products or systems so they may to reach their goals.

Mapping: The relationship between a control, its functions, and the results it produces in the world (Norman, 2002).

Responsive Design: Designing web content in such a way that is responds to any device on which is it viewed. Working from the content structure, designers design websites so when they are viewed on varying sized displays, users can easily access the information content.

Usability: A process of determining how effectively and efficiently people are able to use products or systems created by designers. A core aspect of usability is having people use the product or interface and examine how easy or difficult it is to use. Based on these data, designers make refinements to the system.

Chapter 27
The University Challenge in the Collaboration Relationship With the Industry

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ABSTRACT

Universities suffer from the impact of (1) life cycles associated with technological innovations, (2) the globalization of the economy and culture, (3) the educational needs of an increasingly knowledge-driven society, and (4) the training needs for high-performing professional activities. Solutions to these factors may be found in a positive attitude toward knowledge sharing and collaboration relationships. Collaboration has been considered a way to address the challenges of the 21st century, fostering the necessary innovation, growth, and productivity for all parties involved. Several studies reveal that collaboration can be strongly influenced by knowledge sharing. Collaboration relationships, besides the creation of new knowledge, may result in several outcomes and benefits for the university and society. This chapter aims to address and discuss the university challenges in the collaboration relationships with the industry based on the main results of some empirical studies developed during a research project.

INTRODUCTION

The diversity environment that characterizes the universities propitiates the development of sub-cultures, transforming their communities in complex social organizations composed by diverse cultures, and predominating the academic freedom and autonomy (Sporn, 1996), where close control can induce negative reactions (Starbuck, 1992). Besides this scenario, universities nowadays suffer from the impact (i) of life cycles associated with technological innovations (Gill, 2002); (ii) of the globalization of the economy

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and culture; (iii) of the educational needs of an increasingly knowledge-driven society; and (iv) of the training needs for high-performing professional activities (Bruckmann & Carvalho, 2014; Duderstadt, 2001). Solutions to these factors - which constitute major reasons for a change in universities around the world - may be found in a positive attitude toward knowledge sharing and collaboration relationships.

Knowledge sharing is needed to integrate the different disciplines, ideas, and knowledge of the institution' members (Nissen, Evald, & Clarke, 2014). On the other hand, collaboration refers to the relationship and high level of knowledge sharing between team members (Nissen et al., 2014), and is the creation base for new knowledge (Tan, 2016). Collaboration has been considered a way to address the challenges of the 21st century, fostering the necessary innovation, growth, and productivity for all parties involved. Several studies reveal that collaboration can be strongly influenced by knowledge sharing.

Like in the business sector, universities should encourage and promote internal and external collaboration. Collaboration relationships, besides the creation of new knowledge, may result in several outcomes and benefits for the university and society.

This chapter aims to address and discuss the university challenges in the collaboration relationships with the industry based on the main results of some empirical studies developed during a research project.

BACKGROUND

The Collaboration Relationship Between University and Industry

Today, universities are under intense pressure, motivated by the knowledge society and by the internationalization of institutions, where creativity, innovation, and entrepreneurship emerge as essential elements of competition. This scenario requires a focus shift from inter-organizational collaboration to intra-organizational collaboration, for the purpose of achieving other sources of resources, knowledge, and needed skills (Freitas & Verspagen, 2017). Collaboration has been considered one way to address the referred challenge, helping in the promotion of innovation, growth and productivity which are necessary for all parties involved.

The term "university-industry collaboration relationship" should be understood as an activity that involves the interaction between teams composed of people from academia (teachers, researchers and students) and company professionals. As suggested by Wohlin (2013), when universities enter into a collaboration relationship with the industry, they should not see it as just a place to study, but rather as a partner to do the study with. The objective of this collaboration is to create and share knowledge and technology, with neither party being relegated to a simple case study (Schubert & Bjør-Andersen, 2012). This collaboration is expected to benefit the related members and teams (teachers, researchers, students and professionals), the organizations that establish the relationship and, consequently, the surrounding society (Boyarchuk, Kharchenko, & Sklyar, 2018). According to Gray's view (1989), collaboration itself is not a solution, but an enabler in bringing about added value. To collaborate successfully, considerable effort is necessary (Gray, 1989).

Although both the university and the industry recognize the potential of the relationship, this is complex and often appears threatening to the organizations involved through value and objective conflicts. That said, it is not always easy to involve difficult issues, such as processes not clearly defined or management difficulties (Diamond & Rush, 2012; Gray, 1989). The university-industry collaboration relationship is characterized as a relationship between partners with different organizational and cultural

models. This requires special attention to the definition of systematic management procedures, in order to produce results for both parties (Kauppila, Majava, & Kropsu-Vehkaperä, 2016). According to Clauss and Kesting (2017, p. 186), these mechanisms "serve to define mutual objectives, facilitate coordination, and reduce uncertainties and opportunism". Currently, collaboration is viewed as a critical competency for organizations (Diamond & Rush, 2012).

Understanding the main drivers of this relationship and their proper articulation is a way that may help partners mitigate barriers, overcomes the differences, creates an environment of trust and commitment and consequently achieve the desired success of this collaboration relationship (Kauppila, Mursula, Harkonen, & Kujala, 2015). The three main drivers of a collaboration relationship are the motivation for collaboration, the channel of interaction and the outcome and benefits of the collaboration (Chedid & Teixeira, 2018). The motivations are internal and external factors that stimulate to attain a goal, they are different for universities and industries (Ankrah & AL-Tabbaa, 2015) and it plays an important role in the achievement of results (Lee, 2000), as well as in determining the type of channel to be used in the relationship. The channels are the systems of interaction existent between the partners that allow the establishment of a relationship, and some channels of interaction are more effective than others in order to achieve certain kinds of benefits (Dutrénit & Arza, 2010). Despite the channel of interaction playing an important role of addressing motivation, it is often possible to observe that, regardless of the motivation, the well-known channels are the first to be addressed (Barnes, Pashby, & Gibbons, 2002). The outcome has been one of the main factors that have contributed to increasing the establishment of collaboration between university and industry. They differ between the partners of the relationship and are strongly associated with initial motivation for interaction and with interaction channel used for this purpose (Arza, 2010). Figure 1 presents a framework to the understanding of this relationship, based on these three drivers.

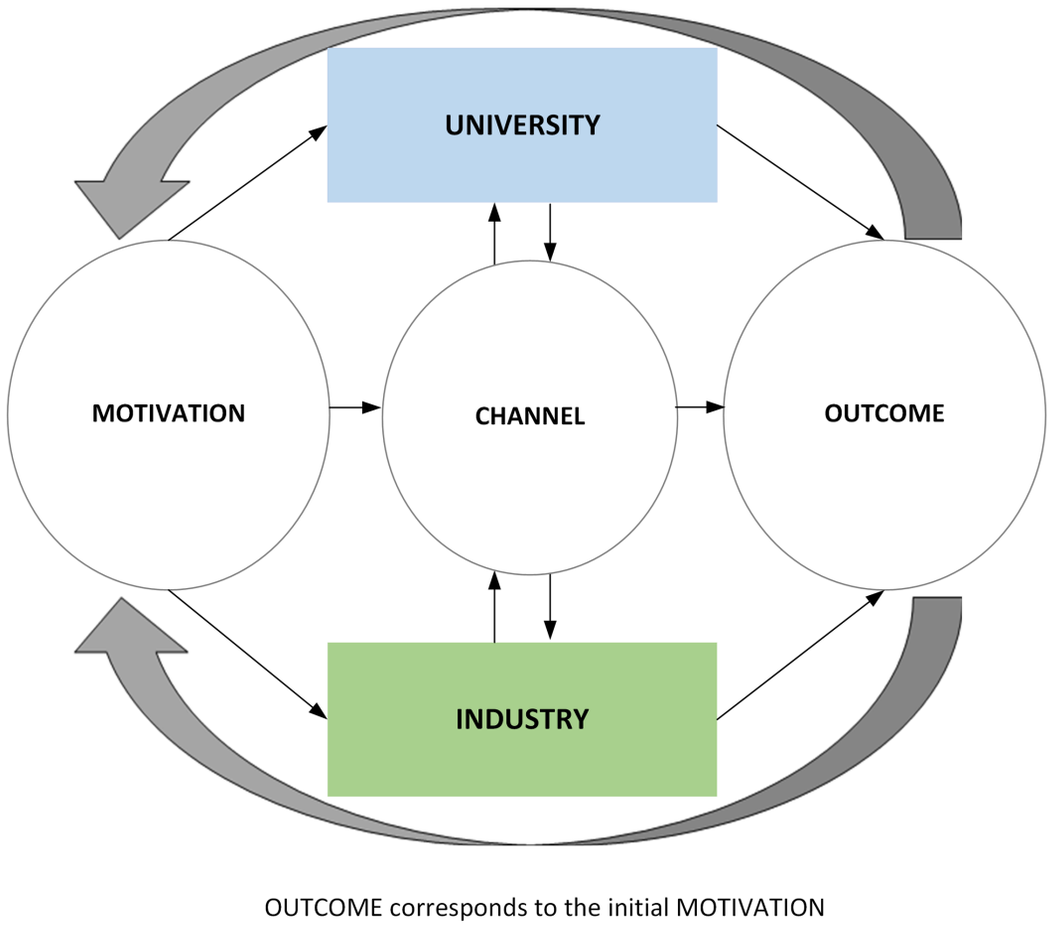
There is also a need to understand and develop a behavioral approach, embracing all relevant interested parties and making it possible to establish a strong linkage and a high level of knowledge sharing between teams (Nissen et al., 2014). Several studies in the literature also suggest that knowledge sharing has a particular influence on building and strengthening internal and external collaboration relationships (Nissen et al., 2014; Tan, 2016; Wu, Chuang, & Hsu, 2014).

The Collaboration Relationship in the University Context

Collaboration relationships in this context can result, in publications, dissemination of research results, the creation of new knowledge, and consist an important source of career advancement, reputation, and self-empowerment of the members (professors and researchers) of universities (Patel & Ragsdell, 2011). Collaboration also leads to a decrease in the redundancy of research efforts and an increase in resource savings, reducing the costs for research (Bruneel, D'Este, Neely, & Salter, 2009). Considering the pre-conditions for successful collaboration addressed by Diamond and Rush (2012, p. 297), such as "a more holistic approach to problem-solving (less rule and status bound), and a more open approach to discussion and problem-solving", it is expected that universities are a special context so that collaboration can be successful.

However, the literature highlights that collaboration in universities "is characterized by strong pragmatism and a high degree of self-organization" (Melin, 2000, p. 31), and that their members collaborate when necessary, configuring itself as a weak point in this kind of organization (Buckley, 2012). In general, universities members emphasize self-study more and they are not always aware of the valuable expertise

Figure 1. University-industry collaboration relationship framework
Source: (Chedid & Teixeira, 2018)



within the universities that can contribute to their work, preferring instead to achieve their goals and objectives independently and individually (Howell & Annansingh, 2013; Seonghee Kim & Ju, 2008).

Collaboration "is significantly associated with knowledge sharing among faculty in academic institutions" (Seonghee Kim & Ju, 2008, p. 285). Currently, the high level of specialization also contributes to the existence of subcultures within their own universities, and their integration into a single institutional culture is one of the great challenges that universities have been facing for years (Sporn, 1996). This specialization, according to Dill (1982, p. 312), may result "in declining involvement in institutional requirements and a lessening of social ties with disciplinary and institutional colleagues", with direct consequences on collaboration and knowledge sharing. Encouraging a higher level of social interactions can be a facilitator in leading to the unification of the various subcultures of the different communities around the main culture (Bartell, 2003; Dill, 1982). In the same way, knowledge in an academic context is created by different forms and is related to the experience and competence of their actors, namely professors and researchers, without any coordination or management supported by a specific strategy.

Given the distinctive nature of the culture of academic institutions and their sub-cultures, and in accordance with Benneworth et al. (2016), there is no single model that fits all situations.

Specifically, as regards internal collaboration within universities, knowledge sharing supports and enhances collaboration among its members. In addition, it promotes intense interaction among its members, which makes possible to solve problems and/or discuss common work tasks, improving their performance and contributing to the success of the institution (Seonghee Kim & Ju, 2008). However, internal collaboration "is rarely prioritized, resourced and commended", and "is often perceived as risky or a challenge to the prevailing organizational cultures/orthodoxies" (Diamond & Rush, 2012, pp. 289, 293). According to Lauring and Selmer (2012, p. 99), members of universities "show acceptance of external colleagues while at the same time are reluctant to collaborate with other department members".

On the other hand, through external collaboration with other organizations, academic or non-academic, universities can find ways to have access to resources, expertise, and knowledge they do not have (Ankrah & AL-Tabbaa, 2015). In particular, collaboration relationships with non-academic organizations can provide the opportunity to develop research in a practical setting, to create teaching and learning conditions in a real environment, and to obtain financial support for the research activities (Patel & Ragsdell, 2011; Vuori & Helander, 2016). However, in general, academics give more importance to participation in basic research than in projects with companies (De Fuentes & Dutrénit, 2012). Additionally, the evaluation criteria of teachers and researchers, even in prestigious universities, do not privilege relations with non-academic communities (Jongbloed, Enders, & Salerno, 2008).

THE UNIVERSITY CHALLENGE

Based on the understanding resulting from the literature review, it was also possible to identify that universities often play a central role in the university-industry collaboration relationships, since they "act as creators, intermediators, nodes, facilitators and resources" (Vuori & Helander, 2016, p. 952). However, there is a limited number of studies in the university's context regarding the relationship between knowledge sharing and collaborative behavior among academics (professors and researchers). Thus, in order to proceed with this study, there was a need to explore and deepen the understanding of this phenomenon in the context of a university. This approach tried to identify some elements that could help to interpret the behavior and practice of knowledge sharing and collaboration, through empirical data collected based on questionnaires and interviews.

In a first approach and considering that the knowledge sharing attitude is motivated and executed mainly at the individual level, the individual factors that could affect the attitude toward knowledge sharing among professors and researchers were examined and analyzed. The conceptual research model was developed based on the Theory of Reasoned Action formulated by Fishbein e Ajzen (1975), and included the motivational factors (intrinsic and extrinsic motivations), and social networks applied by Jolaee et al. (2014) and Soonhee Kim and Lee (2006), as antecedents of the attitude. The results identified that intrinsic motivation and networking positively affect the attitude towards knowledge sharing. However, extrinsic motivation did not significantly affect attitude. These findings were expected, given that members of higher education institutions have inviolable values, like freedom and autonomy (Sporn, 1996) and intrinsic motivation is an activity moved by self-determination and is free of external prods, pressures, or rewards (Ryan & Deci, 2000). Taking into account the characteristics of this institution and their members, the analysis of the findings obtained shows that it is important to establish mechanisms

based on intrinsic motivation and social networks, in order to promote and encourage knowledge sharing and, consequently, improve the collaboration relationships.

As the literature suggests that knowledge sharing has an influence in building and boosting collaboration within internal and external relationships (e.g. Tan, 2016; Wu et al., 2014), the previous research model was extended in order to also investigate the relationship between knowledge sharing and collaborative behavior. Based on this analysis, the results showed that professors' and researchers' attitudes affect their knowledge sharing intention. This finding is consistent with the result of Bock et al. (2005) who identified in their study that the intention to share knowledge is greater when the attitude towards knowledge sharing is more favorable. The results also indicated that, in this study, knowledge sharing intention was not affected so strongly by the subjective norm. This result could be explained by the fact that professors and researchers are fully aware of knowledge sharing and its related benefit for themselves, and that they prefer to go through the decision-making process with fewer interventions from colleagues and peer groups when it comes to knowledge sharing intention. This finding is similar to that found in Jolaee et al. (2014). However, it is different from that of Bock et al. (2005), which suggests that subjective norms can influence intentions, especially within groups with strong collectivist orientation like Korean organizations.

In the context of this study, trust was defined as the degree of relying on sharing educational and scientific knowledge with colleagues. The result strongly supported the hypothesis, meaning that trust had a positive effect on the intention of knowledge sharing. This finding is similar to those found in previous studies reported in the literature within universities. Tan (2016) conducted a survey in five universities in Malaysia and identified that trust has a significant and positive influence on knowledge sharing, suggesting that universities should create and reinforce an environment of trust among their faculty members. The study of Patel and Ragsdell (2011), in two faculties at a British university, also concludes that trust plays an integral part in the knowledge sharing process within organizations. However, current business models with geographically dispersed companies and ongoing partnerships and restructuring actions, as well as the increasing tendency to replace the face-to-face communication by the digital communication constitute a challenge for the development of trust in the relationships. In the opinion of Cook et al. (2005), trust is no longer the central pillar of the social order and may not even be considered very important in most processes of knowledge sharing and collaboration that are managed quite effectively.

Finally, this study identified that knowledge sharing intention has a positive influence on collaborative behavior, being this influence stronger in the case of internal rather than external collaborative behavior.

Regarding the knowledge sharing and collaboration practices in this university, the empirical results also revealed that, in the knowledge sharing process, the main forms of communication are personal contacts and e-mail. On the other hand, the least used forms of communication for the same purpose are networking, video conferencing and groupware. These results may be supported by different perspectives. Snyder and Lee-Partridge's (2013) identify that the adoption of these means of communication allows direct knowledge sharing only to individuals with whom a relationship of trust is established, which suggest that trust is a facilitator element of knowledge sharing. Conversely, Kim and Ju (2008) report that the frequent use of forms of communication characterized by personal is justified by the lack of information on how and where members of university should share their knowledge or who has the need or interest in their knowledge, which suggests the need for a dedicated and appropriate channel for knowledge sharing. The limited use of means of communication-based on technological infrastructure

does not contribute to richer interactions between the members of the university, reducing the ability to enhance knowledge sharing and collaboration (Chen, Wu, & Wu, 2013).

With this study, it was also possible to conclude that professors and researchers are in some way aware of the benefit of knowledge sharing, and in this way, they share part of their knowledge within the institution. However, despite knowledge sharing being one of the core missions of the universities, the study shows that this does not emerge strongly within this institution. It was expected that knowledge would flow more freely among members of the institution since knowledge sharing is fundamental to integrate the different disciplines, ideas, and knowledge possessed by the different university's actors (Ramayah, Yeap, & Ignatius, 2013). Regarding types of external organizations with which respondents establish collaboration, 'other academic institutions' and 'research centers', stand out as the main organizations. On the other hand, the types characterized as non-academic organizations, namely 'industrial organizations' and 'consulting firms', are less than all the other types of external collaboration. Finally, the results of this study concerning the ways of how external collaboration relationships are established reveal that most of the external collaboration relationships occur in typical academic activities like 'participation and/or organization of conferences' and 'guidance and/or supervision of dissertations, internships, and projects'. However, collaboration relationships based on academic activities are generally characterized as a short-term relationship with benefits for only one of the partners (i.e. industry) and one-way knowledge flow, that is, from university to industry (Franco & Haase, 2015).

In order to analyze the perceptions and experiences of a group of participants considered relevant in the collaboration relationship, an empirical study based on a qualitative approach using semi-structured interview was performed. The objectives of this investigation were to understand (1) the main motivations that lead to the decision of establishing a collaboration relationship; (2) the management mechanisms used in the governance of collaboration relationships and; (3) the culture and principles of knowledge management and of knowledge sharing existing in these organizations.

The results indicate that knowledge creation represents an important aspect of the motivation that leads to the establishment of a collaboration relationship. The difference observed between the university institution and the participating companies is highlighted. The answers obtained from the university show a certain individualistic motivation (i.e. centered on the options of the main protagonists of the process); while in the industry, the creation of knowledge arises naturally due to the need to search for new solutions for its customers (i.e. according to market preferences). These results are probably associated with the existence of more individualistic work culture in universities. On the other hand, companies emphasize that the creation of knowledge represents a mission naturally incorporated into the existing work processes, systems and infrastructures. This result corroborates evidence already reported in the literature (Howell & Annansingh, 2013; Tian, Nakamori, & Wierzbicki, 2009).

As the main motivation for establishing a collaboration relationship, the industry identifies the people dimension; in other words, the possibility of hiring experts in the field. However, the university seems to be rooted in the need imposed by certain programs which lead to the raising of financial funds. This motivation seems to become increasingly more important due to the reduction of resources by the government; a result of the economic situation of recent years (Carvalho & Videira, 2019; Jongbloed, 2015), which has caused major changes in the funding structure of Portuguese universities (Feijó & Tamen, 2017). The results also include industry objectives focused on short-term solutions, while the university concentrates on the search for research problems that result in the publication of scientific papers. Therefore, projects where the confidentiality must be maintained until the product's launch, are often of no interest to the academic community. Jongbloed (2015) points out that this is often a point

of tension between academia and industry, where academics resist accepting these conditions. It should be noted that the difference in timings associated with returns seems to be one of the main difficulties – negatively impacting the motivation for a relationship.

Despite the importance attributed to the communication channel in the literature, as has already been discussed, industry and university are practically unanimous in identifying what they consider to be the best channels. Generally speaking, regardless of motivation, the relationships are conducted through informal channels, based on networking derived from past events, more specifically, from former teachers and/or former students. For the industry, the motivation for using this type of channel is due to formal/institutional channels being more time-consuming and highly bureaucratic. Additionally, formal channels often lead to meeting previously unknown partners, and the trust factor emerges as an element to be considered in the collaboration relationship. This means that trust plays a positive role when defining such a relationship (Ehrismann & Patel, 2015). On the other hand, for the university´s interviewees, informal channels are more effective. The university's opinion matches that of Edmondson et al. (2012, p. 9) when they suggest that "people determine the success or failure of industry-university partnerships". It is also possible to observe that the interfaces of collaboration relationships existing in the university are practically unknown by the industry. Meanwhile, the members of the university point to a need for a better institutional strategy that promotes these relations.

Regarding the identification of their best partners, the results suggest that the university and the industry are still far apart and that, in general, they relate better to their peers. The university representatives prefer to choose other academic institutions, while industry representatives prefer other companies. It should also be noted that industry and academia have the same positive perception regarding the importance of long-term collaboration relationships, as well as the need for some investment in the relationship, in order to obtain positive results. Sustainable long-term relationships promote a deep dialog of collaboration, which "constructs a space for joint academic-practitioner knowledge creation, thus solving the knowledge production and transformation problem in management research" (Chen et al., 2013, p. 582) and "create a symbiotic relationship that support the competitive advantage of the organizations involved (Calvo, Fernández-López, & Rodeiro-Pazos, 2019, p. 1).

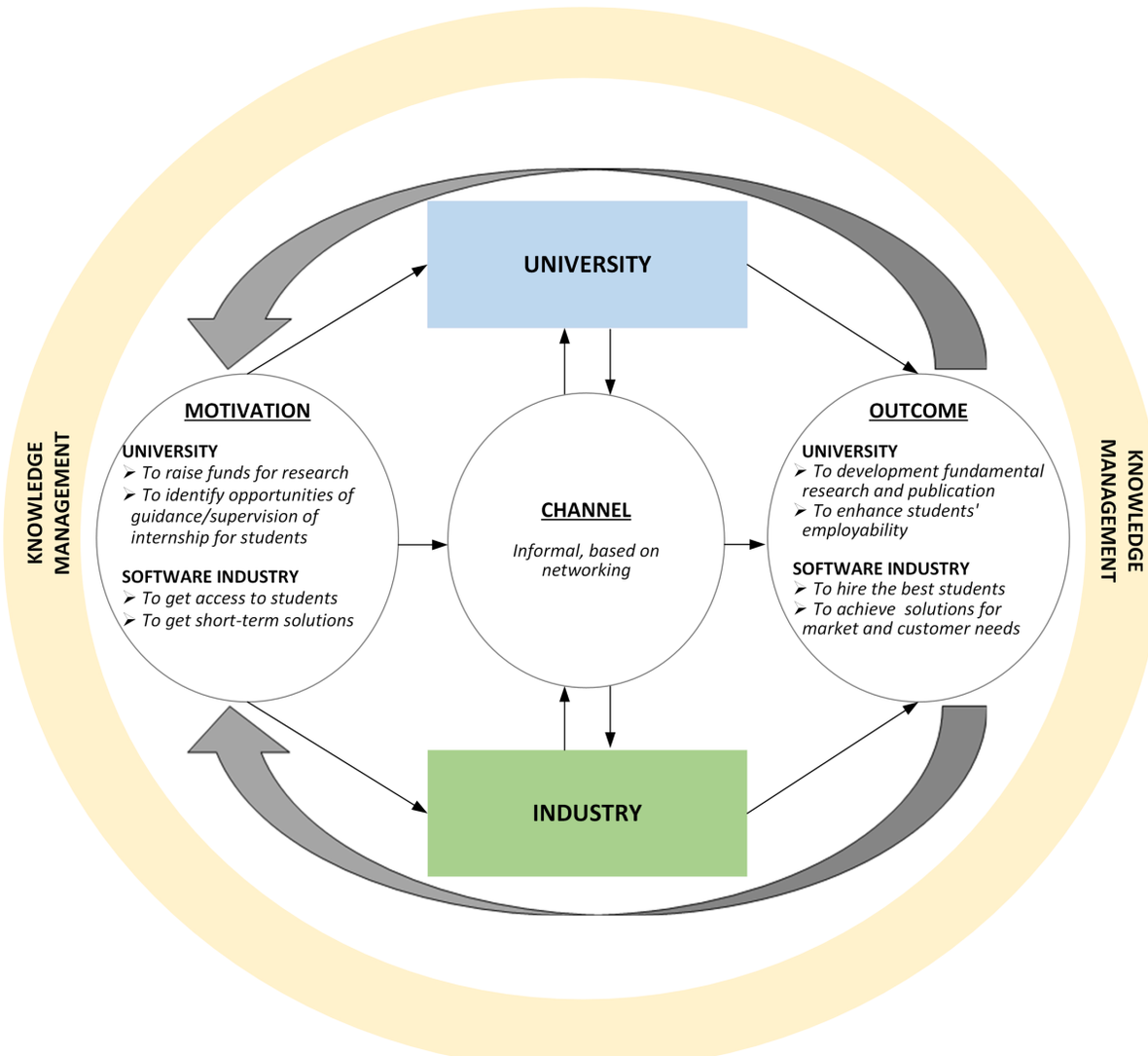
This study also showed the importance of the existence of evaluation mechanisms in a collaboration relationship and, at the same time, revealed the lack of such mechanisms. The existence of an evaluation process promotes the opportunity to learn more and identify strengths and weaknesses of each experience (Wilson, 2012) that could make collaboration relationships more sustainable. In this sense, some proposals have been advanced by both sides, to promote and encourage collaboration relationships in a more sustainable way.

In the knowledge management dimension, the results suggest that people are considered as the most important resources in both organizations. Regarding the use of technology and/or systematized processes in knowledge management, the industry reports the existence of typical methodologies for project management; while on the part of the university the existence of these mechanisms may be more fragile or even non-existent. Industry and university share the view that knowledge sharing is not a problem in their respective organizations. As for the capture of explicit knowledge, this process also occurs without difficulties in these organizations. On the other hand, it should be noted that the parties involved in the study have demonstrated that they do not have mechanisms to support tacit knowledge management, in a situation of loss of their collaborators. As it is not fully recorded, a good part of all tacit knowledge would be lost with the exit of its holders, creating a potential gap in organizational knowledge (Vasconcelos,

Kimble, Carreteiro, & Rocha, 2017). Liebowitz (2009) had already stated that when an employee leaves the organization, it is not simply the knowledge that they possess that is lost, but also their whole network.

Figure 2 summarizes the main results and considerations that emerged from the different studies considered in this work.

Figure 2. Contextualized framework of the university-industry collaboration



SOLUTIONS AND RECOMMENDATIONS

As in business organizations, universities should foster and promote internal and external collaborations. Moreover, strategies to promote knowledge sharing and collaboration are important requirements that

contribute to the overall result being greater than the mere sum of the parties (Weber, Morelli, Atwood, & Proctor, 2006).

In order to enhance the collaboration relationships between the university and the industry in a sustainable way, based on the key findings, it is possible to suggest the following recommendations for its sustainability:

The university needs a clearly formulated strategy to engage with industry, something suggested by interviewees from the university: develop an institutional strategy to promote and encourage internal and external collaboration. This institutional strategy should play a leading role in defining the focus areas for collaboration, designing formats, selecting partners, evaluating collaborations, and continually managing the interactions between the university and the industry. This strategy should also establish an institutional channel providing relevant communication between university and industry and creating a collaboration environment in a holistic way. However, this institutional strategy should also consider the importance of the informal channel. Once most collaboration relationships are initiated and established through already established contacts. These contacts are often personal formed in university or through educational and/or professional networks or previous collaboration. This institutional channel can help overcome some issues addressed in the research:

- Better alignment of expectations and understanding of partners;
- Developing mutual trust and common motivation to collaborate;
- Reducing the distance between organizations and bringing them closer together;
- Allowing both organizations to understand the added value of a collaboration relationship;
- Reducing the time-consuming and bureaucracy of channel formal/institutional.

It is also important to provide incentive and supporting structures that encourage collaborations with industry. It became apparent from the qualitative study that existing platforms have been under-utilized or are unknown for both academics and industries. Paradoxically, the incentive for university-industry collaboration relationship should not come from direct support measures. Although clearly needed and that may help to enhance collaboration, as previously proven in this research, the real incentive comes from the intrinsic motivation of each academic. Social media have the potential for supporting different knowledge management processes and encouraging on participation, knowledge sharing and collaboration. Social media may also help in creating a platform where academics and practitioners can network work together.

The results point to the importance of providing a dedicated and appropriate strategy for knowledge sharing. Additionally, this research showed the relationship between knowledge sharing and collaboration relationship. Despite the results shown that the respondents from the university agree that the institution provides appropriated technologies and mechanisms to support knowledge sharing, a set of personal means of communication is the most widely used. On the other hand, the set of means based on technological infrastructure has a lower level of utilization. Knowledge sharing does not emerge strongly within this institution, except for knowledge resulting from researches, probably reflecting the requirement of publications, since it is the main factor of academic evaluation. However, the possibilities to influence academics are limited and difficult, decisions heavily depend on individual attitudes and intrinsic motivation of academics. This situation does not contribute to richer interactions, reducing the ability to enhance knowledge sharing and collaboration.

The results also identified, on both the university and on the software industry, a lack of systematic approach for capturing the full potential of collaboration relationship. A more systematic and less individualistic approach allows organizations to capture and to enhance opportunities that can derive from collaboration relationships. In this regard, the university should create and build up a collaboration relationship knowledge base. The existence of a knowledge base, among other aspects, will enable:

- The relationship moves towards a stable, long-term, mutually beneficial partnership, Thanks to the lessons learned in previous collaboration and their utilization in the subsequent ones;
- The record of successful collaboration relationships with industry can provide resources to motivate internal university academics to work together on a project that might not otherwise be possible;
- The implementation of a whole-of-university engagement strategy;
- The capture and dissemination of shared knowledge during the several interactions of groups of work to other members of each of the related organizations;
- The establishment of a competence portfolio based on situations of business practices.

FUTURE RESEARCH DIRECTIONS

The literature revision on knowledge sharing and collaboration in the context of universities revealed a limited existence of empirical studies (Ali, Gohneim, & Roubaie, 2014), having been the main ones conducted in the United Kingdom and Asia (Tohidinia & Mosakhani, 2010). In a recent study, Al-Kurdi et al. (2018, p. 239) claim that "other regions and countries must invest in quality research in this area, as it is essential for the development of a nation's higher education system".

Some directions of further studies could be associated with the need to understand better the university-industry collaboration relationships, such as:

- Universities are complex organizations with a diversity of conflicts. The major part of the studies in university-industry collaboration relationships has treated university as a single unit. The development of a systematic model of procedures of governance and management from a holistic perspective is essential for capturing the full potential of such relationships.
- Although this collaboration being a relationship between organizations with fundamental differences in their characteristics, generally, the studies emphasize the impact of the university on the industry. Future studies are needed to examine the contributions and impacts of this relationship on each partner.
- It seems to be a consensus among authors that sharing of knowledge and collaboration may become easier with social media use. In this sense, it would also be important to understand what type of technologies could help in creating a platform for interactions between university and industry.

CONCLUSION

The changes in the industry sector have been ever more rapid and more substantial. The transition to the fourth Industrial Revolution has become the industry environment ever more complex with rapid technological advances with impact on processes, products and services' life cycles. Toward this scenario, it is possible to suppose that the collaboration relationship between university and industry will become increasingly important for both organizations.

As discussed in the present chapter, university-industry collaboration relationship offers numerous benefits for both parties. As a result of this mutually beneficial relationship, industry companies can achieve solutions for most of their problems, since university offers firms a wide knowledge base of different scientific domains (pedagogical and scientific), specialists (teachers and researchers), training, etc. On the other hand, the university can get involved with specialized professionals and the real world of this industry, which can help its research and educational processes. These potential benefits reinforce the importance and the need to encourage and structure such collaboration.

This work, based on empirical studies, contributes to the identification of relevant facts to the university-industry collaboration relationship. The results obtained can support the institution's management in the strategies definition and development of future actions that significantly leads to sustainable knowledge sharing and collaboration relationships.

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KEY TERMS AND DEFINITIONS

Academia: A community constituted by universities and public research institutes or laboratories. The academia offers teaching, research, and service to the community in various areas of knowledge.

Channel of Interaction: Mechanisms of interaction existent between the partners of a relationship.

Governance: The establishment of policies, best practice, and continuous monitoring of their proper implementation to ensuring effectiveness.

Informal Collaboration: Mechanism that does not involve any contractual relationship between the university and the industry.

Knowledge Sharing: Sharing and transfer are interchangeable in the literature, and commonly appear with the same sense. It is a key process related to the knowledge intensive context. Knowledge sharing promotes the creation of new theories and ideas, and establishment of new research principles.

Motivation: Internal and external factors that stimulate to attain a goal.

Outcome: Consequence or conclusion after a period of time, which can be one result, multiple results, or no results.

University-Industry Collaboration: Bi-directional relationship between university and industry entities, established to enable the diffusion of creativity, ideas, skills and people with the aim of creating mutual value over time.

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Chapter 28
Knowledge Management in University–Software Industry Collaboration

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ABSTRACT

The university-software industry collaboration relationship has been represented a key resource, to the extent that together they can more easily promote technological development that underpins innovation solutions. Through a literature review, this chapter aims to explore the concepts and the facilitator or inhibitor factors associated with the collaboration relationships between university and software industry, taking knowledge management into account. This chapter is organized as follows. In the first section, the authors briefly introduce university, software industry, and knowledge management. The following section, based on the literature reviewed, provides a critical discussion of the university-software industry collaboration relationship, knowledge management in knowledge intensive organizations or community, and knowledge management in collaboration relationship between these two types of industries. Finally, in the rest of the sections, the authors point to future research directions and conclude.

INTRODUCTION

The current environment that characterizes the software industry is extremely dynamic and somewhat complex demanding high-performance solutions, rapid development and cost efficiency. The collaboration relationship with universities has been represented a key resource, to the extent that together more easily can promote technological development that underpins innovation solutions. In addition, several

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studies point out knowledge sharing as an important and strongly influential factor in a collaboration relationship.

Organizations belonging to the software industry, as well as higher education institutions designated in this work as universities are recognized as organizations based on intensive knowledge. Given the knowledge intensive nature of the two types of organizations, the collaboration strategy requires the integration of specialized knowledge dispersed between each of the members of the work teams, usually multidisciplinary. The highly specialized knowledge, both tacit and explicit, is created and shared in the different phases of the relationship (Boyarchuk, Kharchenko, & Sklyar, 2018; Salavisa, Videira, & Santos, 2009). However, tacit knowledge becomes more important to the relations between these types of organizations (Ryan & O'Connor, 2013). Edmondson et al. (2012) add that the true value of a collaboration relationship is often associated with the tacit knowledge that is shared. This implies that possible solutions that aim at the sustainability and success of the relationship should be examined through knowledge management (Gill, 2002; Philbin, 2008).

In this study, the term "university-software industry collaboration relationship" is defined as an activity that involves the interaction between teams composed of people from academia (teachers, researchers and students) and software industry professionals. The objective of this collaboration is to create and share knowledge and technology, with neither party being relegated to a simple case study (Daria & Kostiantyn, 2018). This collaboration is expected to benefit the related members and teams (teachers, researchers, students and professionals), the organizations that establish the relationship and, consequently, the surrounding society (Boyarchuk, Kharchenko, & Sklyar, 2018). As suggested by Wholin (2013, p. 43), when universities enter into a collaboration relationship with the industry, they should not see it as just a place to study, but rather as a partner to do the study with.

Through a literature review, this chapter aims to explore the concepts and the facilitator or inhibitor factors associated with the collaboration relationships between university and software industry, taking knowledge management into account.

This chapter is organized as follows. In the next section, the authors briefly introduce university, software industry and knowledge management. The following section, based on the literature reviewed, provides a critical discussion of the university-software industry collaboration relationship and knowledge management in knowledge intensive organizations or community. Finally, in the remainder sections, the authors point future research directions, and conclude.

BACKGROUND

In this section, this chapter outlines a brief theoretical foundation of the study. The first part covers the context of the study. The second part presents the knowledge management.

The Context of the Study

About the University

Universities (or higher education institutions) are complex and heterogeneous organizations (Bozeman & Boardman, 2013), fragmented into different knowledge domains, structured through communities (e.g. pedagogical, scientific, and institutional) with inviolable values of freedom and academic autonomy

based on traditions and histories (Tippins, 2003). The various communities assume their own culture within a symbolic context, making it difficult to establish a culture with a rational management process and strategic vision (Dill, 1982). Currently, the high level of specialization also contributes to the existence of subcultures within their own universities. Their integration into a single institutional culture is a great challenge that universities have been facing for years (Sporn, 1996). This specialization, according to Dill (1982, p. 312), may result "in declining involvement in institutional requirements and a lessening of social ties with disciplinary and institutional colleagues". Encouraging a higher level of social interactions can be a facilitator in leading to the unification of the various subcultures of the different communities around a main culture (Dill, 1982).

The structuring of the university based on different areas of knowledge also leads to the formation of several subcultures that overlap with the institutional culture (Howell & Annansingh, 2013). Subculture usually exert a strong influence on the behavior and how each member of the institution acts. On the other hand, Howell and Annansingh (2013) define subculture as a set of meanings shared by members of a group, determining how they taught, develop researches and interact with others members of the institution; regardless of whether they are peers, employees or students.

Kerr (1987) suggests that, although the university is one of the sectors of society that can most be affected by political, economic, social and technological changes, unlike other sectors of society, the university has not yet been subjected to any great challenge and "the faculty members continue to operate largely as individual craftsmen" (Kerr, 1987, p. 184). However, Duderstadt (2001, p. 7) stresses that in the current context, we are faced with a "technology that has evolved so rapidly and relentlessly, increasing in power by a hundred-fold or more every decade, obliterating the constraints of space and time, and reshaping the way we communicate, think, and learn".

It should also be noted that universities nowadays suffer from the impact of: (i) life cycles associated with technological innovations (Gill, 2002); (ii) economic and cultural globalization; (iii) the educational needs of an increasingly knowledge-driven society; and (iv) the training needs for high-performing professional activities (Bruckmann & Carvalho, 2014; Duderstadt, 2001). Solutions to these factors — which constitute major reasons for change in higher education institutions around the world — may be found in a collaboration relationship with the software industry.

About the Software Industry

The history of software has evolved significantly in the last 30 years and its increasing relevance and criticality is well documented in several studies in the literature (Druffel, 2017). Looking back at the history of software, it can be divided into two important phases: a first phase where software was exclusively associated with technology. More recently, in a second phase, the emphasis has been put on applications and social changes brought about by software-based innovation processes, with increasingly significant changes in all societal contexts (Campbell-Kelly, 2007).

"Modern society is increasingly more dependent on software that offers quality and reliability" (Mead, Seshagiri, & Howar, 2016, p. 28), since these represent cross-cutting solutions for diverse products, services and processes that are part of everyday life in society. Currently, software represents a critical building element for the main types of systems (Druffel, 2017) and remains a fundamental resource for their connectivity and interoperability. This leads companies in this industry to rely heavily on the ability to discover opportunities and create innovative products, devices and solutions, so they can succeed in their marketplaces.

Taking into account the fact that software is present in all domains, being widely used in several areas, the software industry assumes a fundamental role in the economy and distinguishes itself as a type of business with increasing economic importance (Aurum, Daneshgar, & Ward, 2008; Lippoldt & Stryszowski, 2009).

In today's economy, it is difficult to define the boundaries of the software industry, as its limits are increasingly extended, and the profile of the professionals working in this area increasingly complex. In this context, and needing professionals with this profile, we have the most diverse business areas, such as companies dedicated exclusively to software development, companies from other business areas which also use and produce software to integrate their products (e.g. automotive industry), public institutions such as schools and universities, non-governmental organizations, to name a few (Lippoldt & Stryszowski, 2009). In fact, a significant part of software developed by the software industry is not a final product, but rather an integral component of products from other industries (Lippoldt & Stryszowski, 2009). In 2006, Michael Tiemann (2006, p. 3), vice-president of the world's leading provider of open source solutions *Red Hat*, argued that, "the battle of the next 10-15 years will be about who gets to control the ways in which software can be developed, sold, and used". The market for this type of software has been growing rapidly and has taken on an important role outside the traditional software sector (Lippoldt & Stryszowski, 2009).

Nearly two decades ago Watts Humphrey (2002, p. 1), recognized as the 'father' of quality in software and of CMMI (Capability Maturity Model Integration), wrote that "every business is a software business". He stated that although some managers do not recognize this software criticality in their business, almost all, regardless of type, use software directly or indirectly. Humphrey (2002, p. 4) cites the speech from a vice-president of a bank as an example of the importance of software in business: "we are a software business masquerading as a bank". Recently, Bill Ford, the Chairman of the Board of Directors of the centennial automotive Ford company, aware of this context, stated that the future of the automotive industry, particularly in the assembly sector, goes through a paradigm shift, transforming into a software industry (Kevin, 2017). Bill Ford added that the automotive industry should pay attention to start-ups and technology companies, considering that nowadays, they are the real competitors. Similarly, the General Electric Company (GE), the 13th largest company in the world and traditional industry, presented in its 2013 Annual Report (General Electric, 2014), the Shareholder Letter of its CEO Jeffrey Immelt where he clearly states that in the coming years, all companies of the industrial sector will become software industry companies. In pursuit of this strategy, the GE Digital was created in 2015 with the goal of being one of the 'top ten' software companies in 2020. In the 2017 Annual Report (General Electric, 2018), the GE Digital had already accumulated US$ 4.0 billion in annual revenue.

Given the scope associated with the practice of the software industry, this study uses the broad definition adopted by Lippoldt e Stryszowski (2009, p. 41): "the traditional 'software industry' (i.e. companies or institutions that primarily deal with development of software), as well as the parts of other industries that are involved in software development".

The software industry is characterized as being a "high technology, knowledge intensive, highly mutable industry – with weak entry-barriers and short innovation cycles – which demands continuous adaption, learning and access to knowledge" (Salavisa et al., 2009, p. 1). However, most of the existing companies in this sector are small and medium-sized, operating in a resource scarce scenario, with limited access to finance, specialized personnel and knowledge networks; facing competition from large national and international companies (Lippoldt & Stryszowski, 2009). Many of these companies have been created in the last decades as start-ups or spin-offs from universities, and a significant portion of

these still maintains this link (Salavisa et al., 2009). The current technological complexity, resulting from the wide range of economic activities, goods and services, requires extended competences and a constant update in terms of knowledge on the part of work teams; making this aspect one of the most challenging when managing this type of industry (Druffel, 2017; Lippoldt & Stryszowski, 2009). It should be noted that this industry is highly dependent on the availability and access to human resources.

As such, one of the biggest challenges that this industry has been facing for some years now is precisely the scarcity of resources with adequate software skills (quantity) and the lack of preparation in critical and emerging areas (quality) (Lippoldt & Stryszowski, 2009). It is believed that by 2020 there will be a shortage of more than 900 thousand professionals in the European Union (OECD, 2017). During the 2006-2016 period, the number of professionals in the market with information and communication technology skills (ICT) increased 39.5%, representing a 10-fold increase in total employment during the same period (3.6%). Among ICT activities, 'IT and other information services' and 'software publishing' are the ones with the highest employment growth in the sector. The European Statistical Office (Eurostat), as well as the Organisation for Economic Co-operation and Development (OECD), define ICT specialists as workers who have the capacity to develop, operate and maintain ICT systems and for which ICT constitutes the main part of their activity. Among the various functions of the ICT specialist, are developers and software and multimedia analysts, database specialists and system administrators, etc.

In the meantime, despite this environment and the evolution of new software development organizational arrangements (e.g. outsourcing, global software development, and open source) Aurum et al. (2008) considered that software development still needs to achieve a higher level of maturity. On the other hand, the software development process is a collective, complex and creative effort that varies according to the organization, the type of software and the members of the teams involved in the process (Ryan & O'Connor, 2013). Additionally the software development process consists of a set of activities, which in turn are based on the intensive use of knowledge, through the processing of a large volume of know-how of different domains and technological competencies (Aurum et al., 2008; Mehta, Hall, & Byrd, 2014). This endows knowledge management an important role in software industry operations (Fehér & Gábor, 2006).

The Knowledge Management

Currently, the factors that lead to the success of businesses are not limited to the financial capital, labor and raw material. Knowledge has, for some years, become the most valuable resource for companies — the only one that can raise companies to the level of innovation and, as such, enhance competitive advantage (Gloet & Terziovski, 2004). Through knowledge, organizations can improve development by creating new business opportunities (Pekka-Economou & Hadjidema, 2011). On the other hand, increasing access to knowledge has made the innovation process complex within organizations, making the innovation process strongly dependent on said knowledge (Gloet & Terziovski, 2004).

Given this context, Peters (1992, p. 382) asks the following question: "if knowledge is the source of most value-added, how do organizations accumulate it?". However, according to Drucker (1994) the great challenge is not how to accumulate knowledge, but how to manage it in order to makes it productive, thus emerging the concept of knowledge management.

According to Prusak (2001), knowledge management, as a field of study, had the conference held in Boston in the year 1993 as its initial milestone, which was specifically dedicated to the theme and organized by him and other colleagues. Some 25 years later, the meaning, application and the compre-

hensiveness of the concept of ‘ knowledge management ‘ are still under discussion (Girard & Girard, 2015). According to Girard and Girard (2015, p. 15), “knowledge management has developed from a premature concept into a mainstream organizational necessity”. At present, all scholars of systems, practices and models associated with knowledge management recognize their complexity and, at the same time, their multidimensional and evolutionary nature.

Although knowledge management is a holistic combination of measures involving people, processes and technology management, the literature indicates that organizations in the past have not been consistent in their knowledge management approach. Generally, the efforts to implement this concept into organizations focused on the development of technologies to support knowledge management activities, while not giving due attention to the integration of people and consideration of processes (Gloet & Terziovski, 2004; Grover & Davenport, 2001). However, Smith (2001, p. 319) suggests that “each organization has its unique way to handle knowledge”. Variables such as “degree of maturity of the organization, type of business, core competences, culture, infrastructure and marketplace competition” affect how knowledge is used.

Several authors highlight the important role of knowledge management in the creation of new knowledge and innovation process (e.g. Inkinen, 2016). They point out the need of knowledge management practices in organizations since, “knowledge can be likened to a living system, growing and changing as it interact with the environment.” (Davenport & Prusak, 1998, p. 8).

There are several definitions of the knowledge management in the literature that bring with them the concepts of the domains in which they are applied. In Rowley’s view (2000, p. 327), “knowledge management is a complex process which will be understood differently in different contexts”. Girard and Girard (2015), in their work entitled ‘Defining knowledge management: Toward an applied compendium’, relate more than 100 different definitions in 23 distinct domains. McKellar (2015) adds that, currently, knowledge management is like an ‘umbrella’ under which are other disciplines such as business intelligence, collaboration, big data, business process management, relationship management/customer experience, competitive intelligence, etc., Figure 1.

Although knowledge management relies on three different pillars — technology, people and process — and aims at achieving the objectives of organizations (Davenport & Prusak, 1998), a special dedication to technology has been verified in practice (by organizations). There were substantial investments in highly structured knowledge management solutions, and little attention to knowledge creation processes (Grover & Davenport, 2001). Gill (2002, p. 255) observed that “an increasing tendency of excluding human participation, interpretation and mediation from all sorts of processes and systems in the name of notions such as efficiency, objectivity, transparency and certainty”. Technology, by itself, is not a knowledge creator, but can become a process accelerator if used correctly (Malhotra, 2005). According to Webber (1993), the location of knowledge is not in technology, but in the human mind.

UNIVERSITY-SOFTWARE INDUSTRY COLLABORATION RELATIONSHIP

In a rapidly changing scenario with increasingly disruptive innovation processes, the software industry needs more technology-based solutions to ensure its competitiveness (Wohlin et al., 2012). Companies in this industry have generally sought collaborations with universities, in order to have access to specific knowledge, which allows them to complement the skills that they already possess (Ehrismann & Patel, 2015). On the other hand, universities driven by technological progress and social pressure have also

Figure 1. Knowledge management 'umbrella'

sought solutions to some of their problems by establishing collaboration relationships with the software industry (Coccoli, Stanganelli, & Maresca, 2011). It should be noted, that businesses and universities have faced a common problem related to the lack of professionals in emerging technological fields. This is happening at a time when the paradigm is to migrate to industry 4.0 solutions. This problem is exacerbated by the mismatch/misalignment between the profiles that the market demands and the qualifications that graduates obtain from their university education (Mead et al., 2016). According to Mead (2016, p. 29), this mismatch is currently "too high, with significant adverse consequences for employers and jobseekers".

Given this scenario, Boyarchuck (2018, p. 667) states that, "successes in this field are impossible without the fruitful collaboration between universities and the software industry". However, several authors believe that the traditional models of collaboration relationships are not adequate to the dynamics of these types of industries (Boyarchuk et al., 2018; Coccoli et al., 2011). This reinforces the importance of studies based on empirical data, on factors that may be the origin and that sustain a collaboration

relationship between these two types of industries. The importance of factors related to new collaboration strategies, with new approaches based on the convergence of technologies, teaching and research, as well as on the increasing importance of knowledge, are also highlighted (Boyarchuk et al., 2018).

Although it seems obvious and that the parties involved recognize the need for collaboration, the difference between their individual expectations may make the opportunity for collaboration impossible, and/or even eliminate it completely (Wohlin, 2013). Rodríguez et al. (2014) also point out that one of the challenges of this type of collaboration relationship is that many software industry professionals view academic research as theoretical and of little value in practical applications (product development). On the other hand, researchers often complain that they do not have access to industry data and practical problems needed to develop their applied research (Rodríguez et al., 2014). A collaboration relationship between these industries can help address these challenges by bridging their interests and converging the expected objectives and benefits. In Ehrismann and Patel's point of view (2015, p. 2), "a clear understanding on common, but also diverging interests is the most truthful and realistic negotiation basis"; which may lead to a successful collaboration relationship. The same authors also point out that understanding and respecting one's organizational culture and combining existing intellectual and technological resources to respond to emerging issues can accelerate and improve the quality of their collaboration relationship (Ehrismann & Patel, 2015).

Figure 2 summarizes the main outcomes and challenges of the university-software industry collaboration relationship.

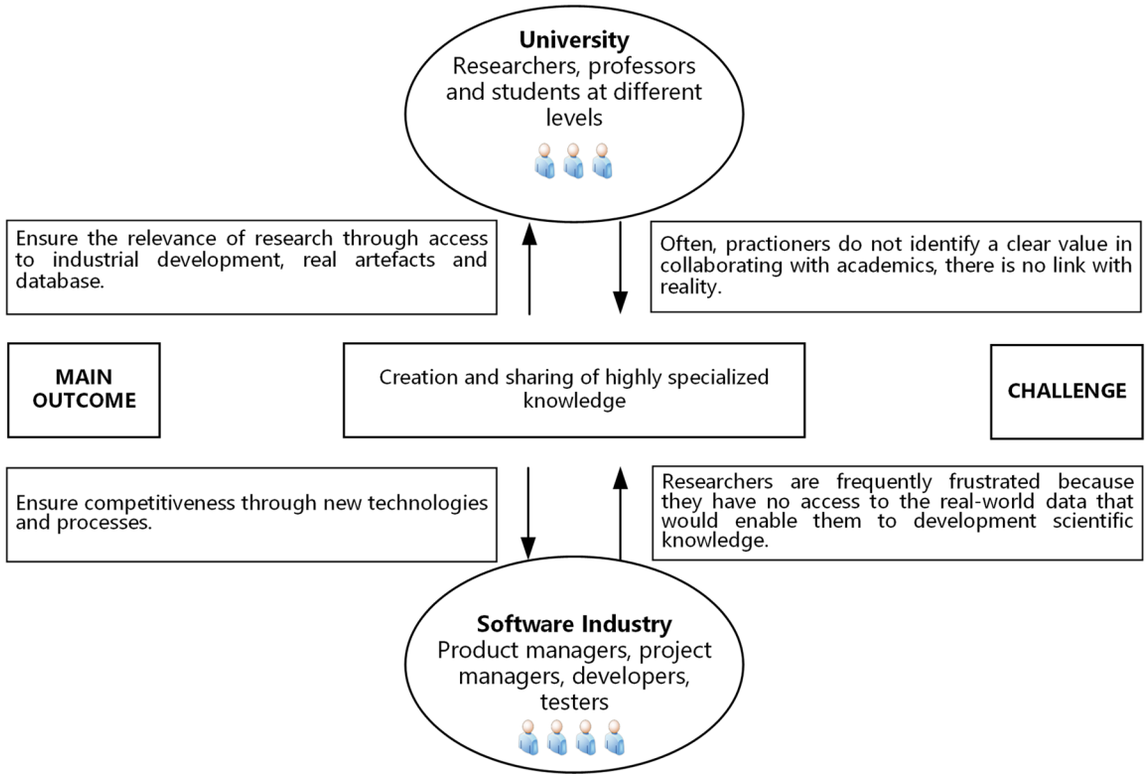
This relationship is characterized by the creation and sharing of highly specialized knowledge; this enables the industry to ensure competitiveness in an increasingly demanding market and provides the university the relevance of its investigations based on the real world. However, in order for this relationship to be successful, the university should seek to understand the real needs of the industry in such a way that the industry professionals attribute their real value to this relationship. Similarly, the industry should be aware of the importance of facilitating access to the existing knowledge base related to its business to the university, which will enable it to create knowledge and solutions that are ever closer to the needs of the industry.

KNOWLEDGE MANAGEMENT IN KNOWLEDGE INTENSIVE ORGANIZATIONS OR COMMUNITIES

According to Swart and Kinnie (2003), the term 'knowledge intensive' can be used to characterize three contexts: (i) knowledge-intensive activities; (ii) knowledge workers and; (iii) knowledge-intensive organizations.

Knowledge-intensive organizations are those where knowledge is of more importance than other inputs. Their main activity is intellectual in nature, and therefore knowledge workers constitute the largest part of their teamwork (Alvesson, 2001; Drucker, 1994; Starbuck, 1992). The absence of formal hierarchical structures and teamwork, where collaboration is fundamental, are the main characteristics of these organizations (Starbuck, 1992). This type of organization generally presents a robust ability to solve complex problems through creative and innovative solutions (Wong, 2005), as well as producing good results during collaboration activities with external specialists (Alvesson, 2001). Typical examples of this type of organization are consulting firms, research centers, engineering firms, high-tech companies,

Figure 2. Main outcomes and challenges of the university-software industry relationship



universities, software development companies, etc. (Aurum et al., 2008; Howell & Annansingh, 2013; Lindvall, Rus, & Sinha, 2003; Mehta et al., 2014).

Knowledge-intensive organizations have an important stock of knowledge that result of the sum of the different expertise of each member of their team and of their daily activities supported by knowledge sharing (Bosua & Scheepers, 2007). This inventory has extraordinarily complex combinations of different layers, requiring the development of strong personal and team relationships, so that it is possible to share and leverage these competencies at a project and organizational levels (Mehta et al., 2014). Personal relationship events involve explicit and tacit knowledge and play an important role in knowledge sharing and creation, and in interaction with other specific mechanisms, including technology. This makes the knowledge of these organizations more dynamic, which requires that each member of the team is kept up to date, avoiding the obsolescence of their knowledge (Aurum et al., 2008; Bjørnson & Dingsøyr, 2008). According to Lindvall et al. (2003, p. 137), "knowledge intensive organizations have realized that a large number of problems are attributed to un-captured and un-shared knowledge, as well as the need to know 'who knows what' in the organization".

Given that the solutions are increasingly multidisciplinary and that, for this reason, each team member has a different specialization, the creation and sharing of knowledge are increasingly fundamental processes within knowledge-intensive organizations (Lauring & Selmer, 2012). In general, specialized knowledge is tacit, which makes knowledge sharing more important in this type of environment (Ghobadi,

2015). The best use of tacit knowledge can guarantee a process of creating more efficient and effective solutions (Bierly, Damanpour, & Santoro, 2009).

According to their characteristics and their activities, it is fundamental that knowledge-intensive organizations define a knowledge management strategy (Lee-Kelley, Blackman, & Hurst, 2007). The knowledge management strategy can be developed based on different approaches; however, several studies in the literature regarding knowledge management of this type of organization, have suggested the codification and personalization approaches (Fehér & Gábor, 2006; M. T. Hansen, Nohria, & Tierney, 1999).

Codification is a 'knowledge conversion' approach to document knowledge, focusing on the use of technology. In this case, the knowledge is properly codified and stored in knowledge bases, so that anyone in the organization can access and reuse it. This approach is closely associated with explicit knowledge. On the other hand, personalization is a 'person-to-person' approach; meaning that knowledge is closely related to the person who developed or holds it and is shared through face-to-face contact. The aim is to facilitate exchanges by creating networks and encouraging face-to-face communication between individuals and teams through informal contacts, conferences, workshops, communities of practice, brainstorming, individual sessions, etc. This approach is more closely associated with tacit knowledge. Technology, given the characteristics of these organizations, plays an important role in supporting these approaches (Bosua & Scheepers, 2007; M. T. Hansen et al., 1999). Hansen et al. (1999) suggest three questions that may help define the main strategy to be adopted: (i) does the organization offer standardized or personalized products? (ii) does the organization have a mature or innovative product? and; (iii) do the teams of this organization depend, mostly, on explicit or tacit knowledge to develop new solutions?

Fehér and Gábor (2006) warn that the choice of one or another strategy is not a precondition for success. Hansen et al. (1999) add that organizations that achieve success are those that focus on one of the strategies and use the other as a support. In other words, they find a balance according to the type and use of the prevailing knowledge in each organization. The same authors add that organizations that try to excel in both approaches risk failing in both as well (M. T. Hansen et al., 1999).

KNOWLEDGE MANAGEMENT IN UNIVERSITY-SOFTWARE INDUSTRY COLLABORATION RELATIONSHIP

Given the intensive knowledge nature of these two types of organizations, the collaborative strategy requires the integration of specialized knowledge, often multidisciplinary, and highly specialized, dispersed throughout each member of the work teams (Boyarchuk et al., 2018; Hermans & Castiaux, 2007). Hansen et al. (2017) and Mehta et al. (2014) add that it is not enough to simply save the results of collaborative projects, but rather that it is necessary to transform the results into knowledge and make it accessible. This is in order to be reusable in new and future projects, and to recognize and capitalize on the specific knowledge of each community and its diversity, so to strengthen the relationship and the social network. According to (Hermans & Castiaux, 2007), the knowledge obtained from a collaboration relationship can represent an excellent starting point for new collaborative projects. Gill (2002, p. 263) states that "it is the sharing of a common knowledge base that, continuously builds upon local knowledge bases which, is at the heart of a collaborative process". These facts, evidenced by the literature, indicate that possible solutions aimed at the sustainability of university-software industry collaboration relationships should be explored and evaluated from a knowledge management standpoint (Philbin, 2008).

Although knowledge management and collaboration are complementary, given that they have common, mutually interdependent purposes and practices (Qureshi, Hlupic, & Briggs, 2004), the few existing studies on knowledge management in collaboration relationships focus on outcomes or structures of success of the relationship (I.-E. Hansen et al., 2017), on reports of lessons learned (Bjørnson & Dingsøyr, 2008). Some authors have also pointed out that studies, in a general manner, identify universities as the only providers of knowledge and technology. Besides that, the focus is very centered on the research and development issues rather than on creating a collaboration environment in a holistic way. There is a lack of evidence about the university's role as the recipient of knowledge created by the industry (Bozeman & Boardman, 2013; Jongbloed, 2015). In addition, the scientific community has paid little attention to the role of knowledge in collaboration relationships and the consequent impact on the promotion of innovation and on society (I.-E. Hansen et al., 2017).

Thus, knowledge management assumes an important role for organizations in delivering the best performing solutions (Tippins, 2003). Particularly in the case of tacit knowledge, which requires considerable managerial resources, its value can ensure a more efficient and effective solution creation process, and the ability to manage such knowledge will define the difference between a good and a better performance (Bierly et al., 2009; I.-E. Hansen et al., 2017).

FUTURE RESEARCH DIRECTIONS

Although the literature suggests that this theme as quite relevant, there is an evident lack of empirical studies that properly investigate the factors that can contribute to the sustainable promotion of this type of collaboration relationship (Feng, Zhang, Du, & Wang, 2015). Additionally, there are few studies that address knowledge management in collaboration relationships (I.-E. Hansen et al., 2017).

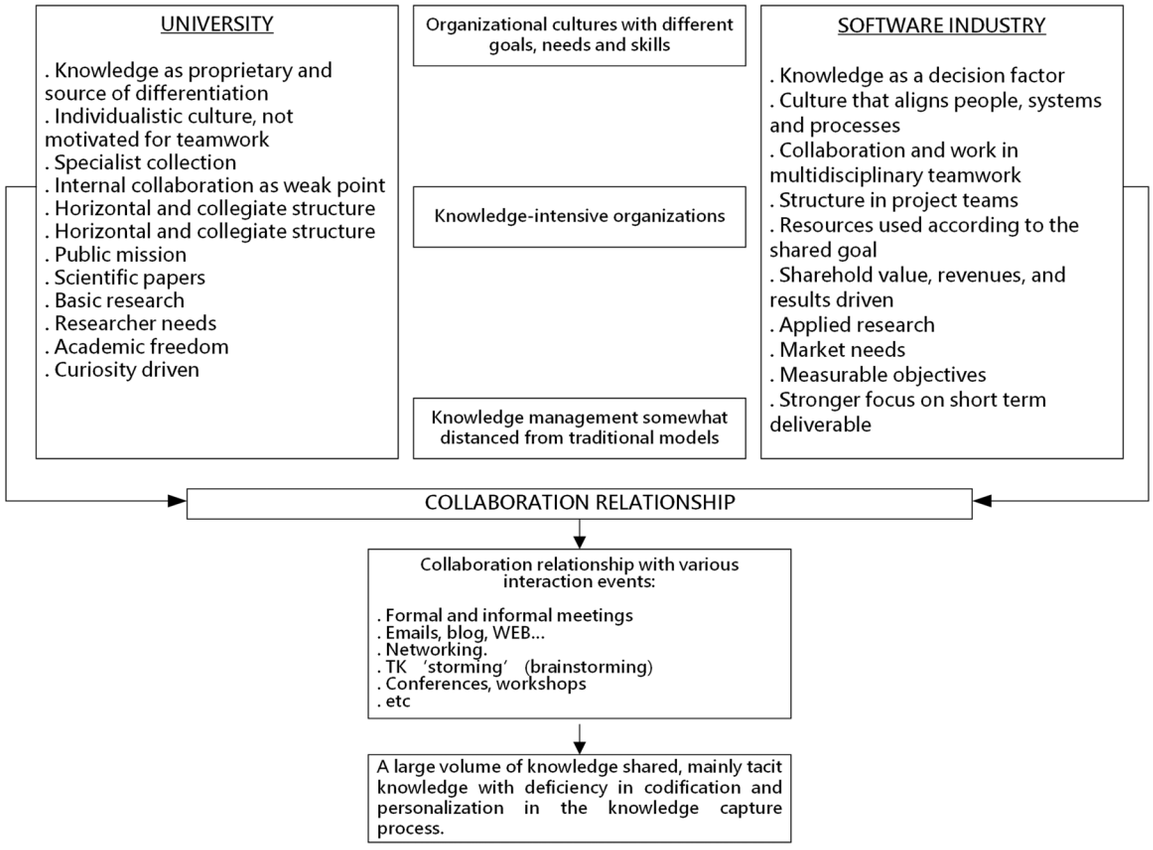
CONCLUSION

The changes in the software industry have been ever more rapid and more substantial. Toward that scenario, it is possible suppose that the collaboration relationship between university and software industry will become increasingly important for both organizations. This collaboration relationship offers numerous benefits for both parties. As a result of this mutually beneficial relationship, software industry firms can achieve solutions for most of their problems, since university offers firms a wide knowledge base of different scientific domains (pedagogical and scientific), specialists (teachers and researchers), training, etc. On the other hand, university can get involved with specialized professionals and the real world of this industry, which can help its research and educational processes. These potential benefits reinforce the importance and the need to encourage and structure such collaboration.

As shown in the framework in Figure 3., the university and the software industry are organizations that present different cultures with different objectives, needs and competencies. However, if this cultural diversity poses a challenge when establishing and conducting of a collaboration relationship (Du Chatenier, Verstegen, Biemans, Mulder, & Omta, 2009), the knowledge-intensive characteristic relevant to each of these organizations also represents an excellent source of creativity and innovation.

Given the knowledge intensive nature of the two types of organizations, the collaborative strategy requires the integration of specialized knowledge dispersed between each of the members of the work

Figure 3. Different objectives, needs and competencies of the university and the software industry



teams, usually multidisciplinary. The highly specialized knowledge, both tacit and explicit, is created and shared in the various phases of the relationship (Boyarchuk et al., 2018; Salavisa et al., 2009). This implies that possible solutions that aim at the sustainability of the relationship should be examined through the knowledge management (Philbin, 2008). This view is also shared by Vasconcelos et al. (2017, p. 1502), who understand that in knowledge-intensive environments "knowledge management processes fit like a glove".

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KEY TERMS AND DEFINITIONS

Codification Approach: Codification is a 'knowledge conversion' approach to document knowledge, focusing on the use of technology. This approach is closely associated with explicit knowledge.

Knowledge Intensive Organizations: Organizations that are characterized by a high proportion of highly qualified workers and where knowledge is of more importance than other inputs.

Multidisciplinary Team: A group composed of members with varied but complimentary experience, qualifications, and skills that contribute to the achievement of specific objectives.

Personalization Approach: Personalization is a 'person-to-person' approach; meaning that knowledge is closely related to the person who developed or holds it and is shared through face-to-face contact. This approach is more closely associated with tacit knowledge.

Software Industry: It comprises the traditional organizations that primary deal with software development, as well as the parts of other industries that are involved in software development.

University: An academic community, made up of schools, departments/colleges, research units, research laboratories and interface units (e.g. technology transfer units, university-company relationship units).

University-Industry Collaboration: Bi-directional relationship between university and industry organizations, established to enable the diffusion of creativity, ideas, skills and people with the aim of creating mutual value over time.

Chapter 29
Knowledge Sharing Practices Among Non-Academic Staff in a Nigerian University

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ABSTRACT

Knowledge sharing, an important part of knowledge management, has particularly been regarded as an important way of increasing competitiveness and performance of organisations. This study investigated knowledge sharing practices among non-academic staff at the University of Ibadan, Nigeria. Descriptive research designed was adopted. Findings reveal that the staff shared knowledge among themselves, and majority had understanding of, and good disposition to, knowledge sharing. The study found that the staff shared both tacit and explicit knowledge, but majorly tacit, and mainly through face-to-face interactions. The major knowledge sharing enabler is improved productivity, while lack of time is the major knowledge sharing barrier. The study concludes that there is a good knowledge sharing practices among the staff. However, there is need for the university to promote more collaboration and knowledge sharing practices among the staff by providing enabling environment for knowledge sharing, in addition to provision of adequate information and communication technologies.

INTRODUCTION

Knowledge has become a key resource and very vital for the development and growth of any society. It is the collection of individual's skills and acquired learning, and one of the most important assets of any organisation. These days, organisations no longer compete solely on financial capital and strength, but on how they are able to leverage on knowledge to have competitive advantage in business. Hence,

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effective knowledge management (KM) through sharing of knowledge effectively is vital for all organisations. In actual fact, KS plays an increasingly significant role in determining the outcomes of KM (Yang & Chen, 2007). Knowledge sharing (KS) is a key element in the survival of any organisation and the driving force for enhanced productivity, economic growth and performance. Therefore, making knowledge available to members of organisation for effective use through sharing should be giving a top priority in organisations.

KS is a social interaction culture, involving the exchange of knowledge, experiences and skills. It is an activity through which knowledge (information, skills, or expertise) is exchanged among people, friends, families, communities or organisations. KS can be considered as the first generation of KM and is described as 'supply-side KM' because people can acquire supplied knowledge through KS systems (Vorakulpipat & Rezqui, 2008). Wei, Choy, Chew and Yen (2012) explain that KS is the dissemination or exchange of tacit or explicit knowledge, ideas, experiences or even skills from one individual to another individual or groups of individuals; while Cheng, Ho and Lau (2009) posit that KS is about communicating knowledge within a group of people. Thus, KS is not only defined as transmitting knowledge to target receivers, but also absorbing and being used by people. KS process consists of two parts: donating and collecting. Knowledge donation involves communicating to others one's personal and intellectual capital, whereas knowledge collection involves consulting colleagues in order to have them share their intellectual capital (van den Hooff & de Ridder, 2004).

BACKGROUND

The concept, KS, has received immense attention due to the recognition of its value in learning, knowledge creation and innovation. KS is actually a key process in translating individual learning into organisational capability. KS comprises a set of shared understandings related to providing employees access to relevant information, thereby building knowledge network within organisation (Hogel, Parboteeah & Munson, 2003). Parekh (2009) highlights some benefits of KS: helps to avoid reinventing research, reduce redundant work, reduce cost of inventions, and expedite creation of knowledge with the help of experts and experienced persons. When properly managed, KS can greatly improve work-quality, decision-making skills, problem-solving efficiency as well as competency (Yang & Chen, 2007). KS is also a learning experience for the sharer. For example, if employees are motivated to share knowledge with their peers but are not sure if they are able to communicate the knowledge in a manner in which it will be understood, they are more likely to use KS as an opportunity to deepen their own understanding and find a better way to organise and explain knowledge before they share it. Moreover, knowledge sharers may learn others' perspectives on the same issue or problem being discussed. Additionally, individuals may share their ideas with others to further develop them and to facilitate creativity. Thus, KS not only improves competence of the people that are involved in the process but also benefits the community or organisations by speeding up the deployment of knowledge.

Liebowitz and Chen (2003) found that it is more difficult to share knowledge in public sector organisations because of the bureaucratic nature of many government organisations and the fact that knowledge is associated with power, and promotion opportunities. However, universities have different interests, goals, values, needs, and motivation compare to other public organisations (Siddique *et al.*, 2011). Universities are knowledge-based organisations or knowledge intensive environments which play major roles in KM through teaching, research and publication (Rowley, 2000). They play critical role

in knowledge transfer through working with businesses and other organisations to support innovation, social and cultural enterprise, as well as supporting learning through teaching, research, training programmes and community development. Thus, KS is very important in knowledge-intensive institution, such as universities, where knowledge production, distribution and application are ingrained (Cheng *et al.,* 2009). It can be said that KS is an academic institution's activity, and a common occurrence for both administrative functions and teaching.

Numerous studies have explored antecedents of KS behaviour from different employees' perspectives and have been able to demonstrate that educational institutions are among the organisations that benefit most from shared knowledge. KS can benefit the universities in many ways such as in teaching, research, administrative services, alumni services and development of strategic planning. The major responsibilities of staff in any university are teaching, research, and community service which are mainly KS activities. Staff in universities (academics and non-academics) can be referred to as knowledge workers as their knowledge is considered important resources and assets needed to achieve the vision and mission of the universities, hence, the reason they are encouraged to share knowledge through publication of research findings.

In order to leverage from KS, many universities have adopted different approaches to achieve success and get a competitive advantage. One of the famous approaches is the introduction of various KM systems, which transform academic staff knowledge and intellectual assets into enduring value (Rowley, 2000). Another approach used is the collaborative KS system, which link academic staff knowledge together towards enhancing overall university performance (Kumaraswamy and Chitale, 2011). For instance, as a way to achieve the objectives of promoting at least one public university in Malaysia to be among the top 100 universities in the world, the Malaysia universities identified the need to establish KS environment and entrench KS culture in the universities.

Non-academic staff in Nigerian universities are employees whose works are administrative, secretarial, technical or professional in nature. They are responsible for the day-to-day operations and management of activities within the university. This category of people includes both junior and senior staff who are not directly involved in teaching of students, but their work comprises general administration of the institution, such as finance, bursary, admission, secretarial, student affairs and welfare, laboratory management, security, maintenance, among other administrative functions. This group of people forms the administrative knowledge-base of universities, whose knowledge is essential in ensuring efficiency of units, productivity, cooperation among staff, establishing mutual trust and giving solutions to daily job-related problem. The job duties of this category of staff entail use of knowledge in order to perform their duties satisfactorily. They require shared knowledge for development and growth and performance.

While many studies have been conducted to investigate KS in the universities, focus have been given to KS among academics, with little attention given to considering KS among non-academics who are responsible for the day-to-day operations and management of activities within the university. A search through scholarly databases and search engines discovered no known study in Nigeria has been done to investigate KS among non-academics of Nigerian University. Specifically, no known study has investigated KS practices among non-academic staff of University of Ibadan, Nigeria. Based on this knowledge gap, there is the need to explore KS practices among this category of staff whose functions and duties are also pivotal to the success and productivity of the university. The study was, therefore, undertaken to fill the research gap and make a major contribution in theory and managerial practices to the current understanding of KS practices of non-academic staff in a Nigerian university.

Review of literature on KS in universities across the world reveals a concentration on the academics. Only one paper, (Rahman et al., 2016), which focused on non-academics investigated the antecedents of KS behavior among non-academic staff of different private and public higher learning institutions in Malaysia and found that the staff had positive attitude toward KS and that attitude and subjective norms both influenced the staff KS behavior significantly and positively. Additionally, it was found that intention of KS variable plays a substantial role as a mediating variable in the relationships. Other studies that have been carried out to investigate KS in universities show divergent findings with regard to KS in higher institutions. For instance, Lawal et al. (2014) found inadequate awareness about the importance of KS and poor attitude of academic staff to ideal of sharing knowledge with one another. Fari and Ocholla (2015) research on KS among academics in selected universities in Nigeria and South Africa found that the academics participated in KS in different ways and that Nigerian respondents revealed significant challenges to KS in their universities, such as a lack of electricity; inadequate print and electronic information resources; poor research management and support; poor conference, seminar and workshop attendance and communication; and poor attitudes towards KS. Chikono (2018) study confirmed that there was willingness to engage in KS activities by Zimbabwe Open University academics. However, lack of a clear knowledge policy negatively impacts on the university's ability to competitively position itself in the knowledge economy. Cheng et al. (2009) examined KS behavior among academics in a private university in Malaysia. Factors affecting the willingness to share knowledge, broadly classified as organisational, individual and technology factors, were examined. Findings reveal that incentive systems and personal expectation were the two key factors in driving academics to engage in KS activity, and that "forced" participation was not an effective policy in cultivating KS behavior among the academics.

In summary, problems identified from literature to be affecting effective KS in universities are negative attitude to KS by staff, lack of awareness of the benefit of KS, fear of losing ownership of knowledge, lack of time to share knowledge, lack of trust, lack of appropriate reward system, inadequate availability of ICTs, poor support services; poor research management, bureaucratic nature of many government organisations, among others. This study presents the findings of an empirical study of KS practices among non-academic staff in a Nigerian university, the disposition of the staff to KS, the types of knowledge shared, means of sharing knowledge, factors motivating KS, as well as barriers to KS.

FOCUS OF THE ARTICLE

The study investigated KS practices among non-academic staff at the University of Ibadan, Nigeria. The study also answered some research questions. Descriptive survey research design was adopted. Stratified random sampling technique was used to select 411 respondents, which represented ten percent of the total population (4113) of non-academic staff of the university as at June 2017. A questionnaire, validated by two experts in the field of information science, was used to collect data. The questionnaire was structured into three main parts and four sub-sections to elicit response with a 4-point Likert scale.

The demographic information of the respondents reveals that majority were males (58.6%), majority were also in the age range 41-50 years (42.5%). About 30% had a minimum of first degree qualification, while majority had more than 10 years work experience.

Research Questions (RQ)

RQ 1: Do non-academic staff in the University of Ibadan share knowledge among themselves and how frequent do they share knowledge?

Results in Table 1 provide answer to research question 1.

Table 1. Knowledge sharing

	Measurement	Frequency	(%)
Do you share knowledge	Yes	348	100.0
	No	0	0.0
How frequently do you share knowledge?	Daily	229	65.8
	Weekly	51	14.7
	Fortnightly	31	8.9
	Monthly	22	6.3
	Occasionally	15	4.3
How frequently do you share job related knowledge with your colleagues?	Daily	249	71.6
	Weekly	55	15.8
	Fortnightly	21	6.0
	Monthly	10	2.9
	Occasionally	13	3.7

All the staff admitted that they shared knowledge. Most of the staff (65.8%) agreed that they shared knowledge on a daily basis, and that they shared job related knowledge with colleagues on a daily basis (71.6%). Hence, the non-academic staff in University of Ibadan engaged in KS on a daily basis. This shows that they understood the importance of knowledge as an essential resource.

RQ 2: What are the perceptions of the staff towards KS?

Table 2. Disposition to KS

	Strongly agree (Freq/%)	Agree (Freq/%)	Disagree (Freq/%)	Strongly disagree (Freq/%)	Friedman Mean Rank
I believe sharing knowledge with my colleagues is good	186 (53.4%)	155 (44.5%)	3 (0.9%)	4 (1.2%)	3.88
I like sharing knowledge with my colleagues	183 (52.6%)	159 (45.7%)	4 (1.1%)	2 (0.6%)	2.18
I like sharing knowledge with my colleagues because i believe i can also learn more by sharing	232 (66.7%)	114 (32.8%)	2 (0.6%)	0 (0.0%)	2.03
I don't think sharing knowledge with my colleagues is a wise idea that should be encouraged	2 (0.6%)	5 (1.4%)	172 (49.4%)	169 (48.6%)	1.90

Results in Table 2 reveal that the non-academic staff had good disposition to KS as majority (about 98%) said they liked sharing knowledge. Majority (98%) also agreed that sharing knowledge is a good and wise idea. Almost all the respondents (99.5%) also agreed that sharing of their knowledge would make them to learn more. The table also provides the test statistic values: Chi-square (χ^2 =741.640), degrees of freedom (df = 3) and the significance level (Asymp. Sig. = 0.000) which shows an overall statistically significant difference between the mean ranks of the related items.

Friedman Test: N = 348; (χ^2 = 741.640; df =3; Asymp. Sig. = 0.000

The respondents had favorable perception and positive attitude towards KS. This means that they had good understanding of the importance of KS in discharging their duties effectively and efficiently. This positive disposition could be attributed to the understanding of the staff about the notion that knowledge represents a resource that has a value (Davenport & Prusak, 1998). The staff may also have an understanding that if they share knowledge, they might receive both extrinsic and intrinsic rewards because an understanding of the importance of KS could motivate an individual to engage in KS (Bock, Zmud, Kim & Lee, 2005; Lin, 2007).

RQ 3: What type of knowledge do they share and which do they share most?

Majority of the non-academic staff (81.3%) shared both tacit and explicit knowledge, but majorly tacit (69.2%) as shown in Table 3.

Table 3. Types of knowledge shared

	Frequency	(%)
Types of knowledge shared		
Tacit knowledge only	10	2.9
Explicit knowledge only	55	15.8
Both tacit and explicit knowledge	283	81.3
Types of knowledge mostly shared		
Tacit knowledge only	241	69.2
Explicit knowledge only	107	30.8
Both tacit and explicit knowledge	0	0.0

Nonaka and Takeuchi (1995) present two distinct dimensions relating to the form of organisational knowledge: explicit and tacit knowledge. Explicit knowledge is that which can be codified into something that is formal, structured and systematic, and can be shared, communicated with ease and be accessible to other people. Thus, explicit knowledge is expressed in formal language, words, symbols and numbers and can be stored in a database that allows the data to be transmitted, conventionally and easily, within the organisation. Tacit knowledge, on the other hand, is highly personal and difficult to formalise, and is based on actions and experiences of an individual (Nonaka & Takeuchi, 1995). Tacit knowledge comes

from experience, perceptions and individual values and depends on the context in which it is generated (Nonaka & Takeuchi, 1995). These characteristics make both types of knowledge sources of sustainable competitive advantage for organisations (Nonaka & Takeuchi, 1995).

The findings of this study are in accordance with the findings of many studies which also found that both tacit and explicit knowledge are shared in organisations, but that tacit knowledge is commonly shared. Smith (2001) opines that tacit and explicit knowledge are the available types of knowledge being shared among employees in the workplace and that organisations should find a means of balancing the use of both. The findings of this study may be connected with the fact that the non-academic staff do not usually publish paper unlike their academic counterparts. They mostly interact among themselves informally where tacit knowledge could be easily shared. Our finding is in accordance with Selamat and Choudrie (2004) who pointed out that the presence of explicit knowledge is meaningless without tacit knowledge to augment it. It is only with tacit knowledge that explicit knowledge can be put into practice. O'Dell and Grayson (1998) also maintain that organisations have a large amount of knowledge to be discovered, mainly tacit knowledge in the form of internal benchmarking, know-how and best practices. Leveraging and making good use of this type of knowledge within organisations could help them compete favourably. Kim (1993) also corroborated that, even in bureaucratic organisations, despite the preponderance of written operational standards and established protocols, the bulk of knowledge is found in unsaid and unwritten knowledge that reside more in people and in interactions among them than in the systems.

RQ 4: What are the various means or ways of sharing knowledge?

Several means or ways of sharing knowledge used by non-academic staff include e-mail, telephone calls, group discussion, seminars, workshops, conferences, memo, internet, and social media as shown in Table 4. However, KS through face to face conversation or discussion ranked top (97.4%), while the use of knowledge map rank lowest.

Table 4. Ways of sharing knowledge

Modes of knowledge sharing	Frequency	(%)
Face to face conversation/discussion	339	97.4
Telephone conversation	312	89.7
Social media (e.g. Whatsapp, Facebook, Instagram, LinkedIn, etc.)	301	86.5
Memorandum	248	71.3
Training (e.g. on the job training, out of office training)	192	55.2
Seminar/Workshop	188	54.0
Electronic mail	150	43.1
Article publication in Journals	111	31.9
Conference	72	20.7
Writing of books	23	6.6
Job aids	15	4.3
Others (knowledge map)	6	1.7

* Multiple choice options

This finding corroborated the results in Table 3 where majority of the respondents indicated that they shared more of tacit than explicit knowledge. Hussein and Nassuora (2011), Opeke and Opele (2014) also obtained similar results from their studies. Through direct interaction, the sharing of knowledge is articulated better and easily codified (Swift, Balkin, & Matusik, 2010), hence, there is less effort in transferring knowledge to the recipients. Studies have shown that technology tools have aided acquisition of knowledge (Hwang & Chang, 2011; Hwang, Chu, Lin, & Tsai, 2011); however, this means of communication has some associated costs. The non-academic staff may not be using the other means such as writing of books, seminar, workshops, conferences or article publication because of the fact that this category of staff do not need to publish or attend conferences to be promoted. Hence majority of them do not share knowledge through publishing or presentation of papers at conferences. In addition, the use of e-mail for KS also will require them to be computer literate, and have access to ICTs, such as computers and the Internet, which are not readily available to this category of staff.

RQ 5: What factors motivate KS among the staff?

Diverse factors motivated the staff to share knowledge. Table 5 presents the findings.

Table 5. Knowledge sharing enablers

	Strongly agree (Freq/%)	**Agree (Freq/%)**	**Disagree (Freq/%)**	**Strongly disagree (Freq/%)**	**Friedman Mean Rank**
Improved productivity	249 (71.6%)	94 (27.0)	5 (1.4%)	0 (0.0%)	8.37
Trust	99 (28.5%)	172 (49.4%)	52 (14.9%)	25 (7.2%)	8.21
Enjoyment in helping others	144 (41.4%)	119 (34.2%)	52 (14.9%)	33 (9.5%)	7.70
Reciprocity in knowledge sharing	140 (40.2%)	121 (34.8%)	32 (9.2%)	55 (15.8%)	7.50
Availability of ICTs	127 (36.5%)	111 (31.9%)	86 (24.7%)	24 (6.9%)	7.36
Motivation from superiors	135 (38.8%)	91 (26.2%)	86 (24.7%)	36 (10.3%)	6.05
Job continuity	98 (28.1%)	122 (35.1%)	104 (29.9%)	24 (6.9%)	5.47
Encouragement from friends/colleagues	111 (31.9%)	97 (27.9%)	83 (23.8%)	57 (16.4%)	4.45
Reward	34 (9.8%)	50 (14.4%)	163 (46.8%)	101 (29.0%)	3.99
Recognition	34 (9.8%)	50 (14.4%)	169 (46.5%)	95 (27.3%)	3.59

Friedman Test: N = 348; (χ^2 = 1848.402; df = 9; Asymp. Sig. = 0.000

Among the factors that motivated the staff to share knowledge, improved productivity rank top (mean rank score = 8.37), while recognition was the least considered factor (mean rank score = 3.59), which shows that reward and recognition are not important motivators of KS among the staff. The table also provides the test statistic values: Chi-square (χ^2 =1848.402), degrees of freedom (df = 9) and the significance level (Asymp. Sig. = 0.000) which shows an overall statistically significant difference between the mean ranks of the related items. Existing literature (e.g. Ardichvili, 2008; Barachini, 2009; Davenport, 1997; Davenport & Prusak, 1998; Holste & Fields, 2010; Ipe, 2003; Jeon, Kim, & Koh, 2011; Lin, 2007; Omotayo & Babalola, 2016; Riege, 2005; Vuori & Okkonen, 2012) has identified a wide range of factors that motivate KS practices. From these studies, the factors could be summarised as: individual or personal factors (e.g., perceived benefit, reward, enjoyment in helping others, trust, recognition, feel of empowerment, contributing to organisation's success, reciprocity in KS or getting knowledge in return, boosting own reputation, subjective norms or social network, etc.), technological factors (e.g., availability of ICTs, training and technical support), organisational or environmental factors (e.g. good leadership, appropriate reward system, sharing opportunities, shared language and goals, social interaction, physical proximity to colleagues, meeting and informal places, motivation from superiors, etc.). However, empirical research (e.g. Ismail & Yusof, 2010; Hong, Suh, & Koo, 2011; Okyere-Kwaye & Nor, 2011; Omotayo & Babalola, 2016; Riege, 2005; Yeşil, 2013) has identified the individual factors as major factors considered by people when sharing knowledge, which the results of this study corroborated. Ismail & Yusof, (2010), for instance found a positive and significant correlation between individual factors and the quality of knowledge shared.

RQ 6: What factors prevent KS among the staff?

Frequency distribution showing factors preventing staff from sharing knowledge is as shown in Table 6.

Friedman Test: N = 348; (χ^2 = 172.399; df = 9; Asymp. Sig. = 0.000

Lack of time (88.0%), fear of misuse of knowledge shared (86.2%), non-availability of ICT tools (70.1%, lack of trust (58.0%), lack of motivation (57.7%), and organisational culture of secrecy (57.2%) are the barriers preventing the staff from sharing knowledge. Lack of time has the highest mean rank score (6.03), while fear of loss of knowledge is the least (4.64). The test statistic values: Chi-square (χ^2 =172.399), degrees of freedom (df = 9) and the significance level (Asymp. Sig. = 0.000) shows an overall statistically significant difference between the mean ranks of the related items. Some other studies (e.g. Bloice & Burnett, 2016; Lilleoere & Hansen, 2011; Peng, 2013; Riege, 2005, Szulanski, 1996) have identified various barriers to KS, some of which are: general lack of time to share knowledge, and time to identify colleagues in need of specific knowledge; lack of sharing opportunities; low awareness and realisation of the value and benefit of possessed knowledge to others; lack of trust, fear of loss of power; psychological ownership; territoriality; lack of social network; lack of leadership and managerial direction in terms of clearly communicating the benefits and values of KS practices; lack of appropriate reward system; hierarchical organisation structure; lack or shortage of appropriate infrastructure supporting sharing practices; unavailability or inadequate of ICT infrastructure; reluctance to use IT systems due to lack of familiarity and experience with them; lack of training, among other factors.

Table 6. Knowledge sharing barriers

	Strongly agree (Freq/%)	Agree (Freq/%)	Disagree (Freq/%)	Strongly disagree (Freq/%)	Friedman Mean Rank
Lack of time	215 (61.8%)	91 (26.2%)	30 (8.6%)	12 (3.4%)	6.03
Fear of misuse of knowledge shared	199 (57.2%)	101 (29.0%)	32 (9.2%)	16 (4.6%)	5.99
Non availability of ICT tools (e.g. computers, Internet access, etc.)	115 (33.0%)	129 (37.1%)	66 (19.0%)	38 (10.9%)	5.87
Lack of trust	125 (35.9%)	77 (22.1%)	41 (11.8%)	105 (30.2%)	5.68
Lack of motivation	63 (18.1%)	138 (39.6%)	72 (20.7%)	75 (21.6%)	5.52
Organisational culture of secrecy (e.g. oath of secrecy)	87 (25.0%)	112 (32.2%)	94 (27.0%)	55 (15.8%)	5.48
Fear of losing relevance	82 (23.6%)	29 (8.3%)	137 (39.4%)	100 (28.7%)	5.33
Lack of enough knowledge	55 (15.8%)	32 (9.2%)	172 (49.4%)	89 (25.6%)	5.27
Lack of confidence	17 (4.9%)	40 (11.5%)	111 (31.9%)	180 (51.7%)	5.19
Fear of losing knowledge	35 (10.1%)	12 (3.4%)	160 (46.0%)	141 (40.5%)	4.64
Others	0	0	0	0	

Our result support Hussein and Nassuora (2011) which found that respondents in their study identified lack of time to share knowledge as the major constraint to KS. This may be connected with the fact that the staff are usually busy at their various duties and so do not get sufficient time to interact with each other during work hours. This calls for the need to formulate policies by the University management to create room for staff to interact during work hours. Canteens or common rooms should be created in order for staff to have opportunity to interact and share knowledge.

FUTURE RESEARCH DIRECTION

Further research may do a comparative study of KS practices between academics and non-academics in all Nigerian universities.

CONCLUSION

Few studies exist on KS behaviour practices among non-academic staff in universities across the world. This study has contributed to literature by providing empirical data on the KS practices of non-academic staff in a Nigerian University. The study has therefore, been able to reduce a research gap and make a

contribution in theory and managerial practices to the current understanding of KS practices of non-academic staff of higher learning institution. The study also gives an exposition into the factors that motivate and prevent staff from sharing knowledge.

The study recommends that university management should encourage more collaboration and KS among non-academic staff by providing enabling environment such as regular organisation of seminar, workshop, conferences and lunch hour break. There is also the need for provision of adequate ICT infrastructures, such as the Internet, to facilitate and encourage KS. Effective KM strategies in universities should emphasise the role of KS to achieve maximum results for non-academic staff, who play important roles in university administration.

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KEY TERMS AND DEFINITIONS

Disposition: Refers to positive or negative attitude of the non-academic staff towards knowledge sharing.

Explicit Knowledge: Is the type of knowledge that is formal, systematic, can be codified, collected, stored, and disseminated, and is not bound to a person.

Knowledge: Is human understanding of a specialised field of interest that has been acquired through study and experience, and can be referred to the condition of knowing something by the non-academic staff with familiarity gained through experience or association.

Knowledge Sharing: Refers to the exchange of explicit or tacit knowledge, ideas, experiences or even skills by the non-academic staff.

Knowledge Sharing Behaviour: Are the tendencies and approaches exhibited by the non-academic staff while donating and collecting knowledge.

Shared Language and Goals: Is viewed as a bonding mechanism that helps different parts of an organisation to integrate or to combine resources. It enhances the understanding, vision and communication among individuals in a group.

Social Identification: Is the feeling of an individual seeing himself as part of a group and sometimes have positive or emotional attachment to such group. It refers to the non-academic staff sense of belonging and positive feeling toward the university community they belong.

Tacit Knowledge: Is the type of knowledge that is subjective, held within the holder, experience based, contextualised, job specific, transferred through conversation or narrative and difficult to formalise, articulate or communicate fully.

Section 4

Leadership, Management, and Organizational Service

Chapter 30
Ushering Change in 21st Century Schools and Who Should Lead:
What Are the Prerequisites and Processes?

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ABSTRACT

In the fast-paced field of education, change in school settings has reached its momentum and the debate on who is supposed to lead the change in school settings has been intensified. Leading change in a 21st century school engages the school principal, teachers, students, the community, and the government. In driving the change, a learner's achievement should be the ultimate goal for every school leader, since learning is the core business of every educational institution. Beyond the school community, parents and people in the community have a major role to play in their child's education, success of implementing change in school, as well as government providing sponsorship/strategic support to facilitate teaching and learning. In light of this collaboration in making schools better, this research has chosen qualitative methods to explore teacher's understanding in Northern State Malaysia of the role of school principals, teachers, students, the community, and the government in leading change in 21st century school settings.

INTRODUCTION

In the fast-paced field of Education, change in school settings has reached its momentum and the debate on who is supposed to lead the change in school settings has been intensified. Leading change in a 21st Century School engages the school principal, teachers, students, the community and the government. In driving the change, a learner's achievement should be the ultimate goal for every school leader, since learning is the core business of every educational institution. In today's class, teachers would love to see their pupils responding to their teaching and every teacher will love to diversify their methods to

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meet students' learning needs and styles. Computer-based teaching or technology-based teaching has been reported worldwide to improve learning tremendously and teachers embrace technology to enrich their teaching. One should not forget the role the school principals play in the facilitation of teaching for better learning. The facilitation takes place when school principal plays the role of an instructional leader where improving teaching, learning and curriculum become their major function and concern. Studies have proven the roles both school principals and teachers play in the student learning achievement. A longitudinal study of Leithwood et al. (2004) on the influence of leadership on learning found leadership as a second factor contributing to student learning and achievement after classroom instruction. This is an indication of the centre roles that school leaders and teachers play in the performance of schools and students.

For the school to prosper and achieve its main objective in the community development, there is a need for community support and its involvement for the prosperity of the school. This is due to the fact that, after the family support, the community serves as the third institution for the school environment (Ihsan, 2010). For civil society or community to be established, the community needs to play a role of providing education and improving community welfare (Ihsan, 2011 in Nalle, Sogen and Tamunu, 2018). Hence, school development lies in everyone's hands and it is not a one-man show.

This is because, beyond the school community, parents and people in the community have a major role to play as the stakeholders in their child's education, the success of implementing change in school as well as and government providing sponsorship/strategic support to facilitate teaching and learning. In light of this collaboration in making schools better, this research has chosen qualitative methods to explore teachers' understanding in northern State Malaysia of the role of school principals, teachers, students, the community and the government in leading change in 21st- century school settings.

BACKGROUND

Education has been ensured by the UNESCO to be the birthright of every man and woman in the world. Since the inception of UNESCO 1945, the organization has committed to use education a mechanism to build peace, eradicate poverty and pave ways for development and intercultural discourse. A New Year with a new revolution ushers in new demands and expectations. In today's schools, the way things are done is completely different from the yesteryear ones. The 21st century education organization is full of complexes and even more difficult to understand and manage as ever. Todays' world is at its fast-pace and in order to cope with these changes and pace, we must change the way education is taught in schools and the methods of learning in our classrooms. The emerging of technology, globalization and knowledge-driven economy has contributed greatly to the rapid changes (McNeill & Engelke, 2014) accelerating unprecedented changes in schools and societies (Friedman, 2016 and Adam, Kutty and Zabidi, 2017). Due to variation of educational conceptualization, tensions have raised among educational leaders on how to lead, manage and administrate. Hence, they found difficult to leverage between priority tasks designed to uplift the academic staff, maintaining daily routine and operation and lower order duties (Adams, Kutty and Zabidi, 2017).

In the midst of achieving the expected goals, school leaders are expected to excellent instructional leaders to ensure a successful implementation of urban school reform (White-Smith, 2012). Learning is the core function of any educational institution and it is empirically proven that teaching comes as

the first factor of learning and school leadership as a second to influence learning. Ultimately, student achievement determines the effectiveness of school leadership and classroom teaching.

In the traditional paradigm of teaching, the school principal is seen as a 'giant' amongst the mountain of school management and administration, and its perceived to be a 'one-man show'. But in the 21st century paradigm shift, the school principal is not solely responsible for the school and student performance, it involves teachers as well. Teachers take accountability for their classroom and student's learning. Thus, power or leadership is no longer centralized, rather, it is distributed amongst teachers and the school community. Autonomy is bestowed on teachers to allow creativity and innovation in teaching. Teachers become or act as leaders the moment they step foot inside their classrooms. Once they are leaders, they play instructor roles and not necessarily only administrative (ASCD, 2015). According to Tanya Tucker, from ASCD, asserted that, in building school capacity to increase student learning and achievement, teacher leadership plays a big on this aspect (ASCD, 2015). It is also supported by the US National Board for Professional Teaching Standard (2014) that, teacher leadership is an important factor to increase student learning, school culture, reduces teacher retention and improves school performance. Thus, for school change to happen, professionals, skilled and experienced teachers must be in place in schools and classrooms.

For further improvement in schools and positive changes, the integration of technology plays greater roles to facilitate teaching and learning. However, parents, family and the government are also reported to be contributing and assisting learning within the school through partnership and support. This ensures every child attains better education and resources. According to the US National Education Association Community (NEA) (2008), the community plays an essential role in the growth and development of its young people as well as in their education. In the NEA research 2008, a correlation was found between parents, family and community involvement in higher academic performance as well as school improvement. With the facts and findings pointing towards collective efforts and collegiality in moving the school forward and accelerating change, this research strives to achieve the following objectives:

- To have an in-depth understanding from some Northern school teachers in Malaysia about the leadership roles that a school principal, teachers (teaching), the government and the community play in leading change in a 21st century school.
- To understand the process of leading change in a 21st century school and know who should be responsible for ushering change between the school principal, teachers, the government and the community as perceived by Northern school teachers in Malaysia.

With the above objectives, this research embarks on answering the following questions

1. What is the role that a school principal, teachers, the government and the community play in ushering change in a 21st century School setting as perceived by some Northern school teachers in Malaysia?
2. What are the processes and who should responsible for ushering change in 21st century school between the school leaders, teachers, the government and the community based on some teachers' perceptions in Malaysian Northern schools?

Theoretical Model for 21st Century School Change and Development

In the pursuance of best instructional practices, educational practitioners tend to infuse into their teaching, learning theories such as behaviourism, constructivism and cognitivism (Masethe, Masethe and Odunaike, 2017). In relation to 21st century learning and the role that the school principals play in learning attainment and school development, Popper's theory of learning affirms that, student learning takes place when students are actively engaged in the learning process by the ability to personally interpret their experience and construct their own knowledge which constructivists advocate (Popper, 2009; Swann, 2012 and Chitpin, 2016). According to constructivist approaches to educational practice, learning occurs or students learn materials presented to them when they have prior knowledge and background of the materials (Chitpin, 2016). This can be understood that, for 21st century learning to occur or take place, school principals and teachers have roles to play in looking at the ways students learn while ensuring as well in empowering students to learn on their own. In this process, the principal should be an assistant for teachers by encouraging teachers to lead students to knowledge, discovering and discussing what they learn through activities (Chitpin, 2016).

With technology, making a big change and impact in today's teaching and in classrooms, teachers have been pressurized to attend professional development training on infusing technology in their classrooms to ensure their teaching and making learning interesting for students. Achieving this has led to the adoption of theoretical perspectives such as Adoption Theory. The Adoption Theory, according to Geoghegan (1994); Rogers (1995) emphasized on five stages that teachers have to go through before technology adoption is ensured in the class: (1) learning how to use technology, (2) to be encouraged in valuing and using technology in the classroom, (3) determining of using technology as teaching tools and instructions, (4) to essentially use technology for educational purposes, (5) teachers' acknowledge and appreciation of using technology as a worthy instructional tool and effort (Lambert, 2015). Similarly, TPACK theory was reported to be a useful framework to guide teachers in integrating technology in their classroom to improve teaching and learning. The TPACK framework of Mishra and Koehler's (2006) explains the importance of infusing technology in teaching. Three components emerged from TPACK framework to a crucial role in integrating technology to improve learning in the class, technology; pedagogy and content (Mishra & Koehler, 2006 and Lambert, 2015).

School Leadership and Change

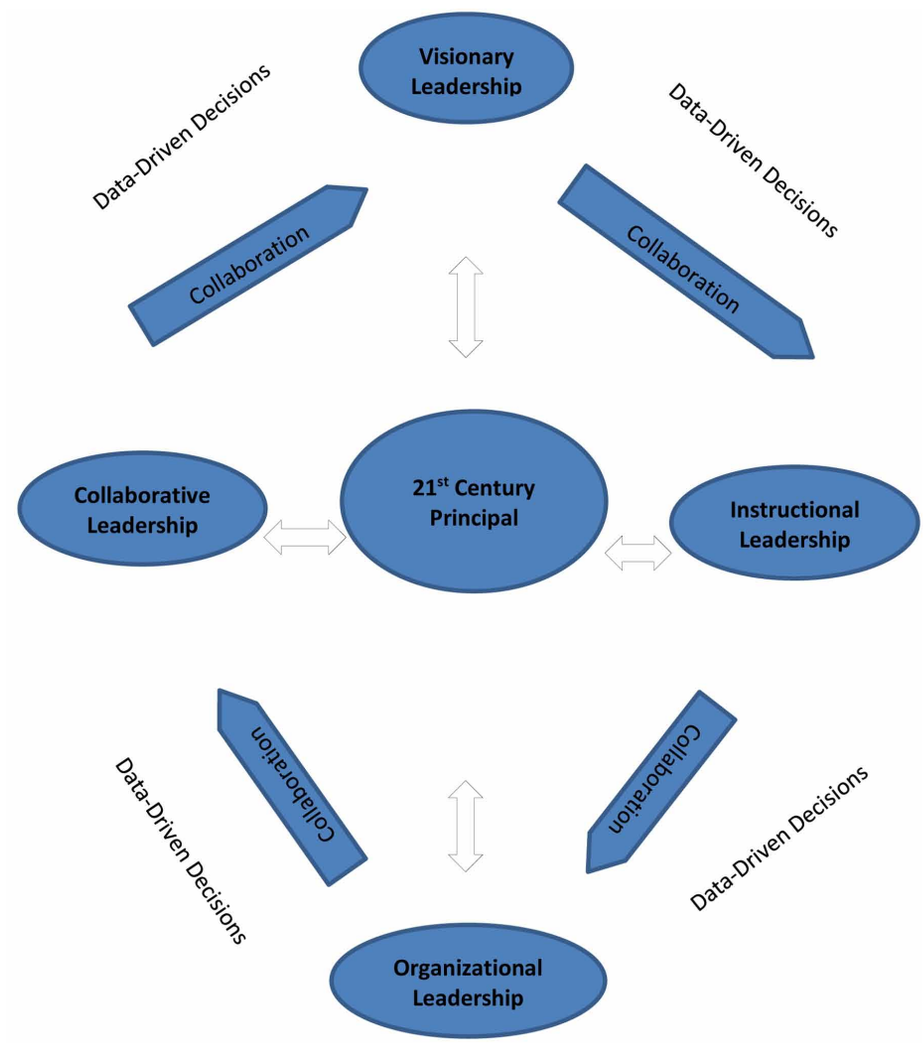
It has been said that for schools to remain relevant, especially in the 21st century, change is inevitable. Principals are reminded when leading change to identify what type of change is required and how this change could affect individuals and how to ensure this change is consistent (Osborne, 2014). Attention has been paid to improving school leadership as a way of transforming schools and accelerating development. School principals are expected to focus on the essentials when it comes to change, especially in the rapidly changing era of standards-based reform and accountability (The Wallace Foundation, 2013). The greatness and effectiveness of a school principal are measured based on their dynamism and adaptability. Principals are considered to be agents of change that drive the vehicle of successful teaching and learning.

Studies on educational change according to the Wallace Foundation Report (2011) has repeatedly confirmed an association between school leadership and student achievement (Kershner and McQuillan, 2016). In the 21st century, the school principal is perceived or seen to be a learning professional leader

and an individual that facilitates change. Change is expected in schools for the improvement of students' learning and their academic achievement. The success of a 21st century school principal depends on his or her flexibility and creativity in making decisions. Most importantly, success lies in a principal's curiosity about what the student learns. A 21st-century School principal will understand the importance of student learning and will strive to put it at the forefront of teaching practices (Roebuck, 2011).

In a 21st-century school, the principal should be aware of their school community needs. The needs vary due to the diverse, complex and globalised world we now live in. With an unprecedented and unpredicted future, school principals should take charge for preparing students for the future. Teaching, learning and teacher professional development could determine school leadership effectiveness as it is correlated with student achievement. Therefore, 21st century school leaders should model and promote teacher learning and student achievement. Technology should be used effectively amongst 21st-century leaders to facilitate teaching and learning (Roebuck, 2011).

Figure 1. 21st century school leader's roles
Source: DODEA 21st Century Teaching, Learning, and Leading, 2014



The above figure: 1 explains the roles of school principals in a 21st Century School. It is considered to be a self-assessment and reflection for principals for continuous growth and professional development. The figure intends to facilitate principals understanding of school leadership in 21st Century schools (DODEA 21st Century Teaching, Learning, and Leading, 2014).

Teacher and School Change

The old teaching model and paradigm sees the school principal as an agent of change. But in the 21st century new model, teachers play an almost equal role with principals in facilitating school change. Taking the 21st century's perspective on teaching and learning into consideration is a new perspective that should be relevant for today's student evolving learning needs (Stronge, Grant & Xu, 2015). As far as teaching and knowledge dissemination are concerned, teachers play pivotal roles in moral infusion and understanding its purpose by making them closer to the needs of children as well as youth. It also pushes them to develop better teaching strategies to achieve their moral goals (Fullan, 1993).

In the 21st century, teaching aims should centralize on knowledge development, higher order skills (e g. 4Cs of creativity, critical thinking, communication and collaboration), lifelong learning and technology integration (Stronge, Grant & Xu, 2015). A 21st century teaching perspective broadens teachers perspectives and prevents teachers from being insular and looking or thinking of themselves as the only knowledge transmitters or content experts. As an alternative, for teachers to remain current, relevant and effective in the new era of 4cs, teachers should be knowledge facilitators rather than knowledge imparters by giving students a chance to learn in their own unique way and to think for themselves (Stronge, Grant & Xu, 2015).

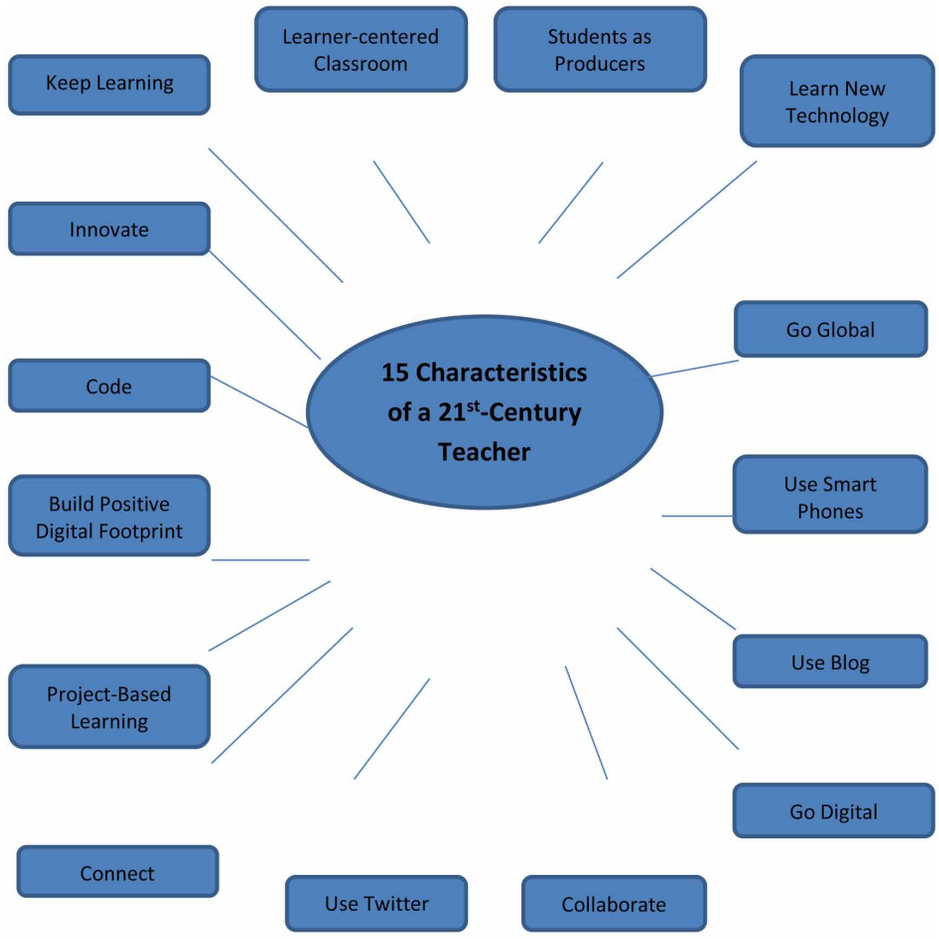
Teacher professional development is seen as a way to help teachers become moral implementers and agents of change. The system cannot change only the individuals in the system (Fullan, 1993). One of the effective strategies of implementing change is the power of leadership distribution. The distribution and collaboration that exist between principal and teachers pave the way for positive changes in schools and ensures disequilibrium to be balanced by support and collaboration. The beginning of a network is created when leadership is distributed whilst also enhancing collegial interactions (Kershner and McQuillan, 2016).

The distribution of power or leadership turns teachers into leaders. It is a paradigm shift that effects change in school and the way a school is administered. It instils a professional culture and academic achievement that puts student learning first. When leadership is distributed, it helps teachers to be autonomous and lead change from their classrooms. Teacher's report that the benefit of distributed leadership results in an increment in knowledge and skills in teaching due to their involvement in leadership positions (Porter, 1987, Lieberman et al., 1988; Troen & Boles, 1992, cited by Boyd-Dimock and McGree, 2015).

Ushering change in a 21st century school could be facilitated by technology, especially in teaching and learning. For ICT to be used as a tool in teaching could render great help to smoothen or promote good teaching amongst teachers and pave the ways for better learning attainment. ICT integration in a classroom helps teachers develop good teaching practices, quality instructions and pedagogy. Moreover, technology acceptance or usage in teaching is an art of 21st century teaching and creating digital or smart classroom is a way forward for 21st century learning.

Figure: 2 describes the characteristics of a 21st century teacher in a model form. The characteristics show the importance of teachers in 21st century school change and what teachers should prepare to engage in school change. Teachers in the 21st century should be able to integrate technology into their teaching,

Figure 2. 21st century teachers' characteristics
Source: Palmer, 2015



thus turning the classroom into learner-centres. Here, students will be the knowledge producers rather than the teachers alone being aware of what is occurring globally. They should use their smartphones to aid student knowledge in the classroom for obtaining up-to-date information on time. Teachers are advised to have a grasp and utilise a Blog to establish students' digital knowledge to be able to access online upload information. It is good to go paperless by organizing activities on websites, this facilitates collaboration between teachers and students. It is also useful to use Twitter to share research and ideas as well as current issues with students. In some countries, government has contributed to the educational change by supporting and financing their educational institutions to go paperless and supplying them with latest teaching materials.

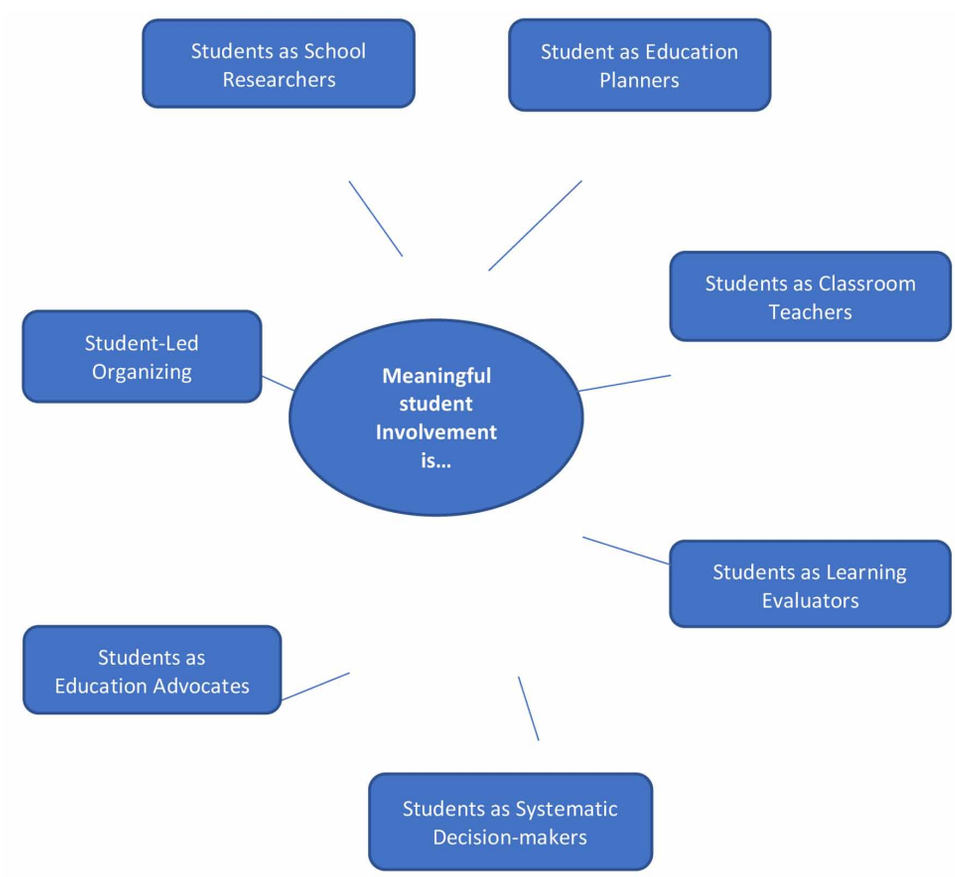
Furthermore, social media also helps in building a positive footprint to publish and produce valuable contents and share resources. Coding also helps teachers to be literate about today's computers and how to maintain professional behaviour in the class and online. In today's world, technology does not only help the enrichment of teaching, but also help to connect with outside the classroom by strengthening relationships between teachers through communication, sharing, discussion and meeting. It assists in

reaching parents, stakeholders and community for better collaboration. In the mist of appreciating technology and its roles in educational institution change, blended learning has found its way to be one of the effective platforms to connect with the students anywhere. Hence, it helps working individuals in the communities that have less opportunity to face-to- face learning to further their studies and obtain professional certificates to improve their performance.

School Change and Students Achievement

The world now is experiencing one of its greatest challenges and changes. For us to be proud of our students' learning and to see them succeed with flying colours in their academic achievement in the future, the field of education and schools need constant change. The focus on the role of students or emphasis on students' learning and achievement is the ultimate method of moving the school forward. Making the necessary changes in schools to the way teachers are teaching and the way students are taught will bring great improvements to classrooms and teaching practices. Through continuous change, schools are allowed to be relevant and are able to withstand 21st century challenges. Changes in an educational setting is a sign of improvement but changes can only occur with the participation of teachers (Campos, 2005).

Figure 3. The benefits of students' involvement in school change process
Source Fletcher, 2005



In the process of change, it is inescapable to exclude students or the emphasis on students' achievement. This is because engaging students as partners in the process of change increases student's commitment to education and the community. Students' involvement in school change allows their voices to be heard, it also improves their knowledge and experiences (Fletcher, 2005). Further to this, when students are involved in the process of change within a school, it is a meaningful step, as it gives a good impression of the school. This is because it motivates and empowers students and provides a sense of democracy within the school. In this process, students are seen as partners, allies and companions in school improvement and development (Fletcher, 2005). Figure: 3 presents the benefits of involving students in school development and change. According to the characteristics in the Fletcher's model, students can be engaged in school change as education planners, classroom teachers, learning educators, systematic decision-makers, education advocates, leaders-organizers and as researchers.

School Change and the Role of Government and Community

Schools are a factor within the macro community. In a 21st century school, parent involvement is important. Parents are involved in the decision-making process and take part in school life and activities. In addition, parents are conscious of what is happening in educational institutions (Szucs, 2009). Since the increased demands of society on the education system expect results from school and teachers, changes in schools are imperative as schools are expected to produce students that will contribute to the development of a nation (Campos, 2005). External support is needed to fully allow change to take place. Lately, there has been a continuous emphasis on the responsibilities of society and the government in the process of school change (Campos, 2005). Outside stakeholders also have to make contributions in school change and its sustainability.

In the collaboration for students' success, parents and community member involvement in the school planning and decision-making process ensures resources meet targets and needs equally, whilst also reflecting the needs of diverse cultural groups. In the US, the active involvement of the community and their efforts tend to foster the development of local leaders and improve social capital for poorer students and students from different ethnic backgrounds (Potapchuk, 2013). In Canada, research and findings have reported that, when parents are in charge of children education, student learning and achievement improves. Parents play a crucial role in education; and students, parents, families, teachers, schools and communities benefit when parents are engaged and involved in the school as well as in education. Furthermore, their involvement enriches schools and transforms schools into positive places to teach, learn and grow.

Education is considered to be a public good or property. The government or district has a direct role to play in school change and development. The government through the Ministry of Education (MOE) generally provides financial support, resources and materials to schools to improve teaching and learning as well as to enhance school performance. The MOE ensures money is spent wisely and resources are used for the needs of stakeholders within the school. They also pass down policies for schools to govern the school effectively. The MOE provides training for teachers to improve their standards and teaching performance as well as for administrative staff to enhance efficiency within the school. Therefore, school change and reformation involve stakeholders inside and outside the school. School leaders are expected to lead and usher change, however the findings demonstrate that teaching is the first factor to influence students' learning. This proves teachers are the leading entity for school change in the 21st century. It is also claimed that the core business of a school or any educational institution is learning, thus this has put

students and learning as leading factors in the 21st century school change. In addition to this, however, when taking government inputs and community participation in school development into consideration, they also play a pivotal role in ushering change in 21st century school change. These arguments, claims and facts pose the critical question of who should lead or usher change in 21st century school change?

Methods

This research uses qualitative design by using open-ended questions. A qualitative approach is used to have an in-depth understanding of the process of 21st school change from the teachers' perspectives. The qualitative method enables the generation of in-depth knowledge in an area that has no existing research (Buchanan and Jones, 2010). The power of the qualitative approach goes beyond numbers and yields rich insights (Patton, 2002 cited by Buchanan and Jones, 2010). In this research, the sample consists of teachers from different schools that are undertaking a 'Leadership in Education' course in 2016-2017. Purposeful sampling was used as the participants were well aware of the importance of school leadership, teaching and learning, the government and the community in the school development especially in Malaysia. In this study, 31 students from the Leadership in Education course participated by giving them open-ended questions. The participants were teachers from different schools in Kedah, Northern Malaysia. Qualitative research seeks for saturation and does not need a large sample size for generalization as for quantitative design. Saturation in qualitative design talks about reducing participants that do not add new or important information to the study. For phenomenological research or studies, Creswell (1998) recommended five to twenty-five respondents while, Morse (1994) recommended at least six respondents. Therefore, based on these rules of thumbs, 31 respondents interviewed in this study is adequate and justifiable.

Again, why the responses from these 31 students taking the master program in educational leadership and management are valuable, it is due to their knowledge about educational leadership and management. Their knowledge about the roles of principals, teachers, students, community and government as topics related to their roles were taught in the class and part of the course outlines. It is also due to their exposure to the school environment and their vast experiences in teaching and learning. In this regards, as far as saturation is considered in the qualitative design, their perceptions and responses are genuine and considered as the right source to interview.

The research questions were based on ushering change in a 21st school, the prerequisites for change, processes, responsibilities and who should lead or usher change between principals, teachers, the government and the community in Northern schools in Malaysia. The interview questions have nothing to do with their classroom assessment questions. The interview questions were open-ended, solely designed for the purpose of research by asking participants to share their ideas based on what they had learned in the class on how to make a change in a 21st century school, as well as the process and requirements for change in the school and who should lead the change. The data were analysed using Nvivo 11. During the analysis, Mind Map and Word Cloud were created for each main idea or item to identify the general and dominant words used by the respondents and how their responses/answers connected to the main idea. Word Cloud helps in discovering the most frequently occurring words and phrases in the data. Moreover, the Project Map was also created to display or connect project items and identify patterns whilst making decisions.

REPORT AND INTERPRETATION

Theme 1: Principal's Role in School 21st Century Change

Figure 4 presents a Mind Map for a principal role in 21st century school change. The figure illustrates participant's ideas and a process. Perhaps it could be called prerequisites for principals to facilitate school change in the 21st Century in Malaysian Northern State. The participants of this study believed that in order to usher or lead school change, a school principal in the Northern State of Malaysia should be innovative, creative (e.g. leadership quality and as an agent of change), and should have training and development (e.g. 21st century skills and professional development):

Leader's innovations nowadays are expected to be exposed for further exploration by their team members and as well be positive to welcome ideas or comments made by fellow members to ensure that the innovations they introduce works perfectly well (LP1).

This suggests that the leadership role as an agent of change that contributes to the effectiveness and success of the school(LP5).

Leaders must have the knowledge and leadership skillsl. That's why all principals must attend NPQEL (National Professional Qualification for Educational Leaders) to train school principals to become great leaders and to have the knowledge of leadership (LP6).

The principals should have leadership knowledge, skills, (e.g. technology and planning as well as strategy) and should be learning oriented (e.g. student achievement, learning environment and student-based learning), collaborate with parents (e.g. networking) and apply proper application of leadership styles (e.g. shared, moral, transformational, teamwork, participative and visionary leadership as well as communication and classroom observer and feedback).

Principals (leadership) play an important role in contributing to the smooth running of the teaching and learning in the 21th century in many branches (LP7).

Most leaders in this 21st Century bring about a lot of innovation in the leadership roles they perform, everyone is carried along which gives a sense of shared leadership whereby a particular member of a team is given the authority to lead a team on rotational basis. (LP3).

Theme 2: Teachers' Roles in School 21st Century Change

Figure 5: presents participants' ideas and the roles that teachers should play in 21st century change in Malaysia, especially in Kedah, Malaysian Northern State

First, they believed the teacher should lead change in a 21st century school and in the process of leading change. Teachers should focus on instructional methods (e.g. facilitator, motivator, using different type of technologies, using different teaching methods such as mind mapping, discussion, PBL, role play and others).

Figure 4. Mind map for principal's roles in 21st century school change

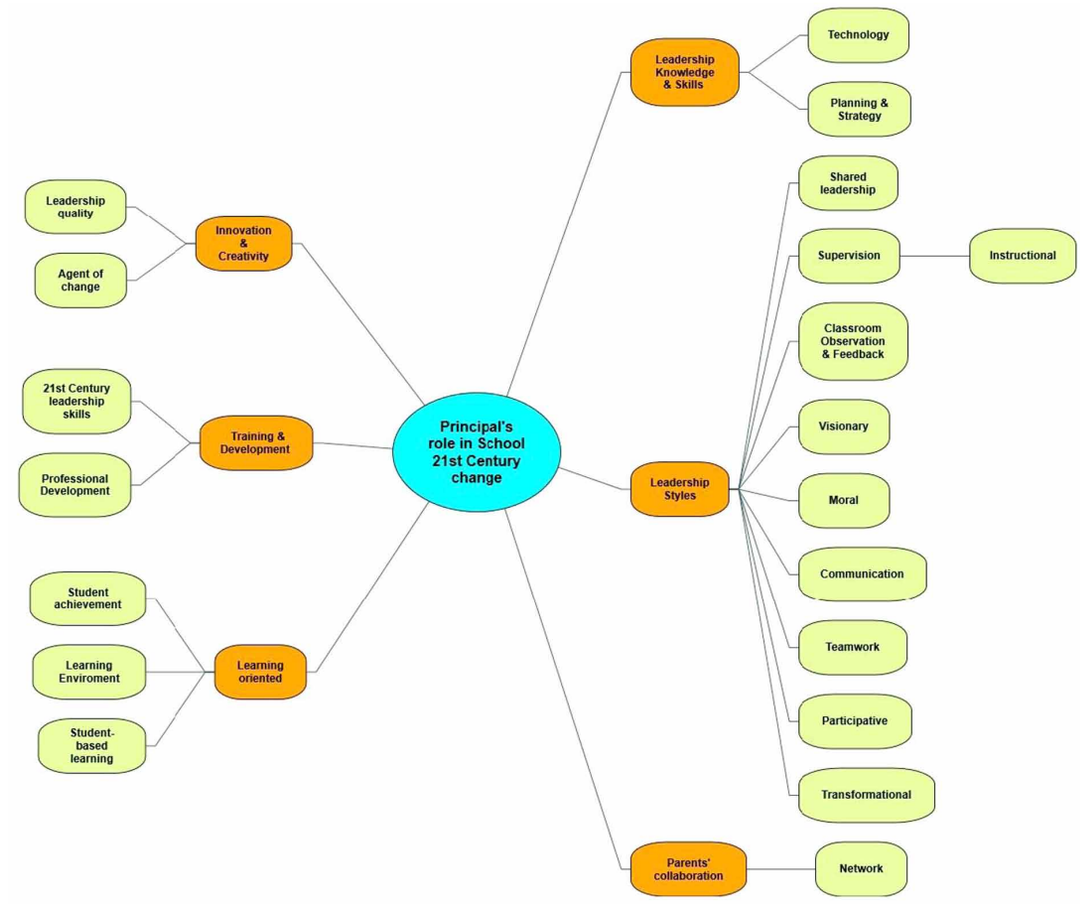
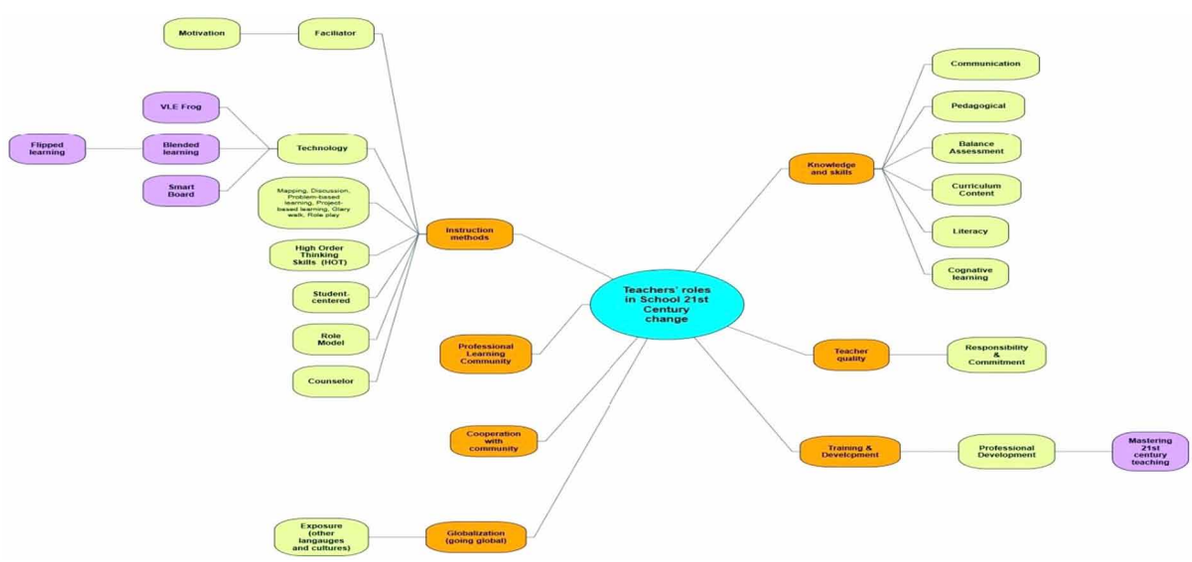


Figure 5. Mind map for teachers' roles in 21st century school change



They expect teachers in Northern State Malaysia to provide a professional learning community for students, and cooperate and be exposed to the community as a whole.

In addition, teachers should go global. Teachers can learn languages, cultures and communication skills by talking to other people from other parts of the world.

In addition to this, the participants predict change within a school to be accelerated with teachers having increased knowledge and skills (e.g. communication, pedagogical, content, literacy skills with the application of balance assessment and knowledge of student's cognitive learning):

A Profesional Learning Community (PLC) between teachers also needs to be held regularly. This partnership could actually improve the teaching skills in the classroom such as the sharing of best practices (TP8).

Also, another participant said:

The teachers play an important role as a facilitator for the students to use technology to develop their High Order Thinking Skills (HOTS) (TP9).

Teachers in the 21st century have to be masters the 21st century pedagogy. This means that teachers should know how to apply media and information technology in teaching and learning process (TP6).

Teachers should gain knowledge on how to blend their student abilities with learning styles such as, I- think mapping, group discussions, individual tasks, role play, gallery walk and so on. Teachers also need to have a good relationship with parents and the community in order to know their students better and it also helps with collaboration in learning projects (TP4).

Teachers need to prepare themselves with IT literacy so that they can make more contribution in education (TP2).

The participants in this study assert that quality teachers (e.g. take responsibility and are committed) also have something to do with school change and teacher training and development will pave ways for school change in a 21st century school. One of the participants said:

The quality of teachers is the main determinant of student achievement within a school. Their role requires commitment and a teacher's task becomes very challenging with the learning needs of the 21st Century.

Theme 1: Community Roles in School 21st Century Change

In terms of the role of the community in 21st century school change, Figure 6 presents participants' ideas. The participants believe that, community stakeholders such as the government (by providing financial support and facilities) play a pivotal role.

Government networks such as the VLE Frog Program is established as a platform for discussions and delivers the latest information to parents and students about the programs carried out in school (CP3)

Every year, the government allocates the biggest portion of the nation's budget towards education (CP1)

The Government should also change the traditional notes and textbooks system to a system involving information, media and technology skills.

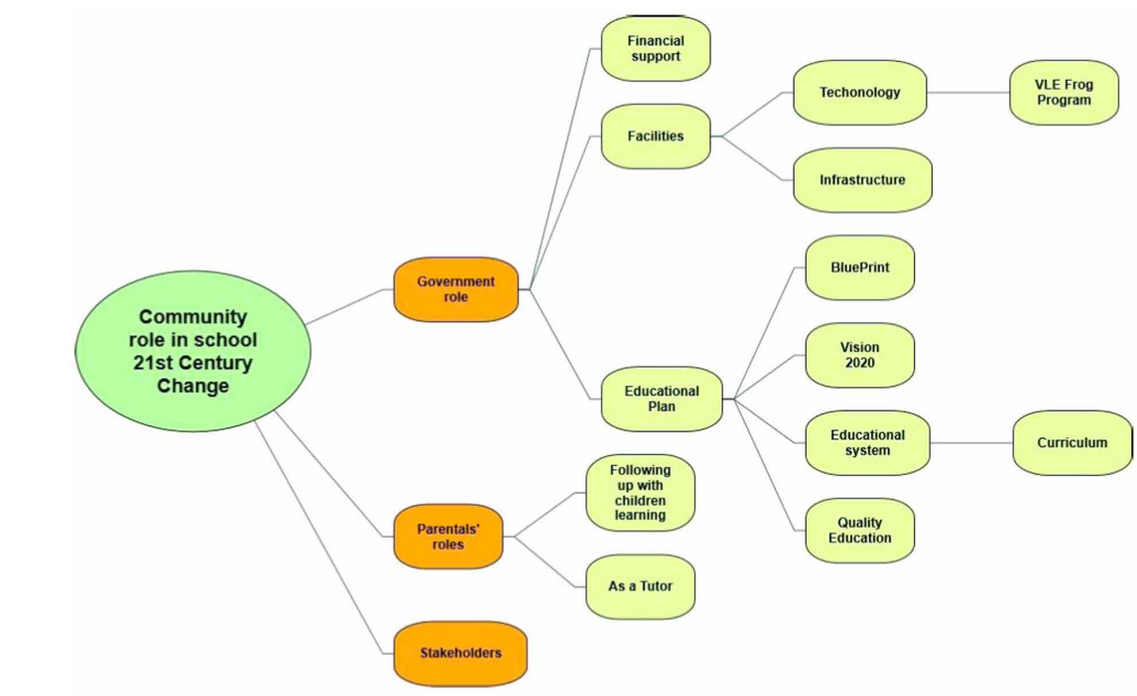
Also,

To achieve 21st century education, the answer will be strong, authentic community connections and actions (CP1).

The first step is to expand the school's vision to include the community (CP2).

It is argued that the government should have a strong educational plan in Malaysia. For example they should introduce and provide a blueprint on how they plan to achieve a 21st century education system by 2020. They should place emphasis on improving the educational system for quality education in Malaysia. In addition to this, parents (whilst providing child care and acting as home tutors for their children) and stakeholders such as the community and the government, should be responsible for school change in Malaysia.

Figure 6. Mind map for community roles in 21st century school change



Step two is to reach out all stakeholders that the school's need to get connected with, more specifically the people that are in the same pathway, for example the Ministry of education, and the state's education departments (CP4)

Parents who care about their children's education at home and school will provide better results in comparison to parents who do not care about their children's education (CP3).

In order to analyze and comprehend the words used by the participants in this research, figure 7 from Nvivo (Query+ word frequency) presents the dominant and most commonly used words amongst participants. From the image, we can see words such as teachers, students, school, 21st century, learning and education are the most frequent words used by the participants. This shows a great emphasis and a connection of teachers with 21st century school change. It also demonstrates a connection between teachers and student learning and education in general. Moreover, this is a strong indication that, according to the respondents' views, teachers are the impetus for school change in the 21st century in the Malaysian Northern State. Word Cloud is an important image and another data vitalization to show the important words used by the participants and their leading descriptor that framed participants' answers (DuBose-Morris, 2013). Word Cloud should not be taken slightly as it is an indication of how carefully participants have chosen their words. Participants' main preferences can be captured as a single word at Word Cloud. Word Cloud in Nvivo helps to merge their main major responses in a single word and well-designed Word Cloud lead to the relative important themes. Therefore, Word Cloud is considered in this chapter to illustrate in a single word the respondents' main issues and theme.

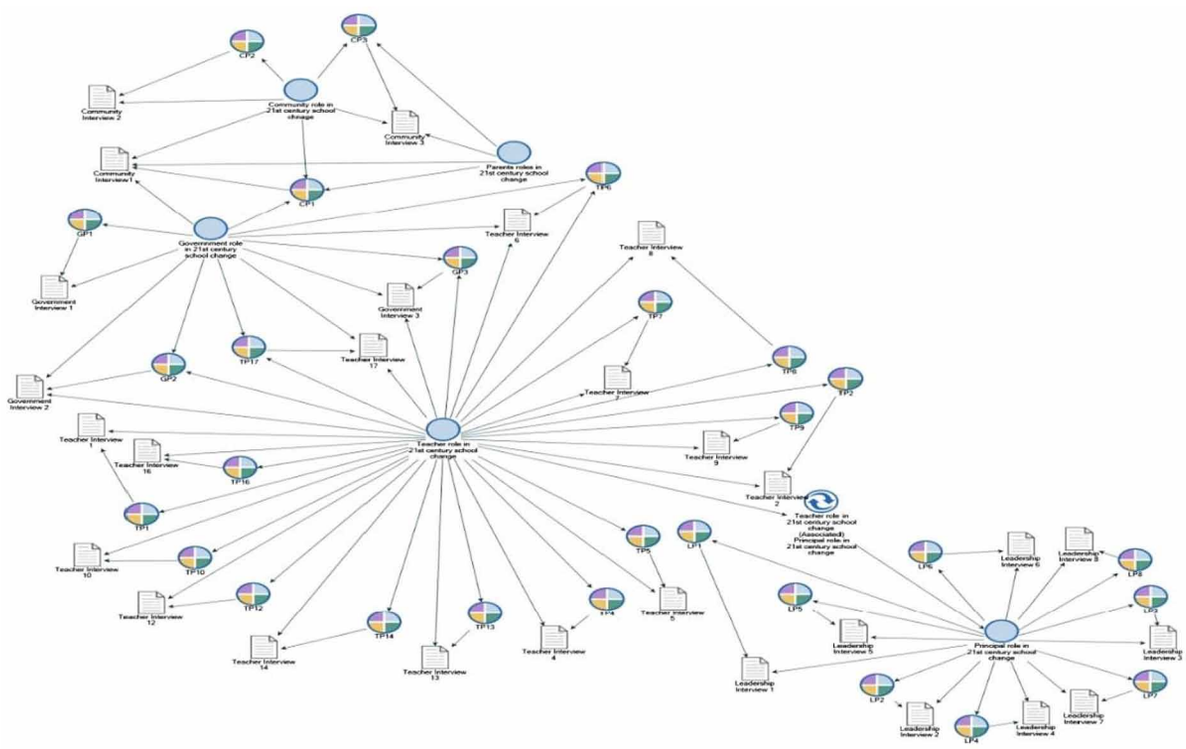
Figure 7. Word cloud

Project Map

Figure 8 presents an overall project map of the findings. The 'NVIV' analysis of participants explored their understanding of how to usher change in a 21st century school in the Malaysian Northern State, what they believed the requirements for change were and who should be responsible for change between a school principal, teachers and the community. It was found that 17 out 31 respondents ranked and believed the teacher played an important role in school change compared to the school principal and the community. From their understanding, teachers should be responsible for ushering in 21st century school change in Northern schools within Malaysia. From the Project Map, 8 out 31 reported that the principal should take the lead and be solely responsible for school change whilst 6 out 31 viewed that the community which included parents were responsible for the change.

Additionally, the Project Map also illustrates that there is a relationship found between a teachers' roles and the principal's role in 21st century school change. This is an indication that collaboration should exist between teachers and the principal for school development. Studies and findings have confirmed that to accelerate development, principals and teachers play crucial roles. Principals facilitate teaching for teachers whilst teachers transmit knowledge to students. Both work towards the advancement of learning and the improvement of student achievement.

Figure 8. Project map



FUTURE RESEARCH DIRECTIONS

This research contributes generally to the field of school change and development and specifically in school setting in Malaysia. This research is a call for awakening the Malaysian MOE especially, Kedah State Educational District Office. It illustrates the importance of school leadership and teachers' development. It also draws attention to the importance of the community such as parents, the government and various stakeholders and their active involvement or participation in school development in Kedah. Teachers contribute to school development via teaching and the transmission of knowledge. This research supports Leithwood et al. (2004) findings on the factors that influence student learning and achievement. From their findings, it is confirmed worldwide that teachers or teaching is ranked as the first factor that influence learning and student achievement followed by school leadership ranking as the second factor. Therefore, it is clear that this research has contributed to existing research, studies and findings that assert teachers or teaching are the leading factors in learning development and change.

Interestingly, it is the first research of its kind that explores teachers' opinions in Malaysian Northern State, Kedah on how to lead change in 21st Century schools. It supports the models that are cited within this research's literature on the connection between school leadership, teacher roles and student achievement. We should not forget the role that school leader plays in making change happened. School principal is the manacle of the change and the person that allows change to take place. A principal that allows change is a principal that lends helping hands to teachers through support, teamwork, collaboration and supervision. This is in line again with Leithwood et al. (2004) reports and findings where school leadership placed as the second factor that influence student learning and achievement.

It is also an awakening call for all ministries of education around the globe, school leaders, policymakers, stakeholders and communities to support teachers in making change in school setting a constant culture. With the previous and present findings and reports, teachers are now seen as the 'game changers' that influence school movement. Teachers' welfare, motivation, satisfaction, autonomy and development are crucial. They need to be supported by their school principals' example, in terms of instruction and autonomy in order to feel free to select best or suitable teaching materials for their teaching and learners. Their participation at the ministry level is seriously needed in the development of the school curriculum, syllabus selection, activities and other school development and decision-making process.

In a nutshell, this chapter contributes to the field of educational leadership and administration, especially in today's schools where collective efforts are needed from school principals, teachers and students as well as parents to move the school forward. Since the core objective of school is learning, this chapter takes into the board, the importance of stakeholders in working together to discuss about the challenges, issues, in schools as well as method to adopt in enhancing quality education. With the constructivism underpinning theory of this chapter, school principal and teachers have roles to play in making learning happen such as changing the methods of teaching that allow self-learning and student knowledge construction. In the classroom where constructive learning is used, the process of teaching become student-centred approach and students are given freedom to search for the information and construct their own knowledge. One should not forget that, this can only happen when both principal and teachers become instructional leaders, which advocate instructional leadership and distributed leadership models. As far as constructivism theory is concerned about changes in learning, studies have reported the assistance that the technology provides in improving learning in today's modern schools. In today's learning and classroom, there are many technological tools to facilitate learning such as mobile learning, Cloud computing, MOOCs, iPad, Padlet, Google classroom and gamification. These tools can only

be supported with the help of government, support from the school principal in providing training for teachers to use these instructional tools and the willingness from teachers to infuse them in their teaching as posited by the Adoption theory.

DELIMITATION AND LIMITATION

This chapter strives to determine school change in the 21st century and who should lead this change. This study only sought the perspectives of teachers that enrolled into Leadership in Education class for master degree program in one Malaysian Northern University. Teachers' perspectives were sought due to the fact that learning is a core objective of educational institutions. Teachers play a centre role in learning attainment as teaching or teachers as reported by studies are the first factor that decides student achievement. Notwithstanding, the chapter has some limitations which include seeking only teachers' perspectives and excluding other parts such as school principals, students and community. It also has a limitation on taking only samples from one university and students enrolling into Leadership in Education class. Therefore, the findings of this chapter should not be generalized in Malaysia and to other institutions. But, this chapter proposes further or future studies on this issue in Malaysia and outside Malaysia to replicate the research by taking large sample size of teachers, principals and students from different schools in Malaysia with different methods.

CONCLUSION

To conclude, this research started by exploring how to usher change in a 21st century school from selected teachers from different schools within the *Kedah* Malaysian Northern State. The teachers were Master students enrolled in year 2016/2017 that took courses of the 'Leadership in education' class. In class, they were taught school leadership, leadership theories, teacher professional development, instructional practices and the influence of teaching on learning. They were later given open-ended questions on how to usher change in a 21st century school, the process involved and the required responsibilities. From the responses, this research has displayed the teachers that participated in this study agreed, and provided support for the argument that teachers are responsible for ushering change within schools. They believed teachers do play the main role in school change and reformation and as far as learning is concerned (a core business of every school), a great emphasis should be placed on teaching for school development and student achievement. In addition, the finding within this research also displays the power of school leadership as the second factor responsible for 21st century changes in *Kedah* and perhaps in all schools within Malaysia.

The findings of this study are strongly related to the findings of Leithwood et al. (2004) that reported teaching or teachers as the first factor that influences school achievement. An effective teaching leads to an effective learning. This is also logical as learning is the core business of educational institutions which means that, excellent teachers are highly needed in classrooms for student productivity. It is also expected to see or found school leadership making a second place in ushering change in school especially in the 21st century. This is also supported by Leithwood and his colleagues' reports and findings. In general, school development or change in Northern part of Malaysia if not the entire Malaysia, according to the teachers, is not a one-man show but the collective efforts from all parties.

As far as 21st century is concerned, and as far as distributed leadership theory or model is considered as one of the effective leadership models in 21st century school management, everyone is a leader, responsible for his or her own action. In schools, although, the school principal is the official man in charge of school management but the tasks of moving school forward are on everyone's shoulder. School leaders might carry the heaviest task or positioned as number one responsible, but, they can only be successful in their leadership and management with the school internal and external supports. This has to do with the fellowship support of leadership which many studies have reported that, the success of a leader is in the hands of his or followers. In light of this, we can conclude that, teachers lead change in schools through student achievement, according to this research findings, teachers need the help of school principals as instructional leaders in providing all the needs to support and enrich their teaching.

Therefore, in general, a strong relationship is needed between school leaders or principals and teachers for the success of the school and performance. This research recommends and proposes further research on this issue by taking more samples and including schools in the other Malaysian States. Further studies on this issue will produce increased accuracy and further confirmation of this chapter's existing findings. This may also assist the Malaysian MOE to intensify their efforts to improve education, the school system, training and overall improved development for quality teaching and learning.

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KEY TERMS AND DEFINITIONS

21st Century: The current century or Era that starts January 2001 to December 31, 2100.

Community: A group of people that live in the same place or together. In this chapter, it consists, particularly, parents or stakeholders in the northern part of Malaysia.

Government: A group people or authority that in charge of governing state or country. In this chapter, if refers to the Ministry of Education, Northern Statement or District Educational Department in Malaysia.

Leading Change: Talks about transforming the organization to achieve its objectives. In this chapter, leading change refers to transforming schools from its current position to better ones. It deals with schools responding to the global change and expectations in improving teaching and learning in northern of Malaysia.

Malaysia: An Asian country, situated in Southeast Asia.

Northern Schools: Schools situated in the Northern part of Malaysia.

Principal: An official leader that it is in charge of leading, managing, administrating school and development. In this chapter, it consists of school principals in the northern part of Malaysia.

Students: Persons that study in schools or higher institutions. In this chapter, it consists of students in the northern part of Malaysia.

Teachers: The assigned and paid educators to teach in schools and responsible for student learning and achievement. In this chapter, it consists of teachers in the northern part of Malaysia.

Chapter 31
Transformational Teacher Leadership:
A Global Perspective

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ABSTRACT

Transformational leadership along with change theory have become increasingly popular concepts within the field of educational leadership and administration during the last 20 years. This chapter examines the growth and popularity of transformational leadership, its relationship to organizational change, and the practical and theoretical justifications for its use as a relevant form of teacher leadership from a global and cross-cultural perspective. Emphasis is placed on discussing transformational teacher leadership practices as core strategies for modern educators in the process of overseeing teaching and learning objectives, contributing to school improvement and students' educational attainment, and managing essential change processes within globalized educational environments.

INTRODUCTION

Examining leadership theory from a global perspective facilitates discovering how reliable transformational leadership has been within educational environments, especially pertaining to how such environments define and handle change. It also illuminates the extent to which transformational leadership, in conjunction with change theory, can be a powerful tool for educators and the educational system (Black, 2015). Being unaware of key conceptual aspects of change as it relates to education means that specific tools and resources may be unapplied or unsupported for students who need them (Quin, Deris, Bischoff, & Johnson, 2015). There is a positive relationship between transformational leadership practices and accepting change that should be included in strategies for classroom educators (Quin et al., 2015). School systems that create strategies for change also show higher achievement and success and produce attractive schools for parents (Pounder, 2014).

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This chapter focuses on two intersecting concepts that together form a means of identifying connections between leadership choices and the environment in which leadership choices are made. When linked, transformational leadership and change theory provide insight into how educators cope with classroom change through teaching strategies. It is important to understand how leadership can affect change and, from a global perspective, offer robust evidence demonstrating the powerful link between change and leadership for today's educators.

It may be accepted that transformational leadership offers educators many ways to provide a clear vision of school strategies, classroom expectations regarding teacher leadership, and a curriculum promoting student excellence (Fang, Zakaria, & Shokory, 2016). Nonetheless, questions concerning what transformational leadership is and why it has become so popular remain. The emergence of transformational leadership in education and its connection to change theory also raises the question of what makes someone a worthwhile leader. This chapter seeks to address these questions.

BACKGROUND

Transformational leadership was initially conceived as a process whereby leaders strategically transform the system or organization by increasing their followers' achievement and motivation. In this way, transformational leadership is often defined as a leadership style in which a leader works with teams to identify needed change, creates a vision to guide the change through inspiration, and executes change with committed group members (Hoch, Bommer, Dulebohn, & Wu, 2016). Researchers have noted that four characteristics—idealized influence, inspirational motivation, individualized consideration, and intellectual stimulation—differentiate transformational leadership from other leadership styles (Bass, 2000; Ghasabeh, Soosay, & Reaiche, 2015). Related to transformational leadership is change theory, which involves systematically examining patterns in how organizational processes occur, determining how to remove barriers to make those processes more efficient and effective, and creating a culture of continual improvement (Burke, 2017).

Within the educational environment, it has been argued that how teachers perceive their work environments significantly impacts their engagement in instructional activities (Allen, Grisby, & Peters, 2015). In this regard, transformational leadership can be well suited to education as it empowers individuals and provides them with hope, optimism, and energy as it defines a vision of productivity as they accomplish goals. Additionally, transformational leadership is often considered instrumental in establishing shared beliefs and values that help create comprehensive levels of change and innovation, and it nurtures a school culture that is oriented towards a learning ethos whereby individuals seek to enhance their capacities, ways of thinking, and individual ambition. Learning and growth become a shared responsibility, and teachers feel empowered to be a part of the change process. Consequently, empowered teachers may focus more on actions and behaviors that will improve learning and students' educational outcomes (Leithwood & Jantzi, 2005; McCarley, Peters, & Decman, 2016; Mulford, Silins, & Leithwood, 2004). The question that must be asked, however, is how transformational leadership might be applied in actual pedagogic practices and educational contexts.

This chapter will trace transformational leadership's emergence as pivotal to educational environments through an analysis specific to the global view of the K-12 learner experience. Researchers and educators have argued that educational performance and outcomes cannot be improved without effective educational leadership (Fox, Gong, & Attoh, 2015). In an era in which educational reform and the need

to improve student outcomes seem to be continually discussed, how teacher leadership may be associated with the learning environment must be considered. What is it about that one teacher who transforms learning for the student (Black, 2015)? What characteristics are present in such a teacher, and how does this information relate to leadership theory in which the use of transformational tactics for leadership also implies accepting change theory?

One might begin by assuming every educator has the potential to be a leader. Teachers are responsible for education quality (Finley, 2014), and choosing to become an educator means recognizing traits within oneself suggesting teaching capability. This implies a potential educator can lead the classroom, guide the learner, and demonstrate competency in sharing knowledge. It can also mean using leadership tools to meet today's classroom's increasing challenges. It can additionally be argued that educators are only as strong as the resources extended to them through the educational system and school, community, and stakeholder support (Fang et al., 2016). Furthermore, an educator can demonstrate transformational leadership, but a learner must also be receptive to learning. A transformation occurs when learners' ability to apply knowledge shifts, actively using what they have learned. The literature suggests transformative leadership is needed to provide learners with a continuous desire to learn. This understanding of transformational leadership stimulates opening learning access for all individuals and creating higher educational standards. Nevertheless, these benefits cannot occur without transformational leaders being enabled to operate every day in the classroom. However, in advocating for transformative leadership use in the classroom, one must also consider the implications and risks of not implementing other leadership and change strategies, which is a subject requiring further research (Parris & Peachey, 2013). Transformational leadership has demonstrated some shortcomings, and research supports educators using appropriate leadership styles and tools for a person's knowledge and context (Black, 2015).

Leadership Theory and Transformational Leadership

In tracing the emergence and popularity of transformational leadership, historical context, especially the links between leadership theory and business practices, is important (Bass, 2000). Generally, organizations have tended to give control to one person or many people at the same authority level (Avolio & Bass, 1998). Northouse (2015) has indicated how traditional leadership formats parallel military organization and game theory, which require control, contingency planning, and consideration for how all the relevant components have a role. To build strategies around who is in control and how specific qualities can be fitted into a larger context remains a traditional way of thinking about leadership. Schein (1999) and Sebastian (2018) believe that such understandings of leadership have excluded some participants who lack the outward traits considered necessary for exercising control. Schein (1999) also believes that many leadership skills are not necessarily taught, which advantages those who appear to have innate leadership traits and reinforces beliefs that leaders reflect natural abilities. This perception of leadership may even eliminate certain team members from the leadership "race," as leaders tend to fit a specific ethnic, gender, and demographic profile (Sebastian, 2018). Schein (1999) observes how leadership theory has evolved to encompass individuals who may not otherwise have been considered as having leadership traits and more importantly, the ability to lead in specific environments like schools.

Within the traditional paradigm of leadership theory, leaders are often men who typically lead large corporations that define the business spirit. Leaders may operate as part of an organizational culture in which competition is fierce and the temptation for deviating from ethical practices and making choices based on short-term commercial advantage and improving one's position is heightened (Northouse, 2015).

When leaders fail to treat people with proper respect and to engage with them, this leadership style does not harness the principles of transformation in which decency remains important. An ethically sound leadership entails seeing a wider context in which interactions have clear and morally valid purpose, and where vigilance is required to align an organization with a definite set of defensible values. In education, as in business, commitment to strong ethical standards is important, not for their possible competitive advantages but to allow a ready defining of appropriate action and an understanding of actions' effects on others operating within the same set of values (Beverborg, Sleegers, Endedijk, & van Veen, 2017; Northouse, 2015). A clear ethical purpose allows an educator to lead authentically and directly change the course of classroom actions through transformational leadership. Avolio and Bass (1998) consider that sound ethical practice and transformative knowledge exchange ensure genuine transparency of leadership qualities, which entails a leader with a high level of compassion, understanding, and responsible commitment.

Furthermore, in evaluating transformational leadership, is leadership style something someone must develop or, if given the right conditions, does it become part of a person's character? A leader's actions generate a desire to follow if a leader can repeatedly engage meaningfully with those being guided (Leithwood & Azah, 2016). Leithwood and Azah (2016) consider that one aspect of how people thrive in specific environments through leadership depends on how values are defined through communication. Bass (2000) concludes that leadership traits align with transformation when the relevant attractive qualities lead others to seek to be influenced or mentored by those types of leaders.

Applying Transformational Leadership to Education

It is clear from the discussion thus far that the idea of transformational leadership was developed specifically for the business world, where it has received much attention. The question to address is whether it is appropriate to apply a business theory to education. To answer, it must be recognized that the education system has much in common with traditional business organizations. The educational system involves a group of organizations, some of which are run like businesses (more at the collegiate level), meaning similar leadership styles are involved (Hogg & Terry, 2014; Okçu, 2014).

For instance, the concept of transformational leadership emerged to maintain high business performance through enhancing factors contributing to motivation, morale, and employee belonging (Avolio & Bass, 1998). Transformational leadership is characterized by flexibility in the face of change and requires a capacity for introspection and an understanding of how emotions predict behavior among team members (Beverborg et al., 2017). Effective leaders are aware of team dynamics and can therefore effectively design and coordinate work processes. Black (2015) also believes these qualities can apply to the educational environment. A school can be viewed as an organization with administrative leaders, like principals (Finley, 2014). In a transformative school, the principal is a role model and encourages open dialogue with teachers concerning curricula and teaching strategies, as well as mentors and teachers, to develop a learning environment according to learners' needs (Finley, 2014). However, Finley (2014) found that even in the best schools where conditions are well defined by value systems, teachers may not follow the principal's leadership.

Transformational leadership in education has also been influenced by other similar developments that have occurred in business (Schein, 1999). For example, organizational culture itself responds to market conditions and historical events. Within this context, it might seem obvious that without focused leadership, goals will be unclear and varying dependent systems will interact in an unbalanced manner. However,

forces within industry, such as leadership choices involving outsourcing jobs or prioritizing creativity, burden leaders to make decisions that promote sustainability among an organization's multiple systems. Leaders' proximity to those most affected by choices also alters how they are guided within specific conceptions of what is best for an organization and what the core attributes of interactions must entail.

Moreover, it should be noted that transformational leadership's application in education has occurred because of its perceived success in business (Anderson, 2017). For example, in a particularly well-run system and organization, the members would be valued as the ultimate assets and considered integral to sustainability (Fitzsimons, 2015). If leaders focus more on a system's broader requirements, then other parts of the organization suffer (Hogg & Terry, 2014). In this regard, educational leaders who overlook teacher needs and concerns are ignoring a vital asset within their organizations. For an educational organization to be well-run and effective, teachers cannot be viewed as expendable; they must be viewed as resources of information and insights about how to improve educational outcomes.

Greater use of transformative leadership also suggests organizations are adapting to more recent demands and that traditional models may be unsuited to modern business (Northouse, 2015). Transformation allows a leader to have greater freedom but also greater accountability. Therefore, there is a downside to its use in terms of organizational accountability in the event of failures (Mittal, 2015). With educational systems, a lack of improvement in student educational outcomes typically leads to accusations that the educational leaders do not understand students' needs or are not focusing on the specific issues impacting students' educational development.

Transformational Leadership and Change

Coping with change is part of every organization, especially if growth and survival are to be achieved (Westover, 2010). Change is necessary to ensure employees and leaders remain efficient, given varying challenges over the life of an organization (Oreg, Vakola, & Armenakis, 2011). To cope with conflicts and challenges in organizations, change must occur (Burns, 1978).

More recent change models continue to emphasize group dynamics concerning how people respond and adapt to organizational change, and many researchers cite three main phases of change: actions associated with recognizing a need for change or *initiation*, *implementation* and actions after change, and eventual *institutionalization* (Wallin, 2010). Alternatively, Oreg et al.'s (2011) change framework specifically focuses on how employee or follower reactions towards change are influenced by particular antecedents such as organizational support or effective communication between leaders and followers. The underlying dynamic of this model is that employees ultimately drive organizational change. However, leaders also impact organizational change because their relationship with followers can shape employee behaviors and ways of thinking.

Thus, change theory is relevant to transformational leadership because change is central to transformative leaders' goals: to affect positive changes in organizations (Burns, 1978). Furthermore, transformational leadership is the bridge for organizational change because it facilitates improved relationships between leaders and followers. Moreover, transformational leadership and followers' capacity for change are inexorably linked, underscoring the role of transformational leadership in influencing organizational change (Herold, Fedor, Caldwell, & Liu, 2008).

Furthermore, the best way to promote transformational traits is to embrace change because people learn through change (Black, 2015; Hallinger, 2011). Hallinger (2011) found that once students become learners, they forget they are learning, which is when real transformation happens. Change or the desire

to change behavior is the first step to commitment within any learning process (Black, 2015; Hallinger, 2011). This makes the transformational style more applicable to modern real-life educational contexts. Part of what makes a leader transformative is not a focus on change or its implications but how a leader commits to sharing in the change.

Connecting Transformational Leadership and Teacher Leadership

Teacher leadership has been defined as a process of teachers' leadership of their own development work and knowledge-building, as well as teachers' having a voice in schools (Bush & Glover, 2014). It is also increasingly seen as promoting the empowerment of teachers and students, contributing to school improvements, spreading good practice and collaboration, and generating change initiatives (Bush & Glover, 2014; Hallinger & Heck, 2010; Muijs & Harris, 2007). Transformative practices unquestionably are key for this process because teachers' choices and actions within a system influence others due to the changes that occur during mentoring processes (i.e., teaching and learning practices) (Pounder, 2014). This process allows learners to transform and commit more deeply to the activity of learning, even increasing their love of learning and improving educational outcomes, because the educator's influence on the learner can increase confidence with the relevant subject matter (Afshari, Ghavifekr, Parhizkar, & Ayoufu, 2017; Pounder, 2014).

Additionally, many teachers believe in learning by doing because they want to create an environment where innovative ideas invigorate students instead of using the traditional format of lecture and recall (Beverborg et al., 2017). Transformational leadership at this level suggests learners have power to create the action and highlights the importance of instilling how change can support innovation and collaboration at a more engaged level of problem-solving. Afshari et al. (2017) consider there is a powerful connection between the educator promoting positive behaviors in learners and learners' desire to engage in positive behaviors as an integral part of learning.

Cultural setting seems to promote a universal sense of how the educator's role is respected and serves a purpose (Liu, 2015). Lui (2015) suggests that a strong connection between purposes and values also extends to the educator's perception of the environment. How environment affects the types of leadership and strategy used in the classroom directly relates to identity regardless of nationality or cultural awareness (Lui, 2015). For example, in a school where teachers are encouraged to engage with each other, it is more likely that teachers will plan lessons together so instruction is more consistent and systematic across classes. In contrast, a school environment where teachers are discouraged from collaborating could result in teachers focusing solely on their own classrooms and their own students' educational performance rather than viewing that performance in relation to all the school's students (Heck & Hallinger, 2014). How teachers perceive the educational environment impacts whether they think of their classroom practices and strategies as only impacting their students or the entire school.

The role of the teacher remains more important to the individual than the actual environment. Nonetheless, regarding transformation in the classroom, concern has been expressed on how environmental elements contribute to promoting or resisting change. Overall, according to Lui (2015), one's environment and perceptions concerning its capacity for positive or negative change are not directly determined by culture but instead by socioeconomic conditions. For instance, teachers from cultures where poverty significantly adversely affects students perceived transformation as having minor impact. The environment is understood as forming a barrier against change, and this remains true even if one changes contexts, including organizational or national cultures. However, the use of transformational leadership proved

significant to educators in determining their commitment to staying where they perceived socioeconomic constraints as negatively affecting change for the students. Commitment level is important to discuss in terms of how leaders may not allow an otherwise difficult environment to prevent them from being effective.

Further evidence for a shift towards transformational leadership for teachers as change agents also includes the level of teacher engagement being related to how a teacher is valued by the school. Park, Lim, and Ju (2016) found the deeper the connection the teacher felt with the school, the higher the level of teaching commitment. They also claim that deepening the connection between a teacher and school depends on the support the school provides in terms of resources such as training and motivation. An awareness of being engaged in the learning process while they teach seems also to have little cultural bearing for teachers. Teachers' self-perception derives from their role and its definition within the global context (Park et al., 2016). If the teacher's role is defined as merely providing instruction, a teacher will feel that his or her job is only to instruct students in the classroom. However, if that role is defined as a leader who engages with students, parents, and other stakeholders and serves as a role model for other teachers, then teachers will perceive that their duties extend to all areas of the educational environment, as well as the larger community.

Furthermore, Park et al. (2016) found that engagement is defined by teachers' awareness of their level of affiliation with colleagues in mutual problem-solving and in response to changes within the educational system. Culture is not so much an issue but rather a teacher's awareness of people getting along or not, or a teacher agreeing to rule changes, or administrative roles. This finding suggests that engagement is integral to leadership and transformation, as engagement facilitates leadership through which people connect using dialogue and information-sharing. More engagement also means leaders will be receptive to having such discussions (Park et al., 2016). The degree of willingness to share information also supports more active collaboration and engagement with students.

With discussions of culture leading to change and altering of educational methods worldwide, there is also an understanding that educators will adapt leadership styles to fit their audiences. This adaptation considers that more collective cultures and more individualistic cultures will perceive leaders differently, according to the styles of leadership adopted (Mittal, 2015). How a culture views change will also predict how members of that culture are likely to perceive leadership, which presumes that having the correct leadership style in place is important to promote trust within learning environments (Mittal, 2015). However, it is not the leadership style that remains of primary concern but the communication style between educator and student; this is also true of communication between educators, staff, and other stakeholders in the learning process (Terek, Glušac, Nikolic, Tasic, & Gligorovic, 2015). Terek et al. (2015) also suggest that the type of communication used predicts how well the educator communicates the same information and concepts with the student and with other stakeholders. The level of commitment is high when communication is clear, and the process of exchanging information is valued by each member (Terek et al., 2015).

Cross-cultural analyses have also found educational leadership of any kind requires deep affiliation and trust amongst educators, coworkers, and staff. The level of staff support is important for the use of leadership styles, especially in transformative leadership, because of the trust level that is formed; the value for the educator in having supportive coworkers and students' willingness to accept the challenge of changing the ways they learn are connected (Nyenyembe, Maslowski, Nimrod, & Peter, 2016). Learning activities based on trust and engagement have a positive effect on students. Staff and stakeholders must believe in and value one another just as much as they value any proposed change.

While transformational leadership has benefits, it also involves complexity in terms of how a leader must self-regulate and maintain learning progress. Alongside change, there is a need to continue sharing information with the primary stakeholder or student. Schein (1999) considers that the quality of communication tools helps form clear social connections where people trust in the information and can teach it to other people. With transformational leadership, there is a constant focus on instilling the right message so the vision is understood. Communication is critical, which highlights how certain personalities strong in this area are likely to shape leadership styles and that perhaps not everyone can easily become a transformational leader. Educators need to be sensitive to their strengths and weaknesses and adapt accordingly to achieve a positive outcome.

SOLUTIONS AND RECOMMENDATIONS

Examining leadership theory, specifically transformational leadership in the context of educational applications from a global perspective, involves theoretical generalization. Theories become viable and practical when proven useful. It is possible to compare the effects of transformational leadership before and after applying it, and leadership success can be assessed based on if change and better performance result. While seemingly straightforward, when examining case studies from a global perspective concerning education and leadership, it appears that although transformational leadership is perceived as valuable and powerful, it is not the only leadership style that facilitates change (Hallinger, 2011). It has been common in educational leadership to focus on how a single leadership style, such as transformational leadership, can be effective at creating change, even though a one-size-fits-all approach ignores schools' situational contexts (Barth, 1986). The leadership style used to produce positive changes in schools should be based on a particular school's situational conditions (Day et al., 2010). In this regard, while transformational leadership is significant, other forms of leadership cannot be discounted, which indicates that transformational leadership should not be overrated and that educators need an open mind concerning the tools necessary to achieve excellence.

For educators, transformative leadership may prove effective in reaching students and inspiring them to work harder (Bass, 2000). A leader also needs to create a connection and an awareness to allow transformational qualities of trust and charisma to work (Mittal, 2015). However, other types of leadership have remained important to education within the K-12 environment. In terms of leadership, transformational leadership has not always been a first choice. Instead, and perhaps influenced by business, educational leaders have focused on how to get the job done (Northouse, 2015), as well as on authoritative, transactional, situational leadership styles and leader-follower dynamics (Liden, Wayne, Liao, & Meuser, 2014). Educators have blended various leadership styles to allow flexibility. A teacher likely wants to relate information in a powerful way that is also student-centered and customized to learning style (Pearson, 2016). The myriad of variables involved when creating a learning environment and overcoming specific learning obstacles also suggests that transformative leadership may not always be applicable within every learning context (Posner, 2014).

The classroom, as in other organizational contexts, must remain flexible to introducing effective leadership tools to guide the process of learning and working toward goals (Schein, 1999). A difficulty for transformational leadership is that, while it supports change and clear results, it has less success in sustaining its effects. One reason for this unsustainability is that teachers may initially set lofty goals only to become discouraged when those goals are not quickly achieved (Ross & Gray, 2006). Addition-

ally, job stress can negatively impact transformational leadership's benefits (Schmitt, Den Hartog, & Belshak, 2016). As employees feel greater pressure and strain, transformational leadership's positive feelings and perceptions may be lost. It is possible to speculate that even as teachers feel positively about being treated as leaders and finding ways to connect with students, those positive feelings may diminish when they are blamed for student performance not improving as much as parents and politicians might desire. Manning (2017) states it is necessary to build learning strategies within the context of the environment and make the learning process learner-centered. In doing so, an educator must remain aware that the educational system is in constant movement. How effective can transformational leading be in a constantly changing environment? The educational environment must remain open and geared toward the rapid forces of change. Over time, one may define all the nuances and activities that shaped change as transformational, but one must also focus on all the micro elements and tools present to make the larger transformation possible.

Switching strategies or focus while waiting for an intended change to take effect may be impossible. With other leadership forms, like transactional leadership, the leader can form bonds with people in situations in which negotiation in applying change to behaviors and actions occurs and involves an exchange (Okçu, 2014). The transaction's outcomes can be perceived as transformational, but a leader also understands that bargaining and tradeoff may be more useful in situations in which one cannot wait for the transformation to complete itself. Transformational leadership does not apply to all situations and should not be exclusively promoted. Educators wish to be problem-solvers, even innovators (Pearson, 2016), and should be flexible in their leadership choices for effective learning and to ensure schools can choose from educators not too narrowly focused on one leadership style.

Not recognizing other leadership styles as instigating change can also limit a school's interactive potential within the community. This issue is compounded where a school may already have limited resources, e.g., teachers, because of inadequate socioeconomic infrastructure (Avci, 2015). Leadership styles and targeted audience are connected: If the audience or learners are diverse, then individual needs differ, and an educator must adjust the leadership style to fit the situation without exclusively focusing on the transformational style (Mittal, 2015). Allen et al. (2015) concluded there must be room to adapt to student needs and sensitivity to the varying likelihood of success with transformational leadership, as certain contexts pose challenges (e.g., resource availability) that directly affect how a teacher can effectively reach a student.

While transformational leadership can increase trust and cooperation between an educator and learner, more reliable outcomes occur when the environment is open to change (Avolio & Bass, 1998). The leader must not believe only one type of leadership will work every day. Perhaps, the overarching theme of transformation is that other styles and tools can be used to define the purpose of the activity. Is transformation always present in the classroom, and does the leader make use of other options? The fact remains that other leadership options may be more effective dependent upon the situation. Situational leadership may drive outcomes based on decisions made in an instant requiring proactive engagement (Northouse, 2015). This scenario may require greater forms of authority than transformative, despite leaders' awareness that the core of leading involves connecting and securing people's trust. One must be open and authentic at times in transformative leadership while still believing in a specific image of inspiration. These points only hint at some possible issues with transformational leadership, but, most importantly, any issues must be addressed by all relevant leaders. Education quality relies upon people being open about leadership and seeking this dialogue (Urick & Bowers, 2014).

An educator must apply varying styles of leadership but pursue being a leader even in situations in which the organization does not define one's role in this way (Schein, 1999). Educators must remember they are classroom leaders responsible for impacting students' educational outcomes and, ultimately, their futures. In this way, teachers may work in a school where their role is defined strictly to providing instruction: teachers are still leaders although different leadership styles may be needed to navigate the environment where they are discouraged from openly and actively demonstrating leadership. A leadership style that is less forthright and interactive may be necessary but still makes it possible to inspire and encourage students.

FUTURE RESEARCH DIRECTIONS

Future work must focus on continuing to define the connection between leadership styles and how change is communicated to everyone in a group. It will be useful to know to what extent transformational leadership continues to remain popular with educators. It is also important to examine how the context of its use may adapt further to support continuous learning involving an exchange of skills and knowledge. Future work may lead to an awareness that transformational classroom leadership needs to develop further or transform because of changing needs or even adapt into a new contextualized hybrid form. Meanwhile, research should focus on emergent and other possible hybrid forms of transformational leadership. Research should also focus on leaders' roles, using a global perspective, to statistically compare how leadership styles are used in educational settings and with what degree of success in terms of student outcomes. Moreover, research needs to build on refocusing tools to support a student-centered learning experience while maintaining a strong commitment to a love of learning. In this way, leading students will inevitably require many tools to prepare them for a future of working with innovation and team members. It is important to encourage innovative thinking and collaboration and support classroom leaders who see greater possibilities in leadership forms focused on enhancing knowledge exchange; determining students' learning needs; designing effective teaching practices; participating in decision-making; assisting colleagues to improve themselves professionally; and contributing to a positive, tolerant, supportive, and collaborative workplace culture (Hallinger & Heck, 2010; Harris, 2002; Harris & Muijs, 2003). Also key is recognizing the importance of managing and adapting to complex, challenging change forces that characterize so many modern education systems (Hallinger & Heck, 2010).

CONCLUSION

In conclusion, educators are undertaking increasingly important formal and informal leadership roles in their classrooms and schools and are making important contributions to student learning, as well as engaging in school improvement efforts and change management processes (Hallinger & Heck, 2010; Harris & Muijs, 2003; Muijs & Harris, 2007; Murphy, 2005). The present chapter specifically focused on transformational leadership practices for educators through a detailed examination of the international literature from a global perspective, in addition to providing analyses concerning different perspectives on transformational leadership and its links to teacher leadership within the context of K-12 schools. Transformational leadership holds great promise for today's educators as they work to improve pedagogic practices, establish climates of shared beliefs and values, initiate change and innovation, and strive

towards enhancing educational outcomes. Nevertheless, there will undoubtedly be occasions when it will be neither possible nor desirable to solely utilize a transformational leadership approach. In these instances, teacher leaders should adopt a hybrid, contextualized, or contingent leadership model while working toward establishing a transformational model in their future practice.

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KEY TERMS AND DEFINITIONS

Change Theory: A comprehensive methodology, description, and illustration of how and why a desired change is expected to happen in a context. Theories of change typically define long-term goals (i.e., outcomes), then map backward to identify necessary preconditions.

Culture: A collective phenomenon defined as the set of underlying assumptions, norms, behaviors, and beliefs that are shared by members of a group.

Educational Leadership: A process of influence leading to the achievement of desired purposes. Educational leaders develop a vision for schools based on personal and professional values. They articulate this vision and influence others (e.g., stakeholders) to share the vision. The school's philosophy, structures, management, and teaching/non-teaching activities are all focused towards achieving this shared vision.

Leadership: A process whereby an individual influences others towards the realization of group or organizational goals. Leadership is a process of social influence as it cannot exist without a leader and one or more followers. Leadership is also viewed as eliciting voluntary action on the part of followers, and this voluntary nature of compliance separates leadership from other types of influence based on formal authority and/or power relationships. Lastly, leadership results in followers' behavior that is purposeful and goal-directed in an organized setting like a workplace.

Learning by Doing: An educational theory that theorizes learning should be relevant and practical, not just passive and theoretical. In this way, the acquisition of knowledge and/or skills is attained through direct experience of task completion.

Teacher Leadership: A process involving teachers' leadership of development work and knowledge-building, as well as teachers' voice. It is also characterized by formal and informal groupings and is seen as a key contribution to school improvement (e.g., the spreading of good practice and effective pedagogy, teacher initiatives) via teachers' empowerment.

Transactional Leadership: Originally defined as a hierarchical type of leadership wherein through an exchange relationship between leader and followers, followers are expected to receive rewards for their loyalty from the leader. More recent descriptions of transactional leadership roles within an organization have been expanded to include actions including attending to operations efficiency, evaluating proposals, facilitating conflicts, attending to day-to-day performance, focusing on results, problem-solving, and influencing lower-level decisions.

Transformational Leadership: The ability to affect positive change in people and in an organization is one of the core qualities of transformational leadership. A transformational leader accomplishes this through enhancing follower motivation, morale, and performance through a variety of means. These include being a visionary; connecting the followers' sense of individuality and self to a larger purpose and an organization's collective identity; being a role model for and inspiring followers; positively challenging followers to take greater accountability of their work; providing individualized support to employees and knowing their strengths and weaknesses to align them with tasks that enhance their overall effectiveness; undertaking participatory management; and promoting a work culture that strives towards meeting and surpassing goals.

Chapter 32
Administration of Mega and Open Universities With Technological Singularity Beyond Master-Human

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ABSTRACT

The aim of this study is to foresee a futuristic view of how open universities can achieve their sustainability in the context of technological singularity. Technological singularity predicts that artificial intelligence will prevent human intelligence in the future. Not only can artificial intelligence radically change human habits, but it can also alter learning practices. The foundation of a revolutionary transformation on humanity learning will be established for both the open universities and for the technological singularity beyond master-human. Thus, open universities are not only sustainable, but, at the same time, they can be transformed into ecological learning environments. The framework of the internalizations and predictions of the study participants on open and distance learning environments will help us save open universities in the future.

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INTRODUCTION

The idea that human history is approaching a singularity that ordinary humans will someday be overtaken by artificially intelligent machines or cognitively enhanced biological intelligence, or both. This idea is not science fiction anymore, it is a fact. Von Neumann uses the term singularity, though it appears he is still thinking of normal progress, not the creation of superhuman intellect. Vernor Vinge asserts that mankind will develop a superhuman intelligence before 2030. To Ray Kurzweil, Google's chief of engineering, robots will reach human intelligence by 2029 and life as we know it will end in 2045. Kurzweil defines this transformation as technological singularity that all the emerging technologies first reach the subtleties of human intelligence, then knowledge-based technologies will pass human intelligence increasingly, and sharing knowledge rapidly. Therefore, it is no longer a dream that the cybernetic community will exist in the future.

BACKGROUND

The acceleration of radical transformational technological progress must be the central feature of open universities in this century while we are on the edge of change comparable to the rise of human life on Earth. Open universities, therefore, must keep pace with these rapid changes in technology and society in order to sustain their assets. The precise cause of this change is the imminent creation by the cutting-edge technologies of entities with greater than human intelligence. There are several means by which open universities must achieve this breakthrough and integration new improvements into their systems:

FOCUS OF THE ARTICLE

The aim of this study is to foresee a futuristic view of how open universities can achieve their sustainability in the context of technological singularity. Technological singularity predicts that artificial intelligence will prevent human intelligence in the future. Not only can artificial intelligence radically change human habits, but also learning practices. The foundation of a revolutionary transformation on humanity learning will be established for both the open universities and for the technological singularity beyond master-human. Thus, open universities are not only sustainable; at the same time, be transformed into ecological learning environments. Within the framework of the internalizations and predictions of the study participants on open and distance learning environments help us how to save open universities in the future.

1) Because of the development of computers, which are "awake" and superhumanly intelligent, open universities must develop advancements in artificial intelligence (AI) as learning environments.
2) Because of dense and extensive computer networks and their associated users that "wake up" as a superhumanly intelligent entity, open universities must establish the networks that somehow become self-aware.
3) Because of computer/human interfaces, which become so intimate that users may reasonably be considered superhumanly intelligent, open universities must focus on advanced computer/human interfaces that users must essentially evolve into a new learners.

4) Because of the improvements in both biological science and social science that find ways to improve upon the natural human intellect, the advancements in open universities must allow users to engineer their intelligence.

This study is a qualitative research, and has been designed by adopting an individual and dialogical phenomenological approach model to identify phenomena through perceived by the actors in the situation. This translates into gathering deep information and perceptions through individual interviews, discussions and participant observations, and representing it from the perspective of the research participants. This study will experience from the perspective of the individual, bracketing taken-for-granted assumptions and usual ways of perceiving based in a paradigm of personal knowledge and subjectivity, and emphasise the importance of personal perspective and interpretation.

The researchers will use their own actual and imatinary experiences and others' factual and fictional written accounts and theories to develop a thematic description of the phenomenon through individual phenomenology. This will involve introspection, which is a method of inner observation which involves assuming an external viewpoint toward oneself, stating the facts about oneself as others might if they could observe what the introspector observes. Besides, through dialogical phenomenology, each researcher will interview the co-researcher, and involving the co-researcher in thematizing during the interview. Each researcher will explicitly pay attention to and refer to observations of the co-researcher's behavior as well as to the co-researcher's descriptions of experience.

In this context, a variety of methods have been used in this phenomenologically-based research, including interviews, conversations, participant observations, action research, focus meetings and analysis of personal texts. Those participants have been answering about how open universities will position themselves strategically for the future with technological singularity.

A summary of the findings presented the themes and topics. The discussion will enable the researchers to intrude more into the study by making interpretations and linkages, relating the findings to previous research and commentary, to the authors' personal experience in learning and even to common-sense opinions, and developing a tentative approach. The implications will provide an opportunity to be creative with the ideas developed through the discussion, provided it is made clear what is being done.

SOLUTIONS AND RECOMMENDATION

Technology is effective in education as well as in every other fields. For this reason, recent developments may change the structure of learning and its culture in the near future. In this context, mega and open universities should determine how to achieve technological singularity.

Singularity is about super human intelligence (Vinge, 2003). Technological singularity refers to a stage in which computers are structured to have features close to human intelligence, large computer networks are formed, computer-human interface reaches performance at human level and biology and genetic sciences carry natural human intelligence to a more advanced level. In this context, technological singularity; it can be defined as a hypothetical moment of time when artificial intelligence, human biological development, or brain-computer interface radically alter civilizations and possibly human nature and want to advance to a superhuman intelligence (Eden, Moor, Soraker and Steinhart, 2015; Shanahan, 2015). Based on this definition, universities should develop their existing strategies and restructure their missions and visions in the long term. They must also form their strategic plans to be ready for singularity.

Short, medium and long term success indicators and risk analyzes that are appropriate for these strategic plans should be established based on scientific researches. Furthermore, the following terms need to be drawn on how to integrate the system into the system and how to operate it. For example Human Genome Project has completed the first phase as a project that investigates DNA by removing human gene map and has switched to the second stage designed to improve genetics by making modifications on the structures obtained in the first phase, designed as Human Genome Project-Write (Adams, Kelley, Gocayne, Dubrick et Al, 1991; Collins, Morgan and Patrinos, 2003; Boeke et al 2016). Moreover, the Human Connectome Project is a project that characterizes brain connectivity, functions and variability in healthy adults. The project involves a systematic effort to map macroscopic human brain circuits and their relationship to their behavior in a large healthy adult population (Van Essen, Ugurbil, Auerbach et al., 2012; Van Essen, Smith, Barch et al., 2013). These projects can be considered that indicators of how the future of human and humanity.

Blockchain technology (Pilkington, 2016), a distributed data recording system that provides encrypted transaction tracking, and personal data protection (Zyskind and Nathan, 2015), is the beginning of a process in which many concepts change meaning and new concepts will enter literature. It is necessary to raise the necessary and sufficient number of manpower to make this process enjoyable and sustainable. In this context, human resources management is gaining importance in terms of technological singularity. In the context of the foregoing, the following points should be taken into account.

To be successful in our mega and open universities, they must;

- establish international high quality standardized programs to those who are interested all around the world,
- provide lifelong learning to everyone who wishes to reach from at home or abroad with our central open education system, and
- utilize the advantage and opportunities of information and communication technologies.

FUTURE RESEARCH DIRECTIONS

Although there is a huge debate about the pros and cons of technology and learning as well as intelligence, technological singularity will be a huge mark in the development of the human race. Therefore, it is crucial that Open Universities needs to position themselves strategically for the future, considering the potential of technological singularity, and focusing on its relative strengths. Open Universities will be able to provide their learners with democratized and dematerialized learning environments and services.

The aim of the future research must foresee a futuristic view of how Open Universities can achieve their sustainability in the context of technological singularity. Technological singularity predicts that artificial intelligence will prevent human intelligence in the future. Not only can artificial intelligence radically changed human habits, but also learning practices. The foundation of a revolutionary transformation on humanity learning will be established for both the open universities and for the technological singularity. Thus, Open Universities can be transformed into ecological learning environments. Within the framework of the internalizations and predictions of the study, it is discussed critically us how to save Open Universities in the future.

CONCLUSION

The future of the future is right on its way. The developments observed in all areas of life in this era are much more responsive to learning and human relations. One of the main ways of being ready for change, therefore, is by redefining the existing accepted concepts related to human and learning. In addition, all these new concepts must be created d according to the future. Within these differences, the new roles, responsibilities and roles of the institutions related to human and learning must be clearly defined. Consequently, for these institutions to be ready for technological changes is also imperative that new laws and regulations be enacted and integrated into life before these changes occur. In this study, as a result of the existing technological changes in the societies, new possible concepts related to human and learning were defined according to the future and presented to the readers.

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KEY TERMS AND DEFINITIONS

Clone Consciousness: Transferring an individual's consciousness into an artificial body. All the memory, information and experiences of the individual are transferred into a new body. Morgan (2001) states in his work where he explains the future of his expectation that the consciousness of the people can be transferred into the new bodies that will be produced for them. The team which aimed at developing the technology that would form the gene map of the people and therefore enable the diagnosis of the illnesses together with its cost and quality through the Human Genome Project, which was completed nominally in 2004, prepared the Human Genome Project-write project to continue the previous one in 2016. In this project, it is planned to perform experiments to determine the effects of the new genome sequences and the intervened genome sequences. Many researches, which focus on the similar studies conducted today on cloning from synthetic human bodies, enable making a prediction on the development of a technology through which the consciousness of the individuals will be transferred to different bodies in the future. In this sense, it can be assumed that this technology will be used for backing up the consciousness of individuals and passing their information and experiences down the future generations.

Digital Memory: Transferring the life standards, cultural background and social structures of the individuals and the societies into digital platforms. The futurist thinkers such as Bostrom, Kurzweil and Neumann express that the artificial intelligence will be fed and developed by the big data via technology and the singularity process will start in the near future. It is possible to mention that learning will be reshaped during the singularity period and the learning processes will be reduced to minimum thanks to the artificial intelligence. They are the blockchain systems that will be formed to culturally map the social memory, which will be constituted by the gathering of the transferred learnings, and to transfer this information and experiences to the willing societies. With the different methods of the artificial

intelligence, different situations will be presented to the societies according to their expectations, needs and demands. Thus, it will be possible to determine the master society memory and map, and to enrich them by passing them down the future generations.

Information Bank: The institutions to which the individuals can apply for obtaining new information and uploading the existing information on themselves, and which produce, store and distribute information. Huxley (2008) foresees periods when the information is stored, and humans are produced in Brave New World. When today's developments in artificial intelligence and robotic technologies and the big data are considered, it can be believed that this prediction will come true soon. In the future, the need for institutions where the information is stored and kept secure will be inevitable. These institutions do not present all the information to all the applicants; they decide on the amount of the information to be presented according to the results of certain tests (e.g. simulated consciousness tests etc.) and present the information to the demandants in line with their needs. These institutions are liable to protect the legal and ethical rights of all these processes and operations.

Information Transfer: The transfer process in the information banks. This operation will be designed for a transfer to be performed from human to human, from human to machine, from human to robot, from human to computer, vice versa, and one-to-one or multiply. The coordination, reliability, applicability and sustainability of these processes will be constituted by the universities and other educational institutions through the blockchain technologies. Importantly, it is an obligation for the aforementioned institutions to have the necessary manpower, technology and infrastructure through which they can configure the necessary ecological systems with blockchain technologies and to update them continuously.

Master-Human: More and Vita-More (2013), Istvan et al., who are the supporters of the transhumanism view that can be interpreted as the transition of the human to an upper form and getting an upper form, prepared and shared a declaration and conducted studies regarding the preparation process of humanism for this future. The change in humans from pre-human to post-human cannot be denied when the history of humanity is reviewed. Regarding Hayles' explanation "there are no essential differences or absolute demarcations between bodily existence and computer simulation in the posthuman age", it can be anticipated that the human of the future will have a brain supported with artificial intelligence and a body developed with technology. Then, this human won't be described with the definition of "human" today and this new human can be named as a "master-human". The human that interacts with the systems defined is now "Beyond Master-human".

Mind Bank: The service providing institutions to which individuals can apply to back up and save their own memories. These institutions are liable to protect the legal and ethical rights of this process and operation for the individuals whose minds are backed up. The universities of the future can work with the mission of becoming institutions which help the individuals to back up their minds and use their information and experiences when needed for themselves or other people as much as they allow them to. When today's technologies are considered, blockchain infrastructure and systems come into prominence with their theoretical structure appropriate for this working principle. Relatively, it can be said that "these banks will become institutions which will ensure the infinity of the individual/information".

Simulated Consciousness: The preview of what an individual will do or how he/she will think in different scenarios of the situations by transferring the individual's consciousness into a virtual platform. According to Harari (2016), consciousness is an unnecessary biological by-product of certain brain processes and mind is different from consciousness; as intelligence without consciousness proceeds at a dangerous speed, the possibility of people to stay in the game also depends on upgrading their own minds without getting tired. Harari states that it is possible to trigger a second cognitive revolution by

making changes in the genes of the human-beings and restructuring the connections in their brains. In this sense, simulated consciousness is a system that enables analyzing the people's experiences in their lives, the way they perceive the events, how they attribute meanings to things in different situations, how they make decisions under certain circumstances, who they find important and any kind of criteria they consider during the process of decision-making. With this system, it will be possible to discover over the presumptive scenario how and in what situations an individual, who demands information, will use it after obtaining it, and also to predict matters such as the improvements an individual will provide for his/her work beside how he/she will make a decision in work-related situations during the employment processes. These systems, which will enable reaching an eventual result by picturing an individual's ways of thinking in alternative scenarios, the way he/she will attain a certain result, the decision-making processes in his/her mind, his/her reactions and emotional reactions, will be able to be used in both individual acts and critical social, political and vital decisions.

Skill Bank: It is the area where the learning experiences that will be transferred will be kept and stored securely. These areas will be supported by the universities and other educational institutions. Meanwhile, the transfer operations of the learning experiences will be carried out securely and continuously in these banks. At this point, institutions need to form their own ethical codes.

Transferred Learning: Transferring the learning experiences of the individuals into other individuals. It is the transfer of the individuals' learning experiences that were acquired not in their own living processes but from the lives of other individuals through interpersonal transfer. It will help obtain the experiences of master-apprentice learning and different experts. While the individual produces possible solutions in different times and situations with these learnings transferred to him/her, he/she will be able to predict the best more quickly and the decision-making process will be completed in a shorter time. Grau et al. (2014) tried transferring communication and experience from brain to brain in their research and they had a successful outcome. It was revealed in the researches conducted by HRL Information and System Sciences (2016) that the success of the amateur pilots could be increased by transferring the brain's electrical signals comprised by the experiences of a practiced pilot to the amateur pilots. In this system, the individual can create his/her own learnings and transfer them to the following learners, and this will help the formation of a cumulative system. This process can also be named as "Experience Transfer".

Uploaded Mind: Transferring the information and experiences of the individuals to other individuals digitally. This concept can be explained as the acquisition by transferring from brain to brain, from the individuals who previously had information or experiences in matters like general information, routine tasks, regular processes coming from the past to the present etc. Unlike clone consciousness, not all the consciousness of the brain is transferred into the transferee; only the needed information or experience is transferred. A Brief History of Tomorrow, Harari (2016) stresses the importance of the information flow and shares the viewpoint "save, upload, share". This flow can be ensured with the uploaded mind.

Chapter 33
Making Sense of Data-Informed Decision Making in Educational Contexts

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ABSTRACT

Educational change is a constant reality that is faced by school leaders today. These leaders are held more accountable than ever before for decisions being made. This chapter discusses the strengths in the continuous school improvement approach that develops both leadership and organisational capabilities such as collaboration, communication, and organisational trust within schools and school systems as they continue to deal with the ongoing onslaught of change and complexity present today. In these complex, ever-changing school contexts, leaders have to make multiple decisions on a daily basis. This chapter focuses on making sense of 'how' and 'why' data-informed decision-making continues its rising ascent and significance in educational leadership contexts within schools today. Through the accurate use of educational data within schools, a number of these decisions, can through collaborative decision-making processes assist school leaders and teachers in delivering better educational opportunities and outcomes for students.

INTRODUCTION

Since the beginning of formal schooling, there has been a presence of a variety of school data-sets collected to inform teachers, school leaders and school systems on student learning improvements. Today, internationally data-informed decision-making holds centre-stage in the discourse around school improvement (Schildkamp, Poortman, Ebbeler & Pieters, 2019). When discussing school improvement, research indicates that school data is an important factor that is used (Bryk, Gomez, Grunow & LeMahieu, 2015; Robinson, 2017) to make educational decisions. One of the main reasons for this growing dependence on data has been the ever-changing educational contexts that most schools operate within. The complexity

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found within schools is higher and requires adaptive leadership strategies to deal with the frequency of change that occurs within them.

However, for many school leaders and teachers the task of making sense of various school data sets and pieces of evidence being used is quite daunting. Some have considered the use of data-informed decision-making as both neo-liberal and an accountability-based process (Ball, 2003; 2015; Grek, 2009; Hardy & Lewis, 2017; Holloway & Brass, 2018; Lambert, Wright, Currie & Pascoe, 2015; Lingard, Martino & Rezai-Rashti, 2013; Ranson, 2003). Ball (2015) discusses his notion of neoliberalism and its influence on the common person suggesting that, "As neoliberal subjects we are constantly incited to invest in ourselves, work on ourselves and improve ourselves – drive up our numbers, our performance, our outputs – both in our personal lives and our work lives" (p.299). This notion suggests that continuous school improvement and accountability processes through data-informed decision-making gets perceived as top-down and bureaucratic (Lingard, Martino, & Rezai-Rashti, 2013; Ozga, 2009) where the rhetoric of being governed by numbers within schools (Ozga, 2008) has become a strong discourse.

Rosano, Gates, Zaretsky, Santoro, Kurilko and Brigg (Rosano et.al, 2016) suggest that, all ten recognised types of school accountability are a major factor in school improvement where school accountability is a significant element which leads to 'positive change' within schools (p.139). According to Rosano et.al (2016, p. 139), these accountabilities include: political, legal, bureaucratic, professional, market accountabilities, parent, student, fiscal, personal accountabilities and, lastly, public accountability. Hoy and Miskel (2013) suggest that, "Accountability in education is the acknowledgment of the school's responsibility for a thorough and efficient education for their students" (p. 474). In other words, accountability provides the scaffolding for improvement to thrive and exists in order for schools to continue to remain focused on their own school improvement journey, amidst a number of potent environmental forces that can potentially influence them and at times move them off-course .

This chapter discusses the strength of a data-informed decision-making approach that is being taken within continuous school improvement approaches in place today where the focus is on developing both horizontal and vertical levels of leadership as well as organisational capabilities such as collaboration, communication and organisational trust (Fernandes, 2019b). This is a common trend within schools and school systems across developed nations such as UK, USA, Netherlands, Australia and Canada as they continue to deal with the ongoing onslaught of change and complexity present in schools today. In these complex, ever-changing school contexts, leaders have to make multiple decisions on a daily basis. (Jenlink, 2015). Through the accurate use of educational data within schools, a number of these decisions through collaborative decision-making processes assist school leaders and teachers in delivering better educational opportunities and outcomes for students.

What is school data? Lai and Schildkamp (2013) suggest that school data is information collected and organised to represent certain aspects of schools being studied. School data can be quantitative and qualitative data-sets; ideographic and nomothetic data-sets; normative and descriptive data-sets; and subjective and objective data-sets collected within and for schools. School data includes relevant information about school stakeholders such as students, staff, parents, community, partner schools and networks connected directly to the school. These data-sets are grouped into four broad categories: demographic data, student learning data, perception data and school processes data (Bernhardt, 2003); and, is used to build stronger and deeper continuous school improvement connections across the school.

This chapter unpacks the importance of collaborative data-informed decision-making occurring within school contexts today. It discusses how these data-informed decision-making processes have assisted schools in using their knowledge, strategies, relationships and processes to provide educational

opportunities for all students. It unpacks how reflective-progressive processes of continuous school improvement (Fernandes, 2016; 2019c) enable networked governance systems within schools by having teachers to reflect upon current educational practices and through communities of practice to improve what is educationally delivered to students. The actively engaged role of evidence in data-informed decision-making processes in order to increase whole school improvement and decrease change has also been discussed (Robinson, 2017, Earl & Katz, 2006).

BACKGROUND

In 1969, Samuel Eilon (Eilon, 1969), asked the question: What is a decision? And decided that it was not a choice, conclusion or resolution reached after consideration but a route where, "the decision process is described as a series of steps, starting with information output and analysis and culminating in a resolution from a selection of several available alternatives" (p.B-172). However, as Eilon (1969) unpacked this quintessential question further, he drew to a conclusion that while decision-making is a process, there are no steps in that process that could be considered more crucial than the others but that it was 'the degree of personalistic control' retained by the decision-maker that affected the overall decision being made (p.B-189). He suggested that,

…when the decision process as a whole becomes more and more impersonalistic, it simply follows the rules, and the rules are sufficiently detailed to cater for an ever increasing number of contingencies to obliterate the effect of the individual decision-maker (p. B-189).

It is quite clear that in all decision-making processes, the role of the leader(s) or the decision-maker(s) is critical and in effect the power and authority that they possess influences the decision(s) being made both positively or negatively (Fast, et.al, 2012; Maner & Mead, 2010) alluding to some decisions being perceived as good decisions and others as bad decisions.

Daft (Daft, 2010) discusses how organisational decision-making can be defined as the process of identifying and solving organisational problems. Within this process there are two major stages. Firstly, during the problem identification stage, the decision-maker(s) monitor information about environmental and organisational conditions so that they can determine if performance is satisfactory and diagnose any cause(s) of shortcomings. Secondly, in the problem solution stage the decision-maker(s) consider alternative courses of action with one alternative selected and implemented. According to Daft (2010) decisions can be categorised as programmed or non-programmed decisions. Programmed decisions are similar to technical problems where they are repetitive and well-defined, and clear procedures and skill-sets exist within the organisation for problem resolution. These decisions are well-structured because the existent criteria of performance is clear, accessible information about current performance available, and where any viable alternatives are easily specified. There is also relative certainty that the chosen alternative will be successful. Non-programmed decisions are like adaptive problems where the decisions are novel and maybe poorly defined, and where no procedure exists for solving the problem. In these cases, within an organisation there is an absence of knowledge, clear procedures and skill-sets on how to respond to the problem as no decision criteria exists and those alternatives that are present may not be viable. Likewise, a high level of uncertainty about whether a proposed solution may solve the problem exists. In many non-programmed decisions strategic planning is implemented and adaptive

leadership exercised, because uncertainty is high and the decisions are complex and considered to be wicked decisions for wicked problems.

Within an ever-changing context of change and complexity found across society today, most school leaders are being called upon to develop skills and strategies to address educational issues as wicked problems (Brown, Harris & Russell, 2010). In such situations a growing reliance on data-use that includes both quantitative as well as qualitative data sets; and big data (Mayer-Schönberger & Cukier, 2013) as well as small data, has been found. This trend allows educational leaders to be able to grapple with the complexities of the current issues and develop possible alternatives for them to select from as they lead their organisation through a particular change process.

Non-Rational Decision-Making in Schools

It has been noted that in many instances organisational decisions within educational institutions are not made via logical, rational processes that follow a careful review of the problem, a systematic analysis of alternatives, and the implementation of a best solution. Instead in a number of circumstances, these decision-making processes are characterised by trial and error, speed, conflict, mistakes and coalition-building. In such circumstances, leaders find themselves working under multiple restraints that ultimately limit the rationality of their decisions and where they usually make use of satisficing and intuition along with some form of non-rational analysis within their decision-making.

Earlier on Simon (Simon, 1947) suggested that leaders are found opting for reasonable solutions rather than rational ones. Later Simon (1957) introduced the concept of decisions being based on bounded rationality where decision-makers are called upon to work under three unavoidable constraints: (1) limited, often unreliable, information available regarding possible alternatives and their consequences, (2) the finiteness of the human mind and its limited capacity to evaluate and process the information that is available, and (3) the reality of the length of time available to make a decision. These three factors, constrain leaders who intend to use more rational decision-making strategies to make do with satisficing selections in complex decision-making situations. Hoy and Miskel (Hoy & Miskel, 2001) suggest that,

An individual's decision is rational if it is consistent with the values, alternatives, and information that were analysed in reaching it. An organisation's decision is rational if it is consistent with its goals, objectives, and information. Therefore, the organisation must be constructed so that a decision that is rational for the individual remains rational for the organisation when reassessed from the organisational perspective (p. 319).

In other words, organisational decision-making is conducted in educational settings where appropriate processes are in place to help decision-makers make decisions informed within the limitations of bounded rationality or satisficing. These decision-makers require various types of information and data to be equipped sufficiently in analysing the alternatives available to them. The more diverse the sources of data and evidence available to them, the better they can contend with notions of reliability or unreliability of the data-sets and evidence presented, and deal appropriately with issues such as shortage of time available to make decisions.

Cohen, March and Olsen (Cohen, March & Olsen, 1972) suggest that organised anarchies found in public, educational and illegitimate organisations or for that matter any organisation at some time or the other are characterised by non-rational, non-random decision-making based upon problematic

preferences, unclear technology and fluid participation. They were the first to introduce the non-rational decision-making model commonly known as 'the garbage can model of decision-making'. In this model, they suggest that within certain decision-making contexts that involve organised anarchy there are four independent streams: the garbage can itself which is the decision situation or choice-opportunity that is afforded when the other three streams of problems, solutions and decision makers are thrown into the mix. Each mix of the garbage can depends on the kind of garbage i.e. problems, solutions and decision makers found in this mix, the speed at which these decisions need to be made and solutions found. In fact, in many instances, these messy, chaotic mixes might also result in no decisions being made as the choice-opportunity may lose its currency or decision makers may move onto other choice-opportunities that become available as new garbage cans. According to Fisher and Fisher (Fisher & Fisher, 2014), a key feature of the garbage can model is that it allows for elements of uncertainty in decision-making such as random and stochastic events or actions and elements that lack any rational basis to exist within the decision-making process. Fisher and Fisher (2014) suggest that this happens because the whole diagnostic process and in fact the diagnosis of the situation itself consists of multiple human interactions that may or may not have rational elements directly associated to them. Therefore according to Fisher and Fisher (2014), "The process creates an evolutionary trajectory which becomes modified by the addition of informational items that may reflect uncertainties, opinions, cultural patterning, and themselves be subject to a cluster of constraints which are legal, situational, political, social and psychological" (p.1539). As such, these decision-making scenarios are often found in educational institutions when the rate of institutional change and complexity increases due to external or internal influences, changing policies and processes, and internal complexities and power plays that effect schools today.

At times, decision-making processes found in educational institutions such as schools, use naturalistic decision-making as educational leaders make decisions and perform cognitively complex functions in demanding, real-world situations. In most of these situations limited time, uncertainty, high stakes, team and organisational constraints, unstable conditions, and varying amounts of experience are usually found as contributors. As described in the 'recognition primed decision-making (RPD) model' by Klein (Klein, 2008), when using a naturalistic decision-making process, people make relatively fast decisions without having to compare options. In such instances, it was found that under time pressure, high stakes, and changing parameters, decision makers used their experience to identify similar situations and intuitively choose feasible solutions. Within instances where RPD was found, it was seen that there was a blend of intuition and analysis (Klein, 2003) used by the decision makers. Through their intuition, decision makers followed a pattern-matching process that allowed them to quickly suggest feasible courses of action. In addition to this, through their analytical process, they develop mental simulation that allow them to go through a conscious and deliberate review of the courses of action that are available to them. In the field of education, a Belgian study (Vanlommel, Van Gasse, Vanhoof and Van Petegem, 2017) found that the most common mode for decision-making in schools by teachers is naturalistic based on intuition and analysis instead of a rational data-informed process. Research findings (Vanlommel, Van Gasse, Vanhoof and Van Petegem, 2018) however have indicated that the disadvantage of intuitive data collection is that it could lead to issues of confirmation bias where teachers focus their attention on what they expect to see and consequently might miss important data sets that could questions the assumptions of their decision-making. An Australian research study (Ehrich, Kimber, Millwater & Cranston, 2011) has indicated that when educational leaders and teachers are presented with certain types of dilemmas that are ethically oriented, they tend to use naturalistic decision-making models that are oriented around their own personal and professional value systems, the experiences of self and trusted others and inter-

nal as well as external support structures such as appropriate preparation and support for teachers and educational leaders on ethical decision-making.

In discussing their multi-paradigmatic approach of ethical leadership and decision-making, Shapiro and Stefkovich (Shapiro & Stefkovich, 2016) outline four paradigms: ethic of justice, ethic of critique, ethic of care and ethic of profession which when used provide educational leaders with multiple ways of thinking through emotional and rational approaches before decisions are made. This approach acknowledges the role of intuition as well as rational decision-making approaches used in educational decision-making processes within schools. For e.g. aspects of discipline, curriculum and student learning needs might be more rationally situated whereas respectful relationships towards others or self-regulation are more emotionally-situated. In other words, there is a logical-emotional ethical dimension to educational decision-making that makes it complex but nonetheless, needs to be recognised especially in the increasingly complex and diverse society we live in today where school leaders are required, 'to be able to develop, foster, and lead tolerant and democratic schools'(Shapiro & Stefkovich, 2016, p.23).

Shared Decision-Making in Schools

In order to improve the odds against the limitations of the human mind, the use of shared decision-making approaches help decision-makers work in groups within educational organisations such as schools to improve the quality of the decisions being made. But even in this space, there are issues worth considering. Such as, under what conditions should members of an organisation be involved in decision-making other than the decision-makers? Also to what extent and how should they be involved?

Amongst various models of shared decision-making that are available the Vroom and Yetton (Vroom & Yetton, 1973) and later the Vroom and Jago (Vroom & Jago, 1988) models have been found to be useful and continue to hold currency within modern educational organisations today. In fact, the Vroom and Jago (1988) model allows for a matching of the participation of others in the decision-making process with the nature of what the problem is and the situational context within which the problem is located. Likewise, situating collaborative or participative group decision-making within educational organisations, Hoy and Tarter's shared decision-making model (Hoy & Tarter, 1993) provide a number of key considerations with implications for educational organisations.

Hoy and Tarter's (1993) model helps to determine the extent to which a decision-maker or school leader should involve others in the decision-making process. The first step in this process is to reflect on how each of the group or team members are referenced in a four-quadrant matrix. Where on one side of the matrix is the question, 'Does this decision matter to the individual in a significant way?' And, on the other side of the matrix is the question, 'Does the team member have particular expertise that is going to help make a good decision?' Hoy and Tarter's (1993) model suggests that if the team member receives a yes response for both questions, they should almost certainly be included in the decision-making process. Similarly, anyone without expertise or a personal stake should be excluded. Furthermore, when someone has either expertise or a personal stake, but not both, then the decision is more nuanced and depends on whether expertise is required or someone with more commitment to that decision-making process. In other words, participative decision-making is not appropriate in every school situation and can even become counterproductive if over-utilised within schools. This would indicate the need for due consideration to be undertaken before selection of decision-making teams are made. The role of teachers and other staff members in school decision-making processes will only work if the decisions being made, directly relate to the work being done by them and is central to their position (Rock, 2017).

For either of the participative decision-making models, caution must be taken against the possibilities of *groupthink syndrome* occurring (Janis, 1985) especially in highly cohesive groups or in-groups within schools or other educational organisations. According to Hoy and Miskel (Hoy & Miskel, 2013),

…when smart people think in unison, poor decisions are likely to follow. Groupthink remains a contemporary problem that has been around a long time… It is easy for cohesive groups under pressure to choose unanimity over their motivation to assess realistic alternative courses of action (p.382).

In short, for educational decisions to have a certain level of rationality, the importance of decisions being accurately informed and collaboratively reached at becomes critically important where a focus on the ethical dimension of decision-making must be duly undertaken. The question by many research studies (Begley, 1999; 2000; 2001; Lehrer, 2009) on whether educational decision-making is rationally-based or emotionally-based remains a solid one?

Focus of the Chapter

Educational change is a constant reality that is faced by school leaders today. School leaders are held more accountable than ever before for decisions being made, and even in the face of having collaborative processes in place to make their decisions; can at times be found to have not made the right decisions; due to the limitation of relevant information being available to them; the shortage of time and at times the fact that only limited skill-sets are available to study and analyse the implications of small and big school data-sets available.

In unpacking the role of data-informed decision-making within schools, it is imperative to identify the basis for the need to equip school leaders with the right skill-sets and to develop proactive collaborative spaces with allocated times for those making educational decisions in schools, to be able to identify the alternatives available and develop sound decisions based on intuition as well as careful analysis.

Establishing Data Cultures Focused on Student Learning

Smeed, Ehrich, Kimber and Perry (Smeed, Ehrich, Kimber & Perry, 2011) present eight key findings through which school leaders are able to focus on improving student learning by establishing data cultures within their schools:

1. Leaders need to have a good knowledge of data-informed accountability.
2. Leaders need to provide learning opportunities for teachers to understand and interpret data (Datnow & Hubbard, 2015; 2016).
3. Leaders need to create an ethos of continuous improvement (Fernandes, 2016, 2019c).
4. School leaders need to create a climate of sharing and knowledge- brokering.
5. Leaders need to harness newly graduate teachers' expertise in developing strong data-capable management and instructional systems across the school.
6. Leaders need to build capacity through modelling and setting high expectations by making themselves or their fellow-peers both data-literate and data-numerate (Mandinach, Parton & Gummer, 2015).
7. Leaders need to encourage staff ownership and commitment to mutual accountability.

8. Leaders need to set an example of moral integrity.

These eight findings are comprehensively focused on school improvement. Smeed et.al (2011) theorise that improved student learning needs to be understood more deeply than improvement via test scores (Schildkamp, et.al, 2019), since learning is a complex activity and all learning is not measurable. In fact, within the diverse contexts that schools operate in today, school leaders are expected to provide rich and valuable learning opportunities for all students regardless of their socio-economic backgrounds, gender or ethnicity (Datnow & Park, 2018). Schildkamp et.al (2019) have described what they consider to be a new understanding of data use in schools and state that,

we are seeing a new wave of data use arising, which we would like to call data-informed decision-making, in which data can never completely drive decisions. Instead data can inform decisions, which, combined with the professional knowledge of educators, can contribute to achievement and learning in schools (p. 2).

As suggested, it is clear that having data-informed decision-making systems, allows schools to widen their continuous school improvement span where school leaders as well as teachers work together collaboratively using a multitude of different data sources to improve the educational outcomes of students.

Establishing Data Cultures Focused on Collective Efficacy

Hargreaves, Morton, Braun and Gurn (Hargreaves, Morton, Braun & Gurn, 2015, p.18) unpack the concept of strong data cultures and suggest three main factors that facilitate the development and maintenance of these cultures, where alongside school leaders, teacher judgments are used to support and enhance the decision-making processes. These factors include:

1. Strong professional cultures of collective responsibility similar to professional learning communities or communities of practice, which are not hierarchical in nature or conduct and are inclusive of classroom teachers, special education teachers, specialists, and other school professionals;
2. An assignment of priority to just-in-time valid and accurate data (Schildkamp & Kuipers, 2010; Wohlstetter et.al, 2008) used by the teachers to directly help the students from whom the data were collected (Lai, et.al, 2014) and
3. A collection of multiple qualitative and quantitative measures or indicators of student achievement (Schildkamp, et.al, 2019) for all students across the spectrum, combined with other sources of professional judgment and decision-making.

Hansen, Gentry and Dalley (Hansen, Gentry & Dalley, 2003) outline various mindful elements found within schools that use data-informed approaches for school improvement. These include: shared leadership and responsibility; a mission that identifies its goal and purpose as a learning community; a cadre of leaders, learners, inquirers, and worriers; the identifying of critical issues, essential questions, and focus problems i.e. a problem identification stage; a planning strategy to collect data and information i.e. a problem solving stage (Poortman & Schildkamp, 2016) ; a process for implementation i.e. the development of action plans; allocation of physical and human resources as well as sufficient time to deeply engage in and complete the analytical task; feedback and recycling of the data-informed decision-

making experience; reporting and sharing data analysis results with others on staff and, repeating and continuing the process of data collection, use and change in future continuous school improvement cycles.

It is quite clear that participative decision-making processes go hand in hand with data-informed decision-making. Similarly, the use of various types of school data-sets provide a strong and empirical basis for student learning to be focused at 'the point of need' for every school student. What matters most in a data-informed school context is that the actual and perceived quality as well as the quantity of the data-sets being used for decision-making must have clear connections with the core purpose and goals of education of the school. School leaders developing professional cultures within and outside their schools, must ascertain whether these spaces are supportive of collaborative data-informed decision-making processes. They must ensure that these processes serve the purpose of building effective communication and strong organisational trust through the provision of collaborative and proactive spaces (Fernandes, 2019b). Within these collaborative and proactive spaces, school leaders work at developing collective responsibility so that the purpose of the school data-sets being used is focused on improving relationships throughout the school through the various school stakeholders involved (Hargreaves, et.al, 2015).

SOLUTIONS AND RECOMMENDATIONS

Strategically-Oriented Learning Organisations that Continuously Improve Educational Outcomes

Senge (Senge, 1990) defined learning organisations as organisations where people continually expand their capacity to create the results that they truly desire; and where new and expansive patterns of thinking are nurtured; He also suggested that these were institutions where collective aspiration was allowed to be set free; and, where people engaged in continually learning how they could learn better together. According to Senge (1990),

the organisations that will truly excel in the future will be the organisations that discovers how to tap people's commitment and capacity to learn at all levels in an organisation. Learning organisations are possible because, deep down, we are all learners (p.3).

Scholars, educators and policymakers have mostly considered schools to be active learning organisations. Kools and Stoll (Kools & Stoll, 2016) have identified seven identifying characteristics of schools as learning organisations:

1. Developing and sharing a vision centred on the learning of all students;
2. Creating and supporting continuous learning opportunities for all staff;
3. Promoting team learning and collaboration among staff;
4. Establishing a culture of inquiry, innovation and exploration;
5. Establishing embedded systems for collecting and exchanging knowledge and learning;
6. Learning with and from the external environment and larger learning system; and,
7. Modelling and growing learning leadership.

These dimensions provide school leaders with practical guidance on how schools can transform themselves into learning organisations and ultimately enhance their educational outcomes. The whole concept of situating schools as learning organisations helps establish a clear path for improving both data literacy and numeracy within schools (Mandinach & Gummer, 2013; Smeed et.al, 2011) which resonates with the elements that Hansen, Gentry and Dalley (2003) suggest as a data-informed decision-making approach for continuous school improvement.

Research indicates that by equipping schools with a better knowledge-base; and with understanding and skills of what data-informed decision-making is, schools make informed and better use of their data leading to deeper and sustained school improvement (Balaco, 2010; Renshaw et al, 2013; Smeed et al, 2011). Research also indicates that schools who follow a reflective-progressive approach to continuous school improvement are better positioned to address emerging issues around change and to make subsequent improvements (Ah-teck & Starr, 2014) as strategically-oriented learning organisations (Fernandes, 2016; 2019c).

Maintaining a Proactive Approach Towards Continuous School Improvement Over School Accountability

There is an on-going politicised debate on whether continuous school improvement drives school accountability or school accountability drives continuous school improvement. It provides many interesting findings that offers educators, school leaders and policy makers with qualifying recommendations on how school reform should be understood today.

A number of international research studies have found the ascent of data-informed decision-making as neoliberal accountability measures where teachers and school leaders are put under enormous performativity pressures (Ball, 2003; 2015; Grek, 2009; Hardy & Lewis, 2017; Holloway & Brass, 2018; Lambert, Wright, Currie & Pascoe, 2015; Lingard, Martino & Rezai-Rashti, 2013; Ranson, 2003). Likewise, there is a substantial international body of literature (Datnow & Park, 2018; Datnow & Hubbard, 2015; 2016; Earl & Katz, 2006; Fernandes, 2019b; Lai et.al 2014; Lai & Schildkamp, 2013; Mandinach & Gummer, 2013; Poortman & Schildkamp, 2016; Schildkamp & Kuiper, 2010; Thoonen, Sleegers, Oort, Peetsma & Geijsel, 2011; Van der Scheer & Visscher, 2016; Van Gasse, Vanlommel, Vanhoof & Van Petegem, 2016; Van Geel, Keuning, Visscher & Fox, 2016; Vanhoof, Verhaeghe, Van Petegem, & Valcke, 2012; Vanlommel, Vanhoof & Van Petegem, 2016; Wayman, Cho & Spikes, 2012) that gives evidence on how data-informed decision-making assists school leaders and teachers in improving the educational outcomes of their schools.

Unfortunately, when the wrong drivers for data culture are used, data-informed decision-making can cause performativity problems for teachers, school leaders, schools and school systems. Schildkamp et.al (2019) have found that school leaders can both enable or hinder data use in data teams. Schildkamp et.al (2019) have explored the types of leadership behaviours that support data use in data teams. Their results highlighted five building blocks that school leaders use to build effective data teams in their schools:

1. establishing vision, norms, and goals;
2. providing individualised support to staff;
3. Promoting intellectual stimulation such as sharing knowledge and providing autonomy;
4. Creating a safe climate for data use focused on improvement over accountability; and,

5. Networking to connect different parts of the school organisation by creating an internal data use network within the school.

Schildkamp et.al (2019) suggest that these five building blocks develop both transformational (Fernandes, 2019a) and participative leadership within schools (Fernandes, 2016; 2019c) and provide new understandings on how data-informed decision-making can improve schools in meaningful ways that are rich and nuanced versions of continuous school improvement.

FUTURE RESEARCH DIRECTIONS

Making Use of Assessment for Learning, Assessment of Learning and Assessment as Learning

Assessments are essential components of the instructional processes within any school that generate student data which is then used to improve their overall educational outcomes. Assessments are ongoing processes of gathering, analysing and interpreting evidence; reflecting on findings; and, making informed and consistent judgements to improve student learning. As new ways of thinking around data-informed decision-making are being discovered (Jimerson, 2014; Jimerson & McGhee, 2013), the understandings on assessments have also expanded and deepened. Currently there are three approaches that enable system leaders, school leaders and teachers to gather evidence and make judgements about student achievement: (1) Assessment for learning – this occurs when teachers use inferences about student progress to inform their teaching (formative assessments) (Stiggins, 2002; 2005a; 2005b); (2) Assessment as learning – this occurs when students reflect on and monitor their progress to inform their future learning goals (formative assessments) (Jimerson, Cho, Scroggins, Balial & Robinson, 2018; Jimmerson & Reames, 2015); and, (3) Assessment of learning – this occurs when teachers use evidence of student learning to make judgements on student achievement against goals and standards. These are also known as summative assessments (Masters, 2015) and may include different forms of high-stakes testing.

It would seem that whatever the purpose of assessments, use of data-informed decision-making assists educators, policymakers, school leaders and front line teachers (Wayman & Jimerson, 2014; Wayman, Cho & Jimerson, 2012; Wayman, Jimerson & Cho, 2012) in establishing and understanding the milestones that individual students or cohorts have reached in their learning at particular moments in time. Data-informed decision-making through the use of these assessments and other pieces of data and evidence assists these stakeholders in identifying different ways that they can use this information by activating 'cultures of collective responsibility' to improve educational outcomes (Hargreaves, et.al, 2015. p.19). More research in the use of this three-pronged approach to assessment as a part of the data-informed decision-making portfolio would be beneficial for educational systems to better under how this culture of collective responsibility can be put into richly nuanced continuous school improvement processes within schools across diverse contexts.

Developing an Evidence-Based Systemic Approach for School Improvement

Current debates around data-informed decision-making have in effect pushed evidence-based decision-making to the forefront of both educational practice and policy. In this current context, research evidence that involves a data-informed approach becomes an applicable basis for all kinds of educational decision-making conducted within schools (Earl & Katz, 2006). As Asen and Gurke, (Asen & Gurke, 2014) suggest, there are multiple benefits for developing an evidence-based approach to decision-making in school contexts. Firstly, research provides a common reference point for school improvement that avoids or reduces the influence of political controversy. Secondly, sound and valid research provides practitioners with valuable resources and guidelines on possible ways forward where they reduce change and increase improvement (Robinson, 2017). Thirdly, research and evidence help educators, policymakers, school leaders, teachers, parents and students assess the performance of their school, their cohort or themselves within their communities. This information helps school and system-level practitioners build strong communities of practice or professional learning communities where this research and evidence can be used to make better system-level decisions. For policymakers, having research and evidence along with multiple data-sets on education ensures that the policy and practice nexus is a dynamic interface where the student achievement gap decreases through authentic and adaptive school improvement measures. Parents alongwith students as valuable and worthy partners in education, are involved through school-community engagement in utilising evidence-based knowledge and information that encourages students in their learning.

Asen et.al (Asen et.al, 2013) identify the use of six types of evidence in their school reform study: research, experience, testimony, data, example and law/policy. Asen et.al (2013) define *research* as empirical findings that are derived from systematic analysis of information, and guided by purposeful research questions and method. *Experience* refers to empirical findings derived from direct observations of events or activities. *Testimony* is considered to be the perspective of individuals or groups represented through quotations. Asen et.al (2013) define *data* as measurable quantitative or qualitative school information systematically collected to describe a set of conditions or trends. *Examples* refers to specific cases or incidents used to illustrate typical or exceptional characteristics of the issue being discussed. And finally, they define law/policy as rules and regulations that permit or prohibit particular actions, behaviours, or programs. This definition of research evidence provides schools flexibility to include practitioner-generated as well as system-generated research but is stringent enough to distinguish amongst evidence types and to discount any unsupported claims.

Research into the kinds of professional development needed by school stakeholders to effectively use research and evidence within data-informed decision-making process is worth further investigation. This capacity-building of school and system leaders and followers allows for the next wave of school improvement to have a strong basis for advocating school improvement directions that align well with the exponentially increasing complex realities found in schools today.

CONCLUSION

This chapter focused on making sense of ‘how’ and ‘why’ data-informed decision-making continues its rising ascent and significance in educational leadership contexts within schools. From understanding how decisions are made, to the very nature of decision-making, multiple theoretical discussions

have been provided on the nature of data-informed school cultures, and the elements that make up such cultures and sustain everyone involved. Literature that indicates some of the contestations in this space have also been highlighted to draw the focus of the reader to possible pitfalls, if school improvement measures based on data-informed decision-making have not maintained collaboration, communication and organisational trust as critical elements of the school organisation. Finally, the case is made for more research into the need for a three-pronged approach making proactive use of assessment: – for learning, – of learning and – as learning within cultures of collective responsibility., This urgency for action is made so that both research and evidence are used in ascertaining the right nuanced paths of continuous school improvement for complex schools of today.

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KEY TERMS AND DEFINITIONS

Continuous School Improvement: The process cycle of school improvement with the major components of: creating the vision, gathering data related to that vision, analysing the data, planning the work of the school to align with the vision, implementing the strategies and action steps outlined in the plan, and gathering data to measure the impact of the intervention.

Data Culture: To use data effectively in schools, an intentional creation of the right culture; emphasising safety and collaboration; requiring growth mindsets and relational trust.

Data-Informed Decision-Making: When data informs decisions, which, combined with the professional knowledge of educators, contributes directly to school achievement and learning.

Evidence-Based Decision-Making: A process for making decisions about a program, practice, or policy grounded in the best available research evidence and informed by experiential evidence from the field and relevant contextual evidence.

School Accountability: the process of evaluating school performance on the basis of student performance measures.

School Data: Information that is collected and organised to represent certain aspects of the school being studied.

School Leaders: Anyone within a school who has the power to influence educational reform and change.

Chapter 34
Faculty Organizational Service:
Problems and Solutions

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ABSTRACT

The purpose of this chapter is to list and review some of the problems facing university faculty as they engage in their organizational service activities. University faculty members typically engage in three types of activities: (1) teaching and instruction, (2) research and scholarly compositions, and (3) service and organizational functioning. This chapter focuses on the third type of activities for university faculty members, namely, service and organizational functioning. For the purpose of simplicity, the expression "organizational service" will be used to replace the longer expression "service and organizational functioning." This chapter will provide a list and a review of problems in organizational service for university faculty members. In addition to a listing of problems, the chapter will present possible solutions for the problems.

INTRODUCTION

The purposes of the article are to describe features of organizational service for regular faculty members at a research university, to review problems associated with such organizational service, and to offer candidate solutions for such problems. This critical analysis of faculty organizational service is not intended to disparage faculty organizational service for faculty but rather it is intended to improve it. The informational basis for this critical analysis is not merely a selection of the research literature on faculty organizational service but also the decades of experience of the author at research universities.

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BACKGROUND

University faculty are typically expected to engage in three categories of activities: (1) research and scholarly inquiry; (2) teaching and advising; and (3) service and organizational functioning. At a research university, the first two categories are the most important and most valued for regular faculty members (i.e., faculty members who do not have administrative positions such as that of college dean or department chair). The third category is the least valued for regular faculty members but it is still important.

A typical breakdown of academic time for a regular faculty member at a research university is the following: (a) research and scholarly inquiry – 40% of academic time; (b) teaching and advising – 40% of academic time; and (c) service and organizational functioning – 20% of academic time. Based on a typical 40-hour work week, that typical breakdown of academic time indicates that a regular faculty member should typically spend 8 hours of academic time weekly on service and organizational functioning activities.

The focus of this article is the third category of faculty activities—namely, service and organizational functioning. That category of activities may include service to the discipline of the faculty member (e.g., editor of an academic journal, organizer of academic conferences), service to the community (e.g., consultant to city agency, volunteer to a clinic), and service to the university, college, or department (e.g., member on a university task force, member on a college committee, chair of a departmental committee). The total of all of these service activities for a regular faculty member at a research university should typically amount to eight hours of academic time weekly. For the purpose of simplicity, the expression "service and organizational functioning" will be simply termed "organizational service".

The role of faculty service in faculty academic life has been featured in much scholarship on higher education. For example, Lynton (1994) has argued that faculty service should include service to the community and that each university and every constituent academic unit should clearly indicate how such service is basic to its mission. Holland (1997) reviewed various forms of faculty service including faculty organizational service and provided a model that interrelated organizational factors and forms of faculty service to expressions of institutional service to the community. Such institutional service to the community is of great concern to higher education administrators.

Ernest Boyer (1990, 1996) has written eloquently on the topic of faculty scholarship and service. He has argued that faculty service should not be limited to service to the university or to the discipline of the faculty member, but should also include service to the community in particular or society in general. Ward (2003) continued in that line of reasoning by articulating the role and importance of faculty engagement with the community. Although Boyer's expanded view of faculty service is generally accepted, this paper focuses on faculty organizational service for the university and its units, because that type of faculty service has garnered the most recent discussion (e.g. Meyer, 2018; VanDette, 2015).

The Topic of Faculty Service

To better understand faculty organizational service, a description of the social context for faculty organizational service is warranted. That social context is basically the university. Any university is neither a democracy nor a republic, but rather it is an oligarchy run by an administration answerable only to a board of regents composed of citizens in the community. The administration of any university makes decisions and judgments that are to be accepted by regular faculty members and that can only be overridden by the university board of regents. In any university that does not have a faulty union to protect

the interests of regular faculty members, regular faculty members tend to have little if any influence on a university. Regular faculty members either acquiesce to the operations, procedures, and policies of their universities or leave for some other institutions or work settings.

At a research university, regular faculty members tend to be evaluated on an annual basis with salary increases based primarily on scholarly productivity in terms of books and articles published and grants awarded. Yearly salary increases for regular faculty members tend to be merit-based with an emphasis on research and scholarly productivity. Faculty organizational service is not given substantial weight in any discussion of salary increases for regular faculty members. However, regular faculty members, who become members of the university administration, tend to receive substantial salary increases as members of any university administration receive, on the average, significantly higher salaries than comparable regular faculty members.

With that as background, academic time and its apportionment across the three categories of academic activities becomes an important concern for any regular faculty member. If a regular faculty member at a research university engages mostly in teaching and organizational service and not in research and scholarly production, that faculty member will likely not receive praiseworthy salary increases, not be granted tenure, and not be retained. Any regular faculty member at a research university learns soon that most academic time must be invested in research and scholarly production along with teaching and advising. Organizational service is last in importance for regular faculty members but most in importance for faculty members who are part of the university administration. As a result, regular faculty members need to be careful in their use of their academic time with the recognition that a portion of their academic time needs to be devoted to organizational service. Unfortunately, problems can arise as regular faculty members engage in organizational service.

VanDette (2015) described the case of non-regular faculty members who were permitted to vote on departmental decisions. Voting on a possible faculty hire is a form of faculty organizational service. That opportunity led to the stoppage of a new departmental faculty hire. VanDette argued that there can be problems with faculty organizational service activities and that there should be limits on such activities for certain classes of faculty members.

Recognizing the case reported by VanDette (2015), Beckett (2015) expressed a negative view of faculty organizational service by recommending that contingent faculty members should avoid departmental meetings, as such attendance has little if any effect on their possible salary increases or faculty status. Beckett argued that faculty organizational service is pointless for contingent faculty members. As a response to Beckett's criticism of faculty organizational service, Meyers (2018) with great wit and wisdom expressed the double-edged quality of organizational service: "Service can be a soul-sucking waste of time, but it can also be a form of meaningful networking and professional socialization."

Although organizational service can be more problematic for contingent (i.e., adjunct) faculty than for tenure-line faculty, regular tenure-line faculty members who are tenure-line) can find organizational service to be quite problematic. One primary reason is that such service tends not to be rewarded when merit-based salary increases are determined. A second reason is that organizational service tends to be viewed as a distraction for regular faculty members who are more interested in scholarly research and/or teaching.

FOCUS OF THE ARTICLE

The primary focus of this article is to describe some problems in faculty organizational service. A secondary focus is to present some candidate solutions to those problems. The problems to be listed relate to threats to judicious use of academic time by regular faculty members.

Passive Wastage of Academic Time.

Meetings involving faculty members often constitute a problem for regular faculty members as such meetings are often unproductive and wastes of academic time. But faculty meetings vary in their unproductive use of academic time.

University Meetings

University-wide meetings can take the form of presidential addresses and university senate meetings where faculty serving as university senators are expected to attend. Such meetings can last several hours per meeting and involve hundreds of faculty members in attendance. At such university-wide meetings, regular faculty members rarely speak, listen to administrative pronouncements regarding the state of the university, and, in the case of university senate meetings, sometimes vote on issues if regular faculty members are serving as university senators. The results of such university senate votes are rarely made public and can often be overruled by the administration if the results clash with the concerns of the administration.

College Meetings

College-wide meetings are usually college assemblies with college officials such as the college dean making pronouncements regarding the state of the college and acknowledging accomplishments of the college. Such meetings can last several hours per assembly and involve well over 100 faculty members in attendance. At such college meetings, regular faculty members rarely speak but they do learn about the state of the college. To entice faculty members and staff members to attend such meetings, the college administration makes available gifts such as iPads to people in attendance on a lottery basis. Such meetings constitute episodes of academic time wastage for regular faculty members.

Departmental Meetings

Departmental meetings are at least monthly throughout the academic year. The department chair presides over the meetings with regular faculty members in the department expected to attend. During these meetings, the department chair will make pronouncements of concern to the department or the college. Such meetings can last several hours per meeting and involve well over 30 faculty members in attendance. At such departmental meetings, regular faculty members rarely speak but they do learn about the state of the department. There may be votes taken at such meetings but the results of such votes are rarely made public to the regular faculty members in the department. Such meetings constitute episodes of academic time wastage for many regular faculty members.

Program Meetings

Program meetings occur at least monthly throughout the academic year with programs being subgroups of departments. Such meetings are somewhat small with 3-10 regular faculty members in attendance and last 1-2 hours in length. The program coordinator presides over the meetings with regular faculty members in the program expected to attend. During these meetings, the program coordinator will lead discussions of matters of concern to the program. At such program meetings, regular faculty members often do speak. There may be votes taken at such meetings and the results of such votes are made apparent to the regular faculty members in attendance. Such meetings are excellent episodes of faculty organizational service for regular faculty members and tend to constitute episodes of productive use of academic time for regular faculty members.

Active Wastage of Academic Time

In addition to the passive wastage of academic time by regular faculty members where faculty members act merely as spectators at meetings, there is also active wastage of academic time as they participate in organizational service on faculty committees in which they prepare reports that are either overridden or add to the bureaucratic mass of rules and regulations that beset many universities.

Often regular faculty members are assigned by the departmental chair to serve on a committee and prepare a committee report. Such organizational service often involves meetings with other regular faculty meetings and the preparation of some final report by a certain date. Such final reports along with their recommendations are periodically dismissed by either the department chair or the college dean. Regular faculty members who engage in such committee work engage in organizational service activity that has little if any effect.

Active wastage of academic time also occurs when regular faculty members participate in committees that produce new or modified rules and regulations that add to the ever-expanding list of university, college, and departmental rules and regulations in a university. Such active wastage of academic time is a way of justifying the existence of the committees

Secrecy

Regular faculty members are often asked to vote on various measures. For example, faculty members can vote on proposed departmental policy changes, on faculty tenure and promotion ballots, and on proposed courses. The results of such votes at the departmental level are rarely disclosed. Departments and colleges often operate votes in a clandestine manner. Regular faculty members rarely learn the exact results of departmental and college votes, but the results of program votes are readily available to program faculty members.

Inequity

Department chairs typically determine on which departmental committees regular faculty members are to serve. Such determination is often done without any consideration of the other organizational service obligations of regular faculty members. For example, one regular faculty member may be assigned to serve on an array of departmental committees (the Departmental Graduate Advisory Committee, a Com-

mittee to Review Associate Professors, a Committee to Recommend Departmental Faculty Members and Staff for College-level Awards, and a Committee to Determine Merit-Based Pay Increases for Faculty Members) while engaging in a labor-intensive form of external organizational service (e.g., being the editor of an international academic journal). Other regular faculty members may be asked to serve on only one departmental committee and not providing any form of external organizational service. There is often substantial variation in the amount of departmental and collegiate committee work assigned to regular faculty members. As a result, there is the problem of inequity in the amount of committee work that besets regular faculty members.

SOLUTIONS AND RECOMMENDATIONS

To improve faculty organizational service, the following solutions are proposed to address the four problems that have been cited thus far. To address the problem of passive wastage of academic time, attendance at university, college, and departmental committees should be optional for regular faculty members. Votes on ballots and proposals can occur electronically and any administrative pronouncements can be disseminated to faculty members electronically. However, faculty attendance at program meetings should be required, because such meetings typically require input from all program faculty members.

To address the problem of active wastage of academic time, three solutions are offered. To address the problem of organizational service on committees that produce final reports and recommendations that are dismissed or overruled by administrative officials, those officials should either instruct the committee members the features of reports and recommendations that will not be accepted or should disband such committees and prepare the reports and make associated recommendations themselves. To address the problem of organizational service that produce final reports and new rules and regulations that add to bureaucratic morass, such committees need to justify specifically any new rules and regulations produced. A third solution to reduce active wastage of academic time devoted to faculty organizational service is to form a committee in each unit of the university (i.e., university, college, department, and program) to review all committees in it and extinguish all committees and delete all rules and regulations that are not essential for the operation of the unit. To complement that solution, there should be a sunset provision attached to every committee in a university.

To address the problem of secrecy in university units, there should be full transparency implemented so that regular faculty members are informed of the results of votes taken in their respective units. The clandestine cloak that hides many university operations from public view needs to be lifted to permit regular faculty members to better understand how their organizational service can be effective and worthwhile.

To address the problem of inequity in faculty committee workloads, department chairs need to be aware of all of the forms of organizational service provided by regular faculty members so that the committee assignments made by the department chairs do not result in excessive and inequitable levels of organizational service for certain regular faculty members. Committee workloads should be spread among regular faculty members in a fair and justifiable manner. In so doing, the quality of faculty organizational service will likely improve as will faculty morale.

The primary recommendation to be offered is that the reviews of problems in faculty organizational service and the associated candidate solutions be seriously considered and discussed in universities. Such discussion lead to substantial improvements in faculty organizational service at universities.

FUTURE RESEARCH DIRECTIONS

Future empirical research is clearly evident if the solutions that have been proffered are implemented in universities. After being implemented, the consequences of their implementation should be examined to determine if the desired results occur. If the desired results occur, then faculty organizational service will improve. If the desired results do not occur, then some modification of a proposed solution is warranted and then implemented with subsequent evaluation following and so on until desired results do occur. In this way, the problems in faculty organizational service can be addressed and resolved to improve the operations of universities and the quality of faculty academic life. The implementation of the solutions presented in this paper will clearly provide many opportunities for future empirical research.

CONCLUSION

This article provided a critical analysis of the topic of faculty organizational service, problems with such service, and candidate solutions for such problems. Its primary conclusion is that the quality of faculty organizational service can be improved if the candidate solutions presented in the article are carefully examined and implemented in universities.

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KEY TERMS AND DEFINITIONS

Adjunct Faculty: Faculty members who are hired on a limited basis such as on a yearly basis. They are not protected by tenure rules. The contracts of adjunct faculty members can be renewed.

Contingent Faculty: Faculty members who are essentially the same as adjunct faculty.

Faculty Organizational Service: Faculty activities that consist of service to the academic institution of the faculty member and its academic units (e.g., member of a departmental committee, chair of a faculty promotion committee).

Faculty Service: Faculty activities that include service to the academic institution of the faculty member (e.g., member of a departmental committee, chair of a faculty promotion committee), service to the discipline of the faculty member (editor of an academic journal, organizer of an academic convention session), and service to the community (e.g., volunteer to a community organization, consultant to a state agency).

Non-Tenured Faculty Member: A faculty member who does not have tenure.

Regular Faculty Member: Faculty member who does not hold a position in the administration of a college or university.

Tenure: A form of academic appointment that is indefinite and that is terminated only for cause (e.g., use of university computer to engage in illegal drug trade) or under extreme conditions (e.g., closure of university).

Tenured Faculty Member: A faculty member who has tenure

Chapter 35
Increasing Education's Return Rate for Public Interest Professionals

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ABSTRACT

The author argues that the student loan debt crisis is, in fact, a shortage of public interest professionals. Solving this problem requires replacing the Becker Human Capital Model with a new post-secondary finance model, based on a suggestion of Carolyn Hoxby. The new model says that if the social benefits exceed the upfront costs, get the education. This is in contrast to the previous model that says if the lifetime income exceeds the upfront costs, get the education. The new model suggests counseling to help students be efficient in their college careers and back end debt forgiveness for people recruiting to public interest professions. Pell Grants tied to particular career paths would be used to attract non-traditional students to prepare for public interest careers.

INTRODUCTION

Some years ago John Wang observed that the United States economy Is "in the midst of a revolution … driven by the masses of data that we can now collect and analyze about consumers" especially in regard to "their needs and desires." And, as he pointed out, this "new Age of Big Data … poses huge challenges" as well as "presents new opportunities" (Wang, 2012). If we are to meet these challenges and capitalize on these opportunities in all areas of our economy we must emulate the changes we have made in the American health care system. The health care system, embracing such innovations as computer assisted diagnosis (CAD) has made great strides in capitalizing on the possibilities of these technological breakthroughs in collecting and analyzing data, in part because of advances in our understanding of disease processes.

One area of the United States economy ripe for improvement through updating of our economic theories and technology is in the training and utilization of public interest professionals. A return rate

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to education in these professions that is too low to attract recruits has led to a shortage of public interest professionals. Our country is not producing enough such professionals nor is it overcoming the shortage through immigration as it has been able to do in high technology fields in demand in the private sector.

It is this shortage of public interest professionals -- which is acute in some fields and, related to how we finance post secondary education in this country -- that is the student loan debt crisis as far as this chapter is concerned. Even in those instances such as dentistry where overall we have adequate numbers of service professionals, thanks to distribution problems we have urgent unmet needs among low income patients or those in remote rural areas. In some cases, e.g. high school STEM discipline teachers and guidance counselors we are both failing to produce enough teachers and compounding the shortage by not distributing them in a way that would maximize students served.

The main point of this chapter is that the solution to the shortage of public interest professionals is simple in principle: (1) we must counsel high school students to be efficient in their post secondary educational careers beginning no later than the junior year, and (2) we must provide back end subsidies including salary hikes for people recruiting into public interest professions such as teaching in our public schools and guidance counseling.

This chapter is divided broadly into two parts: first, a discussion of how the shortage of public interest professionals arose and second, a detailed discussion of the author's proposal for solving the shortage. In the first section, the author will argue that this shortage of public interest professionals is a crisis resulting from galloping inflation in post secondary educational costs and wage stagnation on one hand and our society's reliance on a model for financing post secondary education that is out of date on the other. A new financing model will be presented to address the drawbacks of the current model.

In the second part of the chapter the author will develop his proposal for integrating the high schools more closely with post secondary institutions by counseling students to be efficient in their college careers. However, he will also introduce an important exception to this generally applicable advice.

Furthermore, he will also develop his proposal for back end debt forgiveness for students (which includes salary hikes for public interest professionals). While the author believes huge benefits in post secondary educational cost savings for students and greater educational success rates are possible if we implement counseling on how to be efficient in one's college career, these benefits can only be realized if we overcome challenges including (1) incentives in the current system for financing post secondary education fail to encourage students to efficiently utilize their time in post secondary educational institutions, (2) the influence of politically powerful interest groups that benefit from the current financing system and/or political leaders espousing policies that would aggravate the student loan debt crisis, and (3) technical problems that remain to be solved.

BACKGROUND

The post secondary education system in the United States is largely financed by tuition fees charged to students although other income comes from gifts, government subsidies, and earnings of the investment portfolios of the schools. It is a system that directs enormous sums to relatively few institutions such as the Ivy League colleges and universities and paltry amounts of funds to many other post secondary institutions including schools that provide a disproportionate share of the public interest professionals in the country's inner city school districts that largely serve a population of low income and nonwhite students.

No one is required to go to a post secondary educational institution, unlike primary and secondary public schools that serve students less than eighteen years old. The choice of where to go for post secondary education, what to major in, etc. is entirely up to the students themselves and the financing model, known popularly as the Becker Human Capital Model behind this system says that students make these decisions based on assessments of the upfront costs compared to lifetime earnings, the assumption being that if the latter exceeds the former the student will pursue post secondary education.

In the past few years, this system of financing post secondary education has been called into question. The mass media have pointed to the enormous student loan debt, reported on students who are so deep in debt they can never hope to repay it, etc. This article attempts to sort out the real problems and prescribe solutions to them.

FOCUS OF THE ARTICLE

The Current State of the American Post Secondary Educational Finance System

As indicated above. the primary source of funding for post secondary education in the United States is the students and/or their families. As a result of galloping inflation in the price of a post secondary education especially since the new millennium and wage stagnation most students in America's post secondary educational system will need loans to get the credentials they require in their chosen professions. Education researchers (e.g. Sara Goldrick-Raab, 2016, Sandy Baum, 2018) have made a persuasive case that lower class and many middle class students are increasingly frozen out of post secondary schools, especially four-year colleges, by the high tuition costs.

The American post secondary education system is beset with problems. There is general agreement that many private colleges have precarious financial situations brought on by the fact they cannot raise tuition without risk to their enrollments. Particularly concerning in this regard is the situation of the historically black colleges and universities (HBCUs) from which many of the teachers and other public interest professionals have come for our inner city schools and other essential services.

Economists fret that students want to go to college but they do not know what they want to do when they grow up (Baum, 2018). The size of the student loan debt, currently 1.6 trillion dollars has drawn much media attention and calls from prominent politicians to cancel the debt (most vociferously from Senator Bernie Sanders of Vermont who ran unsuccessfully for the Democratic Party nomination for president in 2016 and is running again to be his party's nominee for President in the 2020 election).

One of the biggest obstacles to having an education system that produces enough public interest professionals is the simple fact that no agreement has been forged among economists and other stakeholders as to just what are the problems that need to be solved. For instance, the size of the student loan debt is the problem as far as Sen. Sanders is concerned; the size of the debt is making Federal Reserve Chairman Jerome Powell uneasy (CNBC, 2018); but itis not especially bothersome to other economists. As Pulitzer Prize winning author David Wessel (2016) scoffed "there is no … crisis if by crisis is meant a huge number of Americans are buried under piles of debt for college educations that they aren't paying off." Wessel is correct in the author's opinion. The crisis is due to the fact that (1) the return to education is unsatisfactory in many fields that the author refers to as public interest professions. These public interest professions are rigorously defined by their having a high public benefit resulting from the profession's

work but a private benefit sufficient to low to attract adequate numbers of people to the profession. This is an unacceptable cost to the economy and society as in the case of too few public school teachers, especially in STEM subjects. (2) the shortage of these professionals is compounded by current government policies; recommendations of influential political figures; or policy analysts rigorously deriving their ideas from the Becker Human Capital Model, an out dated financing model.

Mainstream economists broadly agree that getting a college education is a good idea and going into debt if need be to get it makes sense from the standpoint of the lifetime earnings enhancement that results (CEA, 2016). If the country is to have enough professionals in the public interest, however, as a society we cannot burden those aspiring to be public interest professionals with a heavy debt load.

The reason for this is simply the disincentives to pursuing a public interest profession. Not only is there the cost of undergraduate education to consider. There is also the huge expense of graduate school. Mainstream economists' advice and policies they have put in practice have unfortunately compounded the problems our society is having of producing enough public interest professionals.

Consider the mainstream position on how to get students to want to go to college. As a result of the Great Recession of 2007-2009, American attitudes about a college education changed dramatically. The public's confidence that a college education was a ticket to the middle class (see Long, 2015) evaporated, replaced by skepticism that a college education might be worth the cost. Most Americans however came to accept the idea that if you had the right credentials-- i.e. those demanded by employers -- you would still benefit from getting a college education.

How did the mainstream economists react to this new development? They decided to counsel young people on the benefits of a college degree even in a time of fast rising costs. James McAndrews, emphasizing he was speaking as an economist, rather than in his role as an executive with the Federal Reserve Bank of New York, noted "the evidence strongly supports the view that a college degree, while expensive, is a worthwhile investment not only for the individual receiving the education but also for society as a whole." McAndrews added, "For individuals, the expected benefit-cost ratio of a college degree is well over 1.0 and growing." He reminded his audience of the well publicized fact "college graduates on average earn 80 percent more than those without a college degree, and are far less likely to be unemployed, regardless of the phase of the business cycle" (McAndrews, 2015).

At a graduation ceremony of the University of Baltimore, Maryland. in December 2016, Janet Yellen, the Federal Reserve Bank Chairwoman at the time, emphasized that "the vast majority of student borrowers who complete their degrees find work that allows them to keep up with their payments and pay off their loans." She further told the audience, "a college degree increasingly will be important in helping workers compete in a world-wide labor market that is constantly inventing ways to replace people with machines" (Harrison, 2016).

Yellen is right of course in what she says. However, as Sandy Baum, a leading scholar of the economics of higher education points out, most students want to go to college. They do not need to be told the benefits of a college education.

However, students do need to be told that being admitted to a post secondary school is no guarantee that you will graduate and enjoy all the benefits that McAndrews and Yellen rhapsodize about. Webber (2018) offers the following sobering statistics: "There is little payoff without a degree, and 6 in 10 students who start don't ever finish." And the forty percent who do complete their degree counts all students finishing within *six years*. If our society is to produce sufficient teachers, social workers, etc. to meet our needs, something must be done to assure that a higher percentage of students finish their degrees and a much higher percentage of those finishing do so in four years. This is because to earn an advanced

credential most professions in the public interest require several years of additional education beyond the bachelor's degree. Jonathan Cole, a sociologist at Columbia University who has served as provost of the university, points out that typically students getting the doctorate require eight years to finish up their studies (which comes on top of the four to six years needed for the bachelor's degree) (Cole, 2016).

A roseate view of the benefits of a college degree is a minor faux pas. A more serious error the mainstream economists made was to urge students to get all the education they could even going into debt to acquire the credentials our post industrial economy demands. Students listened but the message they heard was not the one the economists wanted to convey. Economists wanted students to choose a major, then a school, and get a credential demanded by the economy (Baum, 2016, Akers and Chingos 2016). A lot of young people, primarily from families where no one previously had gone to college, enrolled in schools of dubious quality. These students, referred to in the economic literature as "nontraditional students" left school without obtaining a degree in proportions far greater than traditional students. And even if the nontraditional students did earn a degree, in many cases the degree did not equip them with the skills needed by the economy (Looney and Yannelis, 2015).

What went wrong? This was not a problem brought on by the galloping inflation in education costs and the wage stagnation that mainstream economists blame for many ills of our education system. It is a problem of the financing model that we as a society have relied on for producing our skilled workforce since it was developed in the mid 1960s. This model, popularly known as the Becker Human Capital Model, says that if the lifetime earnings exceed the upfront costs get the education you need to practice the profession. It is simple and intuitively obvious.

Unfortunately, the Becker Model assumes a rational consumer making a decision based on all the pivotal facts. However, as economist Douglas Webber has remarked, students "with rare exceptions," are "individuals who have barely entered adulthood," who are making "decisions of whether to pursue a college degree, where to go, and what to major in using information that is, at best, incomplete." Yet he adds, "these decisions are—for most people—the most consequential financial decisions" they will ever make and their choices will have "life-long ramifications" (Webber, 2018).

When the mainstream economists preached that the road to wealth was through college they forgot to add that you needed good guidance in choosing your career and the school at which to get the necessary credentials. Maybe the economists can be forgiven for that oversight. Despite the high cost of postsecondary educational choices and their long term consequences good guidance is not uniformly available across all income classes to students, on how to achieve a positive return to education for themselves. Especially in the case of low income students, good guidance on how to select a post secondary school, secure financial assistance, and be efficient in one's college career is difficult to find and usually not affordable when it is available. The professional association of high school guidance counselors recommends a ratio of counselors to students of 1:250 but the national average is close to 1:500 and independent education consultants think that to do a proper counseling job the ratio would not be more like 1:55 (Teare, 2017).

The acute shortage of good guidance services for low income students is particularly concerning because from their ranks will need to come the teachers and other educational professionals our inner city schools must have to prepare future generations of students for the challenges of globalization.

SOLUTIONS AND RECOMMENDATIONS

A New Financing Model is Needed

The first order of business the author maintains is to replace the Becker Human Capital Model with a new model. Its purpose is to address the deficiencies of the Becker Human Capital Model, e.g. it is outdated, based on questionable assumptions of a rational actor possessing all pivotal information needed to make an informed decision, has variables that for public interest professionals cannot be computed, and leads to mischievous polices. The new model is based on a suggestion of Caroline Hoxby, a professor of economics at Stanford University. According to Hoxby, "Loans should be the tool of choice if and only if the problem is students' being liquidity constrained from investing optimally in their own human capital." However, she adds, "If the problem is not liquidity constraints but that education produces social benefits that exceed private benefits, the appropriate solution is tuition that is subsidized (such as we see at public colleges)." Hoxby "Comment" on Looney and Yannelis (2015).

The Becker Human Capital Model, the author maintains, is outdated. Its assumptions are questionable, especially in the case of the majority of students interested in attending college, its main hypothesis while intuitively appealing requires information students cannot be assumed to have if they aspire to careers in public interest professions, and perhaps most serious of all it is the intellectual father of mischievous policies. One especially egregious example of that is the Trump administration proposal to require all students who took out loans to pay for tuition to repay their loans. This would apply to students currently shielded by the borrower defense rule that protects students who enrolled at schools subsequently closed for fraudulent practices. Aside from the fact these students do not have the money to pay even their rather modest debts, the rationale the Trump Education Secretary offers for this new proposal is ludicrous. It asserts that, "post secondary students are adults who can be reasonably expected to make informed decisions. And she insists that they must take personal responsibility for their decisions. This rationale is the assumption on which the Becker Human Capital Model rests (and which most people know is unrealistic in instances of most students making post secondary educational choices for many reasons including their tender ages).

The socio-economic model handles the problem of not being able to tell if the lifetime earnings exceed upfront costs by posing a second question: are the public benefits greater than the private benefits? If the answer is affirmative the model says that the government should provide the education in this field at its cost. Therefore, teachers, social workers, etc. would get their education costs paid for. The problem is (1) which level of government, and (2) how would this be done? The author leans to debt forgiveness rather than upfront payments. However, for nontraditional students and others for whom these costs are too prohibitive Pell grants may be appropriate.

One especially nice feature of the new financing model is that it incorporates the Becker Human Capital Model as a special case. This may surprise some people because numerically the students who can depend on the Becker Model greatly outnumber the students for whom it is unsuitable, such as those aspiring to careers as public interest professionals. Thus, it is not necessary for those who find the Becker Model quite useful to give it up. But as shown above, the new model that the author refers to as the socio-economic model does solve some problems such as appropriate policies for nontraditional students better than the Becker Model does.

The new model also provides suggestions for types of solutions to the educational system problems. For instance, since the new model says that the decision to seek post secondary education is nonrandom

and non-rational, it endorses counseling for students to enhance the probability they will make a decision that optimizes their social benefits. It also endorses back end debt forgiveness (and Pell grants if needed) that will encourage students to recruit to public interest professions since these are occupations that may not pay sufficiently to justify the student's investment of his/he own resources.

High School Students Need Counseling to be Efficient in Their College Careers

The main thrust of this article is that we need policies that encourage students to seek degrees in public interest professions where we have shortages. One important objective is to help students minimize student loan debt at the point they have graduated from college. This is because high undergraduate student debt is a disincentive to pursuing a graduate degree needed to practice a public interest profession. (Some students will enroll in graduate school simply to delay having to pay their debts but they will be unlikely to actually enter a public interest profession given their high debt loads).

An obvious place to begin impressing on students the need to be efficient in their post secondary education is the application process through which students gain admission to a post secondary educational institution (Ward. 2017). Meredith Kolodner (2017) catalogued the principal errors students make that raise the cost of their undergraduate education and likely also increase their debt: While still in high school students should be counseled to avoid the temptation to work while in college. If they must work to help keep costs down, the students should strictly limit their hours to no more than 25 per week because she says a new study finds that "more than 25 hours can get in the way of passing" one's courses, especially for low income students who arrive on campus less prepared by their high schools for college work than their more affluent fellow students."

Another problem (possibly linked to the first issue of working too many hours in a school job lowing student progress), is that many students are taking too few credits per term, e.g. twelve credits instead of fifteen.

Transferring from one school to another should be avoided unless absolutely necessary. "Colleges and universities usually require 120 credits for a bachelor's degree but students graduate with about 135 on average, according to data compiled by Complete College America, a nonprofit research and advisory consultancy. In New Mexico, the average is 155 credits Kolodner notes. This discrepancy between total credits earned and those needed for a degree is because the school to which students transfer often accepts only a portion of the credits earned at the original school. This is an issue that needs to be addressed nationally because more and more students are starting at community colleges to save money before continuing on to a senior college. Unless agreements are worked out between community colleges and senior colleges to accept more credits the students may find that their efforts to earn a degree economically have backfired. In that case they would have been better off at the more expensive senior college right from the start.

A fourth serious problem, one that high school counseling should ameliorate, is that students arrive on campus with no clear idea of what they want to do when they grow up. Mainstream economists (e.g. Sandy Baum, (2016), Beth Akers and Mathew Chingos (2016) insist rightly that it is critical to student efficiency and indeed to success in achieving the desired credential that students have a major in mind before they embark on their post secondary educational careers.

Realizing that high school counseling to get students to be more efficient in their college studies is a long way off, colleges in many cases are addressing these same issues once students arrive on campus. For example, they have begun pushing students to declare majors earlier or at least narrow their areas

of interest so that they can chart out a path to a four-year track. New technology is helping the schools implement this plan. "Digital advising tools have become increasingly common," Kolodner remarks. Now "instead of scrolling through a course catalog," students at many colleges can "create schedules on interactive maps that aid in fulfilling core and major requirements."

Colleges have noticed that social isolates are also more prone to drop out than students who are active in campus life. Students need to join clubs, participate in sports etc. For students at commuter schools this may not be so easy but they should be encouraged to do this anyway.

Finally, colleges are taking steps to enforce student discipline. Springfield College in Massachusetts, Kolodner reports, "has forced students to manage time better. She says that "students on academic probation must meet weekly with a coach who helps them prioritize their work and connects them with tutoring services. Three missed meetings [with the coach] are grounds for expulsion from the school."

It would be better if students were counseled about the need to be efficient in their college careers than to depend on colleges to deal with the consequences of student's lack of preparedness for college. While colleges are addressing the problems caused by students who arrive without clear goals for what they want to accomplish during their college years, this is more costly both in terms of money and wasted lives. Colleges do not necessarily address student lack of preparedness until the students show clear signs of floundering. Wouldn't an ounce of prevention at the high school level be better than a pound of cure for the struggling student in college?

This is the guiding principle behind the Bottom Line Program that started in Boston in 1997 and currently also operates in Chicago, and New York City. A random assignment outcome evaluation concluded "Bottom Line advising has a substantial positive effect on the overall rate at which students enroll in college and on the quality of where students matriculate." Some highlights of the study were that "survey results indicate that students offered Bottom Line assistance were more likely to enroll full time, had higher rates of participation with student groups, and felt more comfortable on campus than students in the control group" (Castleman and Barr 2016).

One nice feature of the Castleman and Barr study is that the control group cohort received whatever other counseling resources were available in the community rather than being required to forego any assistance whatsoever. Not only was this ethical but it also served to show how much better the Bottom Line Program was than a placebo (of whatever resources were available prior to its being implemented).

Because the type of counseling for students aspiring to go into public interest professions is a key piece of this chapter's proposal, it is important to look at what the Bottom Line Program does that is effective and not simply at the overall conclusion that counseling by that program was efficacious. The Bottom Line program "begins working with admitted students between the end of their junior year and the start of their senior year. Each student meets with their advisor for an hour every two to three weeks during the application season." The advisors, according to the report authors, help students identify potential schools, write essays, complete applications, and apply for financial aid as well as select a suitable college. The focus of the Bottom Line program is picking an affordable college "where [the students] can succeed."

The Bottom Line program did notably well with particular segments of the student population. According to the evaluation authors, 72 percent of Bottom Line advised students with "Below median GPA" enrolled in a college versus 59 percent of non-Bottom Line students with below median GPA. Eighty-two percent of the female Bottom Line advised students versus 70 percent in the control group enrolled in a post secondary institution.

The Bottom Line program clearly made a positive impression on students who went through it as regards dealing with the college application process. Fifty-eight percent of students in the Bottom Line program stated that the college access advisor was very important in the application process versus 21 percent in the control group.

Finally, the "treatment students were almost 10 percent more likely to rank costs as one of the top two factors in deciding where to attend," a fact the evaluators believe "reflective of the fact that Bottom Line students were nearly 20 percent more likely to have met with [a Bottom Line counselor] to review their financial aid letters than were control group students."

The Bottom Line program, in this author's opinion, illustrates what is possible if the professional guidance counselor standard of one counselor to 250 students were met—although this is unlikely to oc for several years even if this country committed to fulfilling that goal. It is useful, however, to ask what might be possible if instead this country were to meet the standard of one counselor for every 55 students, a caseload considered the right size by professional independent education consultants.

The best way to show what is possible is by contrasting it with the Bottom Line Program. The latter starts working with students at the end of their junior year. In the author's opinion, this is a serious weakness of the Bottom Line Model. It would be better to begin working with students when they have completed their freshman year in high school. With students entering their sophomore year, the counselor can emphasize the value of joining the right clubs and teams, getting tutoring to help the student improve, especially in English writing and reading skills and mathematical skills. Students taking this advice to heart will probably find it made a big difference in the quality of the schools willing to admit them when they start applying to colleges. It will also most likely result in substantially more financial aid that the admitting schools are prepared to offer as well as a greater likelihood of success in those schools. It is important to remember most scholarship aid is reserved for the more able students, regardless of their ethnic or gender backgrounds. Much need based aid is reserved for students from the most financially hard pressed families. Unless a student is among the fortunate few who can afford to go to college without financial assistance it is simply smarter for students to compile a fine academic record that will demonstrate readiness for college and thus a sensible choice for merit based assistance

Nontraditional Students May Need Much More Intensive Assistance to Succeed in College

In general, students need and will benefit from the counseling urged in section 1. However, this may be insufficient, indeed even incorrect for nontraditional students. First, it is important to reiterate that nontraditional students probably also are students who graduated from high schools with limited guidance services, if indeed their schools had such personnel. But a longterm evaluation of a free tuition program in Kalamazoo, Michigan suggests that free tuition does not budge low college graduation rates of nontraditional students. (Mitchell and Hackman, 2019).

Just 38% of students completing high school between 2006 and 2012 earned a college degree or certificate the evaluator found. "This was up only slightly from the 34% average for the three years before the program existed." As poor as these overall completion rates are, they seem quite impressive compared to the black student completion rates. "Among black students, just 23% from the classes of 2006 through 2012 earned a college credential, compared with 22% before [the inception] of the program" Mitchell and Hackman report.

The evaluators think that high rates of single-parent households, teen pregnancy and homelessness are to blame. These are difficult handicaps to overcome and free tuition alone, or even the modest counseling most students would benefit from is not going to address these challenging obstacles to success. The author thinks that new ideas are needed including combination work study programs that let students earn a decent living while taking a couple of courses at a time toward their degree. This might result in students not getting their degrees for ten or more years. But that is better than not getting their degrees at all. We have to remember that the nontraditional students are a logical group from which to expect to draw the teachers, guidance counselors, etc. that the next generation of black students in the inner city schools will need as role models. Clearly the research shows these students lack far more in the way of a support network that helps students succeed in college and life than do the average white students and programs that maximize their chances to succeed need to be developed to address that reality

People Recruiting Into Public Interest Professions Deserve Debt Forgiveness for Expenses Incurred in Earning Their Credentials

Counseling is not the only element of the proposal for solving the student loan debt crisis offered in this chapter. Debt forgiveness is also essential if we are to solve the shortage of public interest professionals. This proposal takes an expansive view of the meaning of debt forgiveness for recruiting into a public interest profession. Strictly speaking debt forgiveness is simply a reduction of outstanding student loan debt perhaps over a period of time and prorated for the amount of time the individual works in the public interest profession. However, the bottom line is what really matters rather than the mechanism. If wages offered to people recruiting into a public interest profession are hiked, as proposed by Senator Kamala Harris, as aspirant for the Democratic Party nomination as president, that is fine from the standpoint of this chapter. It has the same effect of reducing the amount of money owed by the student since it is assumed higher wages will lead to bigger payments by the student to retire the debt.

When the author began circulating his ideas to economists interested in the economics of higher education for their comment and suggestions, Kevin Lang, a Boston University economics professor, pointedly asked who will pay for these counseling services and especially for the debt forgiveness. The best answer the author can give at this time is "It depends." Some relevant considerations include who is benefiting from the work the public interest professional is doing. A federal agency hiring that individual clearly should be responsible for paying as part of its compensation. But suppose the employee being hired is a state employee rather than a federal employee but at least some of the work of this state employee is mandated by federal legislation. In the author's opinion that portion should be paid by the federal government rather than the state government. In other words, the full burden of the cost of a debt forgiveness program could be shared among levels of government.

Another issue that needs addressing is whether the debt forgiveness should be insensitive to the income level of the recipient. The answer again is "It depends." If the only practical way to get pediatricians to work on remote Indian Reservations is to offer debt forgiveness regardless of the wealth of the recipient then as a society the author maintains we must pay. The billionaire scion of a very rich family would get the same debt forgiveness therefore as the pediatrician who grew up in a family of sharecroppers and was educated on need based and merit based scholarships his/her entire life. Nevertheless, the author is enthusiastic about the idea of graduated levels of debt forgiveness based on the wealth of the recipient (or the recipients' guardians) as proposed by Senator Elizabeth Warren who is vying to become the Democratic Party nominee for President.

Comparing Proposals for Solving the Student Loan Debt Crisis

Numerous proposals for solving the student debt problem have been offered. The author cannot possibly do justice to all of them but in this subsection he will make clear from the standpoint of the theoretical and policy perspective of this article where he stands on particular ideas incorporated in many of the proposals.

The criterion against which the ideas in other proposals will be assessed is whether they are consistent with the thesis of this article that the decision to go to college and/or graduate school is a nonrandom non-rational decision and second that people who recruit to public interest professions deserve government support since these professions have public benefits often exceeding their private benefits.

The proposals that will be reviewed will be elements, rather than specific proposals. For example, the author will assess calls for free college tuition rather than the specific proposal of a candidate for president who may be calling for free tuition (but whose total proposal has other elements as well). Or, the author may assess the value of Pell Grants per se rather than the entire perspective of an economist proposing Pell Grants.

Pay hikes for teachers (and other public interest professionals) The author sees merit in the idea of hiking the pay of teachers and other public interest professionals. Hiking their pay is another way of accomplishing the aim of debt forgiveness, namely to help those practicing professions in the public interest enjoy dignified middle income lives.

Pell Grants The author also sees merit in Pell Grants. But he prefers (1) merit based aid rather than need based aid and (2) tying any need based aid such as Pell Grants to students to their agreeing to recruiting into public interest professions by, for example, taking courses that would lead to a degree in a public interest profession, etc.

Free tuition for all Since the 2016 presidential election campaigns, proposals have been made by aspiring presidential candidates calling for some variant of free tuition for all, e.g. for either the first two years or for a full four years.

The author is generally unfavorably disposed to calls for free tuition and calls for blanket debt forgiveness. Both proposals are certainly popular with many voters for obvious reasons. But they are ruinously expensive and represent a transfer of wealth to people who do not need it. Most students even now have little trouble paying their student loans out of their incomes. The majority of students who have serious loan problems are in professions in the public interest and their incomes are indeed inadequate to pay their loans. This is because the loans were taken out to defray expenses connected with their graduate school education for the most part. Note also the observations reported earlier about the Kalamazoo Promise program with its low college completion rates, especially for black students, based on many years experience with this program.

Debt forgiveness for people recruiting into a public interest profession If the author is opposed to blanket debt forgiveness for the same reason as he opposes free tuition for all he is receptive to debt forgiveness for practicing a public interest profession. Starting salaries for teachers, the public interest profession with perhaps more members than any othe, are low across the board. Teachers do not begin making a decent living for many years, perhaps seven or eight after starting their careers, even in states such as New York that pay teachers fairly well. While the idea of back end debt forgiveness is appealing, designing a workable plan around this concept will be challenging. Kevin Carey (2019) points out, "Incurred debt can vary widely for the same fields." He reports that to get a master's of dispute resolution at Pepperdine University students borrowed an average of $153,000, while at the next most expensive

place to get that same credential, Creighton University, on average they borrowed $88,000. An article that appeared in the Chronicle of Higher Education illustrates the difficulties. The article's author Katherine Mangan (2019) starts by asking, "When a graduate of a Ph.D. program in public administration accumulates more student-loan debt than someone with a law degree from Harvard, what does that say about the market forces that guide graduate education?" And she further rhetorically asks "And what potential earnings calculations would drive students at several overseas veterinary colleges to each take on nearly $300,000 in debt?"

Debt forgiveness cannot be allowed to degenerate into a subsidy for second rate schools. Generally, the government should avoid picking up the tab for novel programs preferring instead to fund programs where a corpus of knowledge has accumulated and professional standards of competence in the field are well established. Research has shown that tuition fees and student debt levels are often excessive in new degree programs for which professional standards are not established, especially at for profit post secondary institutions.

FUTURE RESEARCH DIRECTIONS

The thrust of this chapter has been applied economics and it seems appropriate to the spirit of the chapter to limit the discussion of research directions to issues of practical concern. In this vein, a careful study of specialization in law and medicine is warranted to refine economic knowledge of the public benefits of those professions. Right now the mainstream view of law, for example, is of a profession with little public benefit, primarily engaged in transfer payments that add virtually nothing to the economy. The author in other writings has critiqued this economic view but for reasons of space limitations has decided not to discuss this issue here (Fisher, forthcoming 2020).

CONCLUSION

The student loan debt crisis is real and alarming. From an economics standpoint, it is a problem of the unsatisfactory return to education. From a policy standpoint it is a guidance problem. The low payoff from education manifests itself in physicians, for example, avoiding pediatric medicine because compared to other medical specialties the compensation is unattractive. Dentists avoid practicing in low income neighborhoods because earning the income they require to pay off their school loans in a reasonable amount of time is not possible unless they practice in affluent neighborhoods. Despite a crying need for nonwhite public school teachers, especially STEM teachers, in the inner city, black students avoid preparing for or seeking employment in these school districts.

The solution to the student loan debt problem should proceed along two tracks. One is to raise the compensation of public interest professionals to address the low return to education. But we also need to harness technology to get a better handle on the amount and location of needs for particular types of such professionals. If the need is critical for STEM professionals in New Orleans, for example, does it not make sense to invest in building a strong program to educate teachers for that city's system in one or more of the historically black colleges and universities (HBCUs)? At present we simply are wringing our hands over the fact that these institutions do not receive anywhere near the same federal financial

support as prestigious mostly white research universities. The second is to provide the right guidance to high school students considering what they want to do in the future.

Students who are fortunate enough to get proper guidance in high school will probably avoid enrolling in schools that are poor fits for them either because they are expensive, or of dubious quality, or perhaps both. And they will also most likely avoid accumulating crushing burdens of undergraduate debt which overall is an incubus to seeking post graduate education needed to fill positions as public interest professionals. This in turn will allow the country to fill critical positions in the education, health, and justice spheres among others with competent professionals.

Not enough attention has been given to what constitutes the right guidance. It is certainly advice on how to be efficient in one's college studies. But this may be appropriate only for students from families that have traditionally sent their progeny to post secondary schools. Experience with a generous free tuition program in Kalamazoo, Michigan suggests that we may need to rethink what works for nontraditional students. In Kalamazoo, free tuition barely budged the black student graduation rate from 22% to 23%. The evaluators believe that a toll was taken by the combined ills of single-parent households, teen pregnancy, and homelessness. We may need to adopt new models including resurrecting ideas such as one term of classes and one term of working for money etc. to solve this problem of low completion rates among some segments of our school age population. As the old adage of the United Negro College Fund says, "A mind is a terrible thing to waste."

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KEY TERMS AND DEFINITIONS

Post-Secondary Finance Model: Refers to an algorithm for determining how revenue will be obtained to defray the costs of providing post-secondary education. A model that is totally dependent on government funding is a public model whereas one totally dependent on private funding is a private model. The Becker Human Capital Model is a private finance model whereas the socio-economic model is a mixed private-public model.

Public Interest Professional: A professional in an occupation whose social benefits are higher because the public benefits are greater than the private benefits, e.g. teachers, social workers, etc.

Return Rate to Education: The amount of money in standard monetary units such as dollars, euros, etc. that a person making an investment in education derives from the occupation they practice as a result of having gotten that education. It is expressed as a percentage of the cost of that education. For example, if it cost $250,000 for the education and the student received $275,000 above what the person would have gotten anyway then the return to education is 110 percent of the cost of the education.

Social Benefits Equals the Sum of Public Benefits and Private Benefits: Private benefits are those accruing to the student by virtue of the education such as enhanced salary income. Public benefits are those accruing to society or others as a result of the work the student does in his occupation. For instance, the great new mathematical skills a student learns from his teacher in algebra class is a public benefit.

Chapter 36
Comprehensive Marketing Intensity Indicator for Higher Educational Institutions

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ABSTRACT

Higher educational institutions (HEI) have lately involved the marketing approach both locally and globally. While almost all HEI now involve marketing of education service, there is no comprehensive assessment indicator available for the marketing intensity. Marketing intensity as a new term is the holistic involvement of an organization into marketing not reflected solely by monetary variables. The chapter attempts to bring the term marketing intensity into the discussion of HEI and to build a comprehensive marketing intensity indicator, which may be easily used to compare HEI with respect to marketing intensity. The chapter presents the conceptual and theoretical model of the indicator.

INTRODUCTION

The discussion over the marketing approach of HEI is a recent one (not more than two decades) but having multitude of approaches. The institution is perceived by researchers as a company or a business entity and the stakeholders of HEI as customers either direct or indirect. The division of entities related to HEI on the basis of different parameters is an issue not agreed upon by the researchers. What is agreed is the characteristic of the HEI services i.e. intangibility, inseparability, perishability etc. All these discussion highlights the subjective issues while deciding about the HEI in the light of specific or general marketing strategies. The question which is of paramount importance is the intensity of an HEI with respect to marketing strategies. In a general sense, it may be decided only on the basis of the

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amount spend/cost incurred on marketing. But it is to be noted that HEI may not market their services only through funds apportioned for marketing. Whether consciously or unconsciously, an HEI is marketing on several parameters both monetary and non-monetary and that all may not be reflected in their marketing expenses. Thus, it may, several times be misleading to decide on the basis of money/amount spend on marketing exclusively mentioned in the appropriate heads of the accounts.

When such an assessment is made by an individual, specially, having no or less assess to the quantitative data, it makes the task a complicated one. Any potential entity to the HEI thus fails to assess the marketing pace of the HEI in a simple yet comprehensive manner. In this backdrop, there is a need to assess the marketing intensity of HEI through a comprehensive method while following the principle of objectivity. This is in order to minimize the subjective analysis on the marketing intensity by individuals where the mind may not stuck to particular parameter at multiple times and may give more priority to intuitive judgment which involves selections of parameter comfortable and easy for the individual. Thus, the objective of the study is to attempt the development of a comprehensive indicator of marketing intensity for HEI that is objective, as well as parsimonious, in order to minimize the quick, intuitive and subjective judgment on marketing intensity of HEI free from hindsight and biases (free here means minimization).

In this chapter an attempt is made to create a benchmark marketing intensity indicator that is easy to apply without much mathematical calculations and at the same time relevant for marketing assessment. This assessment can be done both by the institutions as well as third parties or the students itself. As the higher educational institutions are using more marketing strategies than before, it is high time that a simple and comprehensive marketing intensity indicator is developed.

REVIEW OF LITERATURE

The literature related to marketing of higher educational institutions is scarce and that too does not include the discussion on marketing intensity. The primary reason is the unavailability of a comprehensive indicator for HEI. However, other aspects of marketing related to HEI has been captured in researches as well has been critically examined.

The customer concept related to HEI has been highlighted and discussed by Marzo, Pedraja and Rivera (2007). Their conclusions were the generalizations on the basis of sample universities of Europe. They have categorized the users of university services into two, i.e. stakeholders who are defined as availing services indirectly and customers availing services indirectly. Though, past studies have highlighted that the concept of customer in higher education is similar to the concept of customer in other businesses (Sax, 2004; Svensson & Wood, 2007). While according to Marzo, Pedraja and Rivera (2007) stakeholders in context of universities include students, their families, the community, society, the personnel, public authorities; customers include somebody who pays to receive the university service. The customer of higher education has been identified by many researchers but there remain no consensus. However, it is but natural due to differences in the policies and procedures of different countries.

Studies specifically focusing on the discussion of customers in higher education are myriad. According to Kotler and Fox (1985) customers in HEI include students, employers, teaching personnel, society, public administration, families, administrative and service personnel. Later on Robinson and Long (1987) removed society and public administration from the list of HEI customers. Further, the list was reduced to the list only including students, employers and teaching personnel (Ermer, 1993). The

organizations, European Foundation for Quality Management (1995) and National Institute Standards and Technology (1995) came with their own standard and included employers, society, families and others as the customers of HEI. In another study, Brocata and Potocki (1996) have considered students, employers, families and sponsors as the customers of university services. It is basically the study of 1997 by Karapetrovic and Willborn that has included all parties under customers of educational institutions except the administrative and service personnel of universities. Exactly same has been concluded by Rowley (1997) and Reavill (1998) with respect to customers of university services.

Another important study by Brennan and Bennington (1999) has only considered students, teaching and research personnel, society, families and sponsors as the customers of university services. The study by Marzo, Pedraja and Rivera (2007) has concluded that selecting "stakeholders" instead of "customers" widens the scope of marketing of universities or in other words higher educational institutions. They have highlighted the criteria generally used for creating a distinction between the various parties. The criterion has relied on internal customers and external customers. Others have attempted to identify stakeholders that can increase profits of innovative service organizations which plays a key role in marketing strategy (Zeithaml, Rust & Lemon, 2001). There has also emerged an approach to analyze the preferences of the students and management of HEI with respect to quality (Dill, 1997). In addition, the point of relevance is the global communication actions of the universities which may be seen as a marketing strategy to recruit students (Gray, Fam & Llanes, 2003). All this has added to the complexities of the discussion. However, the studies have failed to develop a comprehensive indicator for measuring marketing intensity.

OBJECTIVE OF THE STUDY

The study has a single but profound objective of preparing a comprehensive marketing intensity indicator for Higher Educational Institutions (HEIs) that may be a starting point for assessing marketing intensity.

Background and Conceptual Framework

The previous section has attempted to argue for developing a comprehensive marketing intensity indicator for HEI. The key concepts underlying this development are based on defining marketing intensity, the nature of higher educational institutions and a comprehensive indicator. Higher educational institutions may comprise all educational institutions not labeled as schools. Another criterion to decide about it can be on the basis of level of education. Anyone above senior secondary education will be considered a part of higher educational institution. Though it needs to be considered that this will definitely vary from country to country depending on educational system and the legal framework.

Marketing Intensity

Generally speaking, marketing intensity has not been a standard and conceptual term used in marketing studies. However, the terms have been used to understand the involvement of an organization in marketing activities. This was generally seen as expenses on marketing and advertising. However, this can only be captured through the accounting details of marketing which is a cumbersome work as well as time taking for an individual.

On the other hand, marketing intensity had been specifically discussed by researchers and they have tried to measure it in quantitative terms. Vinod and Rao (2000) and Wuyts, Stremerschan & Dutta (2004) have discussed marketing intensity and have measured it as investments made in selling, general and administrative (SG&A) departments and then representing into ratio between SG&A expenses to total revenue for the organization. Krishnan, Tadepalli and Park (2009) have also discussed and have attempted to measure marketing intensity along with R&D intensity. They have defined marketing intensity, as an investment in marketing activities that is above the median investments made in the major industry to which they belong. They have highlighted how SG&A expense were used as a proxy for marketing intensity. Marketing intensity has been used by researchers along with R&D in studies and thus appears to be a long term, holistic variable. Studies have proposed that entities with higher marketing intensity achieves greater gains since such entities would increase revenue as well as have lower coordination costs. The impact of multinationality on firm performance was moderate for firms with higher marketing intensity. For the purpose marketing intensity was measured as the advertising expenditure divided by sales (Kotake, Srinivasan & Aulakh, 2002). Here, it is to be argued that marketing intensity was confined to advertisement expenditure though its scope must be comprehensive to include other subjective points. This will be attempted in the next section.

Developing Comprehensive Marketing Intensity Indicator

The development of a comprehensive marketing intensity indicator attempts to make it easy for the individuals whether customers or stakeholders of HEI to assess the marketing intensity of the HEI. Already the term "marketing intensity" has been discussed and identified. The need of this indicator is due to three prime reasons:

1. That the marketing/ advertising figures and statistics are publicly or easily not available regarding HEI which makes it difficult for the individuals to measure the marketing intensity in a simple manner.
2. In the absence of data, discussions regarding HEI must be with minimized or reduced halo effects.
3. Marketing intensity is a combination of factors that are diverse and thus needs a fresh introduction and assessment.

In the light of these arguments, it is imperative to attempt to develop a comprehensive marketing intensity indicator. For sake of development of comprehensive marketing intensity indicator four variables are selected:

HEI Reputation

This variable may also be termed as HEI Image/Goodwill. The question to be answered is that how HEI reputation can be a variable of marketing intensity. As it has been discussed in the conceptual framework that marketing intensity includes any variable that may qualitatively or quantitatively indicate the marketing effect in the public domain. In this regard, HEI reputation is a key factor in marketing of the HEI. A good reputation will give more boost to the default marketing program and thus will be tantamount to marketing intensity. However, a bad reputation will give a negative note to marketing program of the HEI and will represent no or low marketing intensity. Further, the reputation of the HEI may be

based on the previous year or past marketing and advertisements of the HEI and there may be other factors responsible too such as use of media, branding etc. The aim here is not to identify the backdrop or the direction of marketing and HEI reputation, rather judging or measuring marketing intensity with the help of reputation. The analysis may be both subjective and objective. While subjective judgment could not be based on perception and information with halo effects, objectivity would be with the help of some proxy quantitative data. However, as an initial and simple measure it would be the subjective assessment of the variable.

Communication/ Media

This variable is the most vibrant in the development of marketing intensity indicator. HEI communicate to the world through different media sources such as internet, newspapers, advertisements, billboards etc. and the major marketing expenses of HEI lies here. Thus, this variable is very important in the development of marketing intensity indicator. Even a subjective assessment of this variable will lead to a bit of quantification. For example, media/communication of a particular HEI would be always measured or rated on the basis of further quantities such as number of advertisements, number of billboards or the same converted into monetary valuation. They may also include items such as money spend on internet promotion and advertisements etc. This is thus a combination of both subjective assessment and objective assessment.

HEI Branding

A new feature in the marketing strategy of the HEI is the use of branding. A personality (academic or non-academic) may also be chosen as the brand of the HEI. Not only this the alumni of the HEI may become renowned academicians, politicians, sports persons etc and may be used for HEI personality branding. This concept is ignored while assessing the marketing of the HEI. But in marketing intensity, this variable will play an important role as it is very much clear that branding plays a vital role in marketing. Branding for the HEI includes logo, motto of the institution or any other symbolism attached to the university.

HEI Quality of Education

Quality is an important parameter that is assessed by a customer of a service. Thus, service quality is an important aspect which depends on perception of the customer. However, quality of education with respect to HEI includes both intangibility and tangibility. At the core of education service provided by HEI lies the intangibility characteristic of the service and here the service quality depends on the perception of the customers or stakeholders. At the periphery is the physical entities such as classroom, projector, etc. which also develops an idea of service quality. This in the tangible nature of quality of education provided by HEI. Both the intangibility and tangibility comprehensively creates a sense of service quality in the customers of HEI.

Measuring Comprehensive Marketing Intensity Indicator

In order to measure the comprehensive marketing intensity indicator each variable will be assessed on the basis of few questions both quantitative and qualitative and weights would be assigned from 0 to 2. Allotment of digits 0 to 2 has been chosen to make it simple yet comprehensive. While 0 may denote no substantial improvement from the status quo of the HEI with respect to several other factors, 2 on the other hand will imply the highest possible activism or improvement in the variable or meaning that the intensity is highest. 1 simply denotes an average position.

The questions selected for each variable are indicative and may be altered accordingly as and when required. However, here the most basic questions are presented pertaining to and relevant for the comprehensive marketing intensity indicator for individual assessment.

Table 1. Variable 1: HEI reputation

S.No	Question	Weights		
		0	1	2
1	Reputation of the HEI in previous few years.			
2	Ranking of the HEI in previous few years.			
3	The ratio of number of vacancies to total application received.			

Source: Prepared by researcher

Three questions have been posted to assess the marketing intensity with respect to the variable HEI Reputation. The first question specifically mentions the term “reputation” so as to assign weights to the perception related to general reputation. The general reputation can be measured by the mind by recalling reports, feedback etc. For objectivity this may be replaced by the mind with an easy question of how many people have given good feedback. Whatever may be the approach the individual will be bound to weight the question. The second question is related to the ranking of the HEI which is a quantitative value but may even be subjectively assessed by the individual. Here, recall that within a particular variable the questions will remain dependent on each other and if all would have been in quantitative terms their correlation would have given a specific idea about correlation among the questions as well as about the variable. However, the objective does not require us to do it. The third and the final question is a ratio between vacancies and applications received which can be both actual data (if available) and the

Table 2. Variable 2: Communication/media

S.No	Question	Weights		
		0	1	2
1	The budget of the HEI for communication/media advertising.			
2	The online discussion/ reviews of the HEI.			
3	The research projects/ findings are regularly communicated/ reported in the media.			

Source: Prepared by researcher

expectation. In other words an individual must have an idea about the rejection rate in an HEI to weight this question or should search for the data to determine the same. A low ratio or a high rejection rate will give more weights to the third question and a high ratio or low rejection rate will give less weight to the question. In this manner the individual can weigh the question and total score.

Table 2 presents the second variable, i.e. communication/media which covers the general and monetary meaning of advertising. First question encourages weighing the advertising on media/communication with respect to the budget of HEI. It can be easily decided by looking at the figures of advertising (if available) otherwise again a subjective assessment is required. In case of going for subjective assessment, the difference between questions one and third must be maintained because it appears that both are same but for the measurement of the indicator they are not. While for the assessment of the third question the movement is from the number of reports covered for the HEI, the first question is only related to the movement from HEI to the media, i.e. HEI approaches the media and not the other way round. Second question is related to the online reviews or discussions related to HEI. The potential students or in academic terms the stakeholders are involved in the forum discussing issues of HEI. This will give an assessment to the presence. A high presence on online forums and discussion will give more weight to the HEI otherwise less.

Table 3. Variable 3: HEI branding

S.No	Question	Weights		
		0	1	2
1	Popularity of the logo/motto of HEI.			
2	Popular academicians/professionals who are associated with HEI.			
3	Promotional events/sponsorship by the HEI.			

Source: Prepared by researcher

Table 3 lists other parameters to score HEI Branding. The first question focuses on the logo/motto of HEI. An attractive or popular logo/motto will get higher weight or vice versa. The second question is related to the popular academicians or professionals who consciously or unconsciously become the brand ambassador of the HEI and indirectly do marketing. HEI have also started organizing events for their promotion directly or indirectly along with sponsoring programs of one or the other type. The more the events and sponsorship to the credit of HEI, the more weight it has to be assigned, the less the number of events and sponsorship to the credit of HEI the less the weight it has to be assigned.

Table 4 is related to the last variable, that is, HEI quality of education and again three questions are assessed. The first question is related to the infrastructure facilities and their popularity. If they are highlighted by the HEI the more the intensity the more will be the weight assigned. The second question is related to the placements of the students which is the benchmark for several individuals for assessing the HEI. A good placement is itself a marketing strategy and thus it has been included here. Finally, the third question is related to the qualification of the teachers and the academic popularity.

With this the total number of questions in all four variables comes out to 12 and each would be rated on a scale of 0 to 2, where 0 means low intensity and 2 means high intensity. In this manner a final score will highlight the marketing intensity of the HEI. In order to discuss the probable outcomes and

Table 4. Variable 4: HEI quality of education

S.No	Question	Weights		
		0	1	2
1	The infrastructure facilities are highlighted and are popular of the HEI.			
2	The placement of the HEI nationally/globally is increasing.			
3	Teachers of the HEI are qualified and world renowned.			

Source: Prepared by researchers

their interpretation the weights would be totaled. In this manner the total score would be between two extreme outcomes represented in Table 5.

Table 5. Probable extreme outcomes

Particulars	Total Score
Minimum Score	0
Maximum Score	24
Total	24

Source: Prepared by the researcher

The minimum score total if 0 will indicate that the HEI has a negligible marketing intensity and it has to take serious measures to successfully commercialize its scope. On the other hand, a score total of 24 will means that the HEI is already involved in high marketing intensity, meaning thereby, that it is utilizing different dimension of marketing to achieve success and to commercialize its activities. However, the point to be noted is that it is expected the most of the time the total score will fall between score total 0 and score total 24. In such case the more the value is close to 24, the more has the marketing intensity and vice versa. With help of this weights score total, two HEI may be compared and all the mathematical functions of a ratio scale may be carried on for decision taking. Table 6 shows hypothetical scores of HEI for understanding interpretation.

Table 6. Hypothetical scores

HEIs	Total Score
A	12
B C D	20 5 10
Total	47

Source: Prepared by researcher

On the basis of the values of table 6 the interpretation of A and C HEI is possible. An example of mathematical interpretation of final scores (hypothetical) is presented in Table 7.

Table 7. Comparison between A and C HEI

Interpretation	Calculation
C has less marketing intensity than A by 58.33%	(12-5)/12*100 = 58.33%
A has more marketing intensity than C by 140%	(12-5)/5*100 = 140%

Source: Calculated by the researcher

A third HEI may be added to add other dimensions to the interpretation such as the information that HEI-B has a total score of 20. The additional comparative assessment is presented in Table 8.

Table 8. Comparison between A, B and C HEI

Interpretation	Calculation
A and C together have less marketing intensity than HEI-B by 15%	20 – (12 + 5)/20*100 = 15%
HEI-B has more marketing intensity than A and C together by 17.64%	20 – (5 + 12)/17*100 = 17.64%

Source: Calculated by researcher

Such analysis may be taken up further to take decisions regarding the position of HEI with respect to marketing intensity without using the quantitative data (it's not even available for public domain on such large variables/factors).

Limitations of Such an Indicator

The comprehensive indicator not only has limitations but also needs improvement. The prime limitation is the use of subjective assessment depending on the information, perception and knowledge of the person/ organization concerned. But the aim of parsimony is much more important in this respect.

CONCLUSION

The study has attempted to touch upon and highlight the term marketing intensity with respect to HEI and has attempted to measure and build a comprehensive marketing intensity indicator. This indicator can be simply used by individuals whether customers or stakeholders of HEI or even the HEI itself. Building such an indicator is a tough task in the presence of almost no studies focusing on development of such indicator for HEI. The indicator has considered only four variables and thus needs to be improved further. The conclusion reached to is that such an easy approach may minimize halo effect as well as hindsight. In addition to such finding, it must be pointed that scaling is an important constraint is building such an

indicator. This effort should be taken forward by other researchers in the future so that the limitations of present scale may be minimized. However, the first step as the most important one should be accepted.

FUTURE RESEARCH DIRECTIONS

Future studies should attempt to test the reliability of the data generated through this Marketing Intensity Indicator on the sample of Higher Educational Institutions. The studies should apply the indicator from the perspective of stakeholders as well as the institutions.

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ADDITIONAL READING

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KEY TERMS AND DEFINITIONS

HEI Branding: The marketing strategy promoting personalities of the institution to build a brand image.

HEI Reputation: The perceived goodwill of the higher educational institutions.

Higher Educational Institutions (HEIs): Educational institutions that are involved in graduate studies and research-oriented degree courses.

Hypothetical Scores: The scores demonstrated in the study as a sample for the real scores.

Marketing Intensity: A concept that attempts to measure the degree of marketing strategies applied for promotion of an organization or product or institutions.

Outcomes: The scores respondents will give to different dimensions of the measurement of marketing intensity as per the parameters.

Chapter 37
Accreditation of Medical Laboratories:
Challenges and Opportunities

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ABSTRACT

Quality test results generated by medical laboratories across the globe are critical for patient diagnosis and treatment. In addition, this is an area of healthcare that requires standardization. Accreditation is the formal recognition by an authoritative body noting that the clinical laboratory has an established quality

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management system and is competent to carry out specific tasks related to testing. The Strengthening Laboratory Management Toward Accreditation (SLMTA) program was established to strengthen national laboratory systems and to drive improvements that are immediate and measurable in developing countries, particularly those in Sub-Saharan Africa. This review seeks to look at opportunities that can be garnered by accredited medical laboratories and challenges in seeking accreditation during the implementation and operational states of the criteria of ISO 15189:2012. It also examines the progress toward clinical laboratories becoming accredited due to the enactment of the SLMTA in resource-limited settings.

INTRODUCTION

Services offered by clinical laboratories are critical to patient care in the healthcare sector. Therefore, they should satisfy the needs of patients and all stakeholders, including physicians. These services are a fundamental part of clinical decision making; laboratory results are the keystone for diagnosis, monitoring, and treatment of diseases. It is reported that approximately 60% to 80% of clinical decisions regarding patient management involve the use of laboratory data (Forsman, 1996). Such investigations are frequently more specific and sensitive than those limited to criteria related to clinical decisions (Mee, Fielding, Charalambous, Churchyard, & Grant, 2008).

Accreditation, as a valued tool for medical laboratories, is recognized worldwide as an effective means of validating the competence of the laboratory. This offers the highest standard of test results and services to clients, including patients and healthcare providers (Kawai, 2010). While accreditation of medical laboratories is mandatory in most countries, it remains voluntary in other countries (Handoo & Sood, 2012). Accreditation involves an independent or authoritative body that certifies that the applicant laboratory meets management and technical requirements and demonstrates competence to successfully complete specific tasks (Kawai, 2010).

International Organization for Standardization (ISO) 15189, based upon ISO 9001 and ISO 17025 standards, affords requirements for quality and competence of medical laboratories (Guzel & Guner, 2009). Many countries have adopted ISO 15189 for their accreditation of medical laboratories, particularly for improving the quality management system, technical competence of staff, and patient safety (Akyar, 2009). There is widespread use of the standard among medical laboratories as a self-assessment tool and by accreditation bodies for both certification and regulation (Handoo & Sood, 2012).

Medical laboratories seeking accreditation using ISO 15189 are faced with many challenges, including insufficient infrastructure, low management support, and increased documentation. Accredited medical laboratories enhance the credibility and competency of their testing services (Peter et al., 2010). On the other hand, medical laboratories that are accredited are known to improve the accuracy of their test results, facilitate rapid diagnostics, and decrease errors at the preanalytical, analytical, and postanalytical stages thus improving quality and safety of patients (Gough & Reynolds, 2000).

This article seeks to examine opportunities that can be garnered by accredited medical laboratories and challenges in seeking accreditation during the implementation and operational states of the ISO

15189:2012 criteria. It will also examine the outcome of the SLMTA program on the clinical laboratory quality and management system that was implemented in countries in Africa and the Caribbean.

BACKGROUND: ISO 15189 - AN OVERVIEW

The Working Group 1 of the Technical Committee ISO/TC 212, established in 1995, published the first edition of an international standard intended for medical laboratories known as ISO 15189 "Medical laboratories – Requirements for quality and competence" (ISO, 2003). To meet the needs of laboratories in the healthcare sector, ISO 15189 adopted the competency requirements of ISO 9001 and the quality system of ISO/IEC 17025.

ISO/IEC 17025, first issued in 1991, is the main ISO standard adopted and used by calibration and testing laboratories and is titled "General requirements for the competence of testing and calibration laboratories" (Akyar, 2009; ISO, 17025). ISO 9001, published in 1987, is adopted and used by organizations as it identifies requirements for a quality management system (QMS). It ensures that it reliably and consistently provides services and products that meet the expectations and requirements of regulatory bodies and customers (ISO, 1987).

The second edition of ISO 15189 was published in 2007. The third and most recent was published in 2012. Since the publication of ISO 15189 in 2013, it has been recognized officially by the International Laboratory Accreditation Cooperation (ILAC) as the international standard with a comprehensive management system used globally for the accreditation of medical laboratories. This is supported by a Joint IAF-ILAC-ISO Communiqué on ISO 15189 accreditation first issued in 2009 and revised in early 2019 when ISO 15189:2012 was published (Akyar, 2009).

The development of ISO 15189, as well as the subsequent publication of its three editions, signified a milestone on the journey toward improving quality and patient safety in laboratory medicine. It is accepted as a valuable guide in promoting the harmonization of new and established accrediting bodies and programs, as well as guaranteeing high clinical laboratory services in laboratory medicine and healthcare (Thelen & Huisman, 2018). ISO 15189 serves as a valuable tool used by clinical laboratories to comply with regulatory requirements of government or accreditation bodies, assess their technical capacity and competence, implement and develop their quality management system, and recognize or confirm their overall competence by accreditation bodies (Kawai, 2010).

ISO 15189:2012 is a complete standard that applies to all areas of a medical laboratory. It is divided into management requirements (concentrating on structure and function of the quality management system, effective management, and guiding policies and processes of laboratory operations) and technical requirements (concentrating on technical competence and matters relating to its processes and procedures) (ISO 15189, 2012). The management requirements mandate regular internal audits and management reviews to guarantee that the activities of the clinical laboratory are effective and adhere to the quality management system, and that there are continued opportunities for improvement. The technical requirements of ISO 15189:2012 demand effectiveness and implementation of the technical competence (Schneider et al., 2017).

The third edition of ISO 15189 sought to (Plebani & Sciacovelli, 2017; Schneider et al., 2017)

1. Guide laboratories to create a quality management system that reduces errors and implement preventative measures

2. Pinpoint opportunities for continued improvements
3. Promote continued evaluation of both the technical capabilities of staff and the quality management system providing opportunities for appropriate education and training of employees at all levels of the organization
4. Endorse the harmonization of all quality indicators
5. Evaluate and improve quality in the total testing process so that errors are reduced in the pre- and postanalytic phases
6. Highlight the flexible scope, allowing clinical laboratories to make all efforts to assure patient safety and total quality of results.

Many countries have embraced ISO 15189. In 2015, approximately 60 countries required medical laboratories to conform to the accreditation requirements of the standard (Schneider et al., 2017).

CHALLENGES OF MEDICAL LABORATORIES SEEKING ACCREDITATION IN DEVELOPING COUNTRIES

Laboratory tests that are accurate, reliable, and of a high quality are critical in guiding decision making in diagnosis and actions which are evidence-based for actual disease prevention, control, and surveillance and management of patient (Plebani & Sciacovelli, 2017). Medical laboratories are critical in providing quality service in health systems globally and compliance with international standard is verified through their accreditation (Antonelli, Padoan, Aita, Sciacovelli, & Plebani, 2017).

Over the last two decades, accreditation has emerged as a chosen framework for building quality and improving competence in medical laboratories in both developed and developing countries in which there are resource constraints (Peter et al., 2010). The accreditation of medical laboratories increases the quality of healthcare for patients, continues improvements in the quality management systems, and increases staff competence through training at all levels of the organization. This results in lessening of preanalytical, analytical, and postanalytical testing errors and associated reductions in inappropriate treatments (Peter et al., 2010).

Medical laboratories in developing and less developed countries, especially those in sub-Saharan Africa, have a critical role in supporting the health system. However, they are challenged with insufficient financial and human resources to support quality improvement. Medical laboratories in these resource-limited settings lack proper equipment, adequate funding, robust quality management systems to manage day-to-day activities, and adequate training for staff. This makes it a challenge to deliver reliable, accurate, and high-standard results (Bates & Maitland, 2006). Therefore, the under-sourcing and poor performance of these medical laboratories foster suspicion in laboratory results among physicians and the public (Woodcock, Fine, McClure, Unger, & Rizzo-Price, 2010).

IMPLEMENTATION OF SLMTA AND SLIPTA

With the goal of improving the quality of laboratory services in developing countries, including sub-Sahara Africa, Caribbean countries, and South East Asia, the World Health Organization (WHO) Regional Office for Africa (AFRO), in partnership with the United States Centers for Disease Control and Preven-

tion (CDC), the Clinton Foundation, and American Society for Clinical Pathology (ASCP), established the Strengthening Laboratory Management Toward Accreditation (SLMTA) program. This program is designed to deliver another approach to the establishment and training of quality management systems, as well as laboratory management in medical laboratories (Yao et al., 2010).

SLMTA is a hands-on, task-based training program to empower laboratory personnel in management with tools and skills required to implement and sustain the finest laboratory practices defined by the standards of ISO 15189 and 12 Clinical and Laboratory Standards Institute (CLSI) quality systems essentials. The SLMTA program comprises three key segments: (1) the checklist for Stepwise Laboratory Quality Improvement Process Toward Accreditation (SLIPTA) developed on ISO 15189:2007 standards; (2) an activity-based training program established on the SLIPTA checklist and for laboratory management using a framework structured into four levels of medical laboratories in a tiered health system (national, regional, district, and community levels); and(3) a task-based framework for laboratory management to assess performance of medical laboratories at various tiers of the laboratory system of a country (WHO, 2010). The goal of SLMTA is to assist medical laboratories in developing countries with training to implement the requirements of the quality management system of the SLIPTA accreditation process in a practical stepwise manner with subsequent achievement of accreditation status. The task-based curriculum of SLMTA involves three workshops and improvement projects for laboratory personnel with supportive site mentoring or visits. In the evaluation of the effectiveness of the training, an audit is conducted at baseline and after the implementation of SLMTA at exit using the SLIPTA checklist (Yao et al., 2014b).

SLMTA and SLIPTA were introduced to sub-Sahara Africa in 2009 by WHO-AFRO. SLIPTA replaces the WHO-AFRO Laboratory Accreditation Process for Laboratory Medicine in 2011 (Gershy-Damet et al., 2010). In the assessments of the medical laboratories enrolled in the SLMTA program, the WHO-AFRO SLIPTA checklist is used to gather and assess performance. The checklist is established on the CLSI (2004) guideline GP26-A3 and ISO 15189:2007 – Medical Laboratories – Particular requirements for quality and competence. The quality system essentials (QSEs) covers the stages of the quality cycle: process management (internal/external quality assessment); documents and records; information management (client management and process control); resource management (purchasing and inventory equipment); organization and personnel (facilities and safety, purchasing, and inventory); and improvement management (management reviews, corrective action, and internal audit).

There are 12 sections of the SLIPTA checklist encompassing 12 QSEs (CLSI GP 26-A3; 2004). Each is assigned a different weight in marks with a maximum of 250 points (Bates & Maitland, 2006). The score obtained by a medical laboratory enrolled in the SLMTA program as audited by the SLPTA checklist indicates the performance level. This decides the rating from 0 to 5 stars.

Based on the scoring system of the checklist, the laboratory audit score of 0-137 is assigned as follows: 0 star; 138-160, 1 star; 161-185, 2 stars; 186-211, 3 stars; 212-236, 4 stars; and 237-250, 5 stars (Yao & Luman, 2014).

OUTCOMES OF THE IMPLEMENTATION OF SLMTA IN DEVELOPING COUNTRIES

SMLTA is described as an organized tasked and quality-based improvement curriculum intended to accomplish tangible and direct advances in the delivery of health services. The program involves the implementation of the quality management system by translating the principles, standards, guidelines, and

concepts into applied behaviors and hands-on practice in the laboratory trainees' environment (Andiric & Massambu, 2015). Since its establishment in 2009, the program has been widely implemented in clinical laboratories throughout countries in Africa, Central and South America, Southeast Asia, and the Caribbean (Luman, Yao, & Nkengasong, 2014).

Most of the laboratories in countries such as Ethiopia, Kenya, Botswana, Lesotho, Zimbabwe, Ghana, and Namibia have developed a five-year laboratory strategic plan. This plan involves the implementation of a quality management system, laboratory strengthening, and accreditation goals. For example, the Ministry of Health in Kenya established a National Accreditation Committee to organize all accreditation activities with the goal to accredit all regional and national public medical laboratories (Gachuki et al., 2014). In Kenya, six blood transfusion centers in different regions and the Kenya National Blood Transfusion Service (KNBTS) were enrolled in the SLMTA program. The implementation of the SLMTA progress resulted in significant quality improvements in these centers, with an increase in the average baseline score from 38% to 79% at the exit assessment within two years (Wakaria et al., 2017).

Similarly, the Ministry of Health in Rwanda registered all 48 district and central public medical laboratories in the process involving preparation for accreditation (Nzabahimana et al., 2014). In Rwanda, three cohorts of a total of 15 medical laboratories were registered in the SLMTA program in 2010, 2011, and 2013. This included workshops and mentorships over a two-year period. It was reported that 14 of the 15 medical laboratories at baseline received 0-star ranking using the SLMTA checklist with significant improvements at exit. Four achieved 3-star, six achieved 2-star, five received 1-star, and four attained 4-star. Five laboratories earned three stars and four laboratories, including the National Reference Laboratory achieved four stars (Nzabahimana et al., 2014). Challenges to the implementation of the SLMTA program include the absence of quality manuals, which made it difficult to perform quality improvement activities (Nzabahimana et al., 2014).

The SLMTA program was exhibited in two consecutive cohorts of 45 laboratories in Ethiopia. There were improvements in average percentage of most of the medical laboratories using the SLIPTA checklist. Forty-eight percent of the second cohort laboratories and 61% of the first attained an elevation in star rating (Hiwotu et al., 2014). The authors noted that though the improvements were immediate and encouraging, more could be accomplished. There were challenges including the absence of harmonization among laboratories, nonexistence of a quality manual and standard operating procedures, and poor awareness (Hiwotu et al., 2014).

The Ministry of Health in Botswana sought to improve the quality of the laboratory services through the adoption of SLMTA. In 2010 eight medical laboratories were enrolled in the program. This included several quality improvement projects and workshops, as well as focused mentoring over a nine-month period (Mokobela, Moatshe, & Modukanele, 2014). There was an improvement in percentage scores from a median baseline score of 53% to a median exit score of 71% for seven of the eight clinical laboratories (Mokobela et al., 2014). The progress in the implementation of the quality management system was described as "slow" although the results were measurable and immediate, highlighting the need for additional mentoring and training activities (Luman et al., 2014).

In Lesotho SLMTA was executed in two cohorts involving 18 laboratories over an 11-month period. The results showed that there was an overall improvement in the audited star ranking using the SLIPTA checklist for most laboratories attaining a 0-star to achieving 1-star, 2-star, or 3-star. It was noted that the most significant improvement in audited score of any of the laboratories was 51% (Mothabeng, Maruta, Lebina, Wanyoike, & Mengstu, 2012). The authors found that the SLMTA program was an instantaneous, quantifiable, and positive influence on the laboratories in Lesotho (Mothabeng et al., 2012).

The implementation of the SLMTA program in Tanzania during a four-year period in the first group of medical laboratories resulted in demonstrated improvement audit scores using the SPLTA of 12 (243%) in cohort II and 2 (203%) in cohort I over baseline scores (Andiric & Massambu, 2015). Guevara et al. (2014) reported the impact of SLMTA mentorship and training program among five national clinical reference laboratories in four Caribbean countries over an 18-month period. Audits using the SLIPTA checklist were conducted at baseline, six months, exit at 12 months, and post SMLTA at 18 months. The findings demonstrated significant improvements of baseline audit score of 1-star (scores of 19% to 52%) on the 5-star scale of SLIPTA checklist to one laboratory achieving 4-star, two reaching 3-star, and two improved to 2-star after 18 months (Guevara et al., 2014). The authors noted that with an increase in the audit scores and star ranking there was a corresponding reduction in nonconformities and improvement in over 100 technical and management standard operating procedures in all five laboratories (Guevara et al., 2014).

Since its launch in 2019, the SLMTA program has been employed globally in 47 countries (Yao et al., 2014). There is evidence that the SLMTA training program produced measurable and observable improvements as mentorship empowers laboratory personnel and improves the quality management system using existing resources (Mothabeng et al., 2012; Yao et al., 2010). A comprehensive review of the SMLTA implementation in medical laboratories of developing countries noted that its success was based on a number of factors including early engagement of senior management and hospital personnel to guarantee their buy-in and ownership of the program, team spirit and commitment to sustainability among laboratory staff, promotion of a culture of quality, and solution of problems identified during the process (Nkrumah et al., 2014; Ntshambiwa, Ntabe-Jagwer, Kefilwe, Samuel, & Moyo, 2014). The trainees in the laboratories viewed the various constituents of the program as critical such as the know-how guidance delivered by the workshops, supervisory visits, improvements projects, mentorship and motivation, and accountability of leadership and other staff personnel (Nzombe et al., 2014; Yao et al., 2010).

The measurement of the progress made through performance scores and star ranking using the SLIPTA checklist were vital to the process (Maruti et al., 2014; Masamha et al., 2014). It is recommended that in order to improve on the gains made in the enrollment of clinical laboratories in the SMLTA program, each country should have a national laboratory policy and strategic plan, develop a technical working group, and provide adequate financial support. These measures should be promoted by their Ministry of Health (Mothabeng et al., 2012).

NUMBER OF ACCREDITATION MEDICAL LABORATORIES IN SOME COUNTRIES

Laboratory accreditation is a valued resource in the healthcare system. It substantially contributes to the management and organization of a critical aspect of private and public healthcare. More importantly, it contributed to clinical decision-making such as in prevention, diagnosis, therapeutic monitoring, and follow-up of the health status of patients. Medical laboratories that are accredited significantly improve the competence and credibility of the testing process and services offered to the public. Accreditation affords verification that clinical laboratories are following established competence and quality standards that are critical to produce reliable, accurate, and patient test results of the highest quality.

The advancement of the accreditation of medical laboratories in some developed and developing countries involves accreditation bodies (national or regional/international), laws and regulations which make compliance mandatory and the involvement of international or national standards such as ISO 15189 and CLSI which are linked to accreditation (Huisman et al., 2007). Accreditation of clinical laboratories in the countries in the European Union involves national accreditation bodies which are members of the European Cooperation for Accreditation (EA). The national accreditation bodies display different approaches toward laboratory accreditation and there are some who propagate the use of fixed scopes while others promote flexible scopes (Huisman et al., 2007).

The growing worldwide recognition of ISO 15189 since the publication of the third edition can be due to governments in some countries that make it compulsory for clinical laboratories to become accredited and increasingly public and private insurance requires it for reimbursement. According to the EA and ILAC regulations, an accredited laboratory must clearly state on their report the tests and services which constitute their scope. The national accreditation bodies in those countries are mandated to publish the accredited scope on their Websites. This will prevent over-estimation of accredited test and clients, including patients are able to enquire whether the service offered is accredited (Thelen, Vanstapel, Kroupis, & Huisman, 2015).

In a report by Huisman et al. (2007), 20% of laboratories in EU countries were accredited using exclusively ISO 15189 while the other used both standards (i.e., ISO 15189 and ISO 17025). In the United Kingdom, the new EN/ISO is an 89-aligned CPA guide that replaced the original CPA standards. In The Netherlands, 30% of clinical biochemistry laboratories offering tests are accredited to EN/ISO 15189. In Sweden, 85% of the laboratories are accredited, with a majority to ISO/IEC 17025 and the others to EN/ISI 15189 (Huisman et al., 2007). In some European countries (i.e., France and Belgium), accreditation of clinical laboratories is mandatory. It is voluntary in other countries (Thelen et al., 2015). In 2010, the accreditation body in France (Comité français d'accréditation [Cofrac]) began accrediting clinical laboratory with the goal of accrediting all laboratories by 2010.

The reasons for such dissimilarity among countries include interest and goals of national and regional accreditation bodies, the buy-in of key stakeholders both public and private, competence of staff, financial support, the availability of trained and competent assessors, and differences in experience (Huisman et al., 2007; Plebani, Sciacovelli, Chiozzo, & Panteghini, 2015). See Table 1.

In the U.S., clinical laboratories are accredited according to the CLIA guidelines for random and specialized laboratory testing by certified organizations (Huisman et al., 2017). Furthermore, in Argentina, the Argentina Accreditation Organization has signatory recognition agreements with inter-American accreditation cooperation (IAAC) and International Laboratory Accreditation Cooperation (ILAC). Medical laboratories are accredited by the standard IRAM ISO 15189:20146 (equivalent to the ISO 15189:2012 translated by the Standardization Organization of Argentina, Acuña, Collino, & Chiabrando, 2015). In Argentina, laboratory accreditation is voluntary. In the last 15 years, the Fundación Bioquímica Argentina in the last 15 years accredited 1,100 public and private clinical laboratories. It included over 7,000 assessments (Programa de Accreditación de Laboratorios, 2010). In Mexico, the ISO180 standard was adopted by the Mexican norm NMX-EC-15189-IMNC. This initiated accreditation of clinical laboratories in 2015. Between 2005 and 2009, 18 clinical laboratories were accredited. By 2015, accredited laboratories include 81 clinical and 4 blood banks (Quintana, 2015).

In Korea, the Korean Laboratory Accreditation Program (KLAP) was commissioned in 1999 by the Korean Society of Laboratory Medicine (KSLM) to promote quality improvement and improve the capacity of clinical laboratories. Over an eight-year period (1999-2006), the number of clinical laboratories

accredited (with a score higher than 60 out of a possible 100) in 2006 (n = 227) was approximately 2.4 times higher than in 1999 (n = 96, Shin et al., 2009). The success garnered by the KLAP in the increased accreditation of clinical laboratories was due to increased efforts relating quality control and training of accreditation offices through workshops and mentoring (Shin et al., 2009). In Thailand, the Thailand Medical Technology Council accredited 197 (24.2%) of the 724 clinical laboratories assessed with the other laboratories showing at least 70% compliance (Wattanasri, Manoroma, & Viriyayudhagorn, 2010).

In a survey conducted in May 2013 in 12 countries, 334 (91%) of the 380 accredited laboratories were in South Africa while the other 35 laboratories were as follows: Botswana (n = 6); Ethiopia (n = 1); Ghana (n = 2); Kenya (n = 8); Mali (n = 1); Mauritius (n = 1); Namibia (n = 7); Nigeria (n = 2); Tanzania (n = 1); Uganda (n = 5); and Zimbabwe (n = 1, Schroeder & Amukele, 2014. See Table 1. In Palestine, as of 2016, there were 14 hospital laboratories, 191 public and private laboratories, and one public health central laboratory. As of 2016, only the Central Public Health Laboratory under the country's Ministry of Health was accredited according to ISO 189:2012 (Abu & Najjar, 2018).

Table 1. Number of accredited clinical laboratories in some countries

Country	Number of Accredited Laboratories	Year of Reporting	Reference
Belgium	22 (10.0%)	2007	Huisman et al. (2007)
Czech Republic	3 (0.3%)	2007	Huisman et al. (2007)
The Netherlands	122 (30.0%) and 98 applicants	2007	Huisman et al. (2007)
UK	101 (9.0%) fully; 116 partially	2007	Huisman et al. (2007)
South Africa	276 private, 62 public & 7 research	2013	Schroeder and Amukele (2014)
Thailand	*197 (24.2%) of 724 labs. assessed*		Wattanasri et al. (2010)
Argentina	1100 public and private	2010	Programa de Acreditación de Laboratorios
Mexico	81 clinical and 4 blood banks	2015	Quintana (2015)
Jamaica	7	2019	JANAAC Website
Korea	227	2006	Shin et al. (2009)
Kenya	4 private & 4 research	2013	Schroeder and Amukele (2014)
Uganda	2 private & 3 research	2013	Schroeder and Amukele (2014)
Botswana	6	2013	Schroeder and Amukele (2014)
Palestine	1	2016	Seir and Najjar (2018)

Laboratories are accredited by ISO 15189. Results are presented as number of laboratories (% of total).

SOLUTIONS AND RECCOMMENDATIONS

Medical laboratories are an essential part of decision making and impacts different areas of health services such as screening, diagnosis, monitoring and prevention of diseases and therapeutic decisions.

Accreditation and certification of medical laboratories against an international standard safeguard the validity of the quality management system, encourages confidence among healthcare providers and patients, and facilitate constant quality improvements of services.

In many developed countries there are large-scale laboratory networks and efforts to implement accreditation can assist in fast-tracking improvements in the operational and quality management system. There should be initiatives aimed at strengthening various aspects of their national public health laboratory system in key areas such as policy and procedures, documentation, long-term strategic planning, procurement and inventory, instrument service maintenance, networking, staff competence and human resource management and training, and overall quality management (Peter et al., 2010). Strengthening the quality management system and improving laboratory capacity requires commitment from management, human and financial resources in order achieve improved performance and positive reinforcement.

It is documented in studies that education and on-going training among laboratory personnel results in improved quality of results and greater satisfaction among health care providers and patients. According to ISO15189, accreditation of medical laboratories requires that staff is competent to perform assigned task. Staff should be adequately educated with the requisite qualification for the job, and competence should be maintained and augmented with continued and proper documentation in personnel files.

In the preparation of a medical laboratory for accreditation, team-work is important. All staff members including technical and managerial should be involved in formulating, editing and proof-reading documents, participating in internal audits as well as in an external quality assurance program, and in continuous service improvement. This foster increased staff motivation and communication, as well as inclusive responsibility. In addition, on-the-job training of laboratory staff is vital for the success of accreditation as persons become an active participant and obtaining certification according to ISO15189 certification and elevates personnel gratification.

This chapter highlights some of the challenges to accreditation experienced by medical laboratories in resource limited countries such as those in the Caribbean and sub-Saharan Africa (Bates & Maitland, 2006). A large number of laboratories in these countries failed to deliver consistently accurate and reliable test results due to lack of equipment, absence of a proper service equipment program, inadequate financial resources and training of laboratory personnel, non-participating in external quality assurance program and lack of an organized management of work (Ndongmo, 2005). The implementation of the WHO-AFRO accreditation process and SLMTA training program provides a pragmatic, effective and stepwise process for recognizing and documenting progress towards attaining the full technical and managerial requirements of ISO1589 (Andiric & Massambu, 2015; Luman, Yao, & Nkengasong, 2014).

There is documented evidence of tangible improvements in the development of the quality management system and overall quality of many laboratories that were participants in these programs and there are those who attained accreditation to ISO15189 (Wakaria et al., 2017; Nzabahimana et al., 2014; Hiwotu et al., 2014). It is recommended that there should be further assistance from other international donor agencies and financial resources from governments which is critical to achieve measurable results and sustain laboratory service improvements. It is also recommended that these countries could establish a laboratory network model of supportive supervision and routine mentorship. In this model, there is peer review and assistance in achieving accreditation or less experienced and unaccredited medical laboratories are mentored by those who attain accreditation particularly in the managerial and technical aspects of ISO15189.

FUTURE PERSPECTIVES

Accreditation of medical laboratories validates competence and is an instrument aimed to improve the quality management system leading to improved standard of services to health care providers such as physicians, and patients. Accreditation is related reduction of errors, higher quality laboratory testing results, shorter turnaround time, accuracy of medical decisions, quicker and adeptness of treatment, and facilitation of the development of personalized medicine. The future of accreditation where there is laboratory-driven improvements due to structured and established processes, on-going quality assessment and systematic evaluation of performance could positive impact healthcare management as well as other sectors of the healthcare system.

In the majority of countries worldwide accreditation of medical laboratories remained voluntary. In some European countries such as Germany, Belgium, Austria and Switzerland, accreditation is affixed in national legislation. In most Western and Central European Countries the requisite for enactment of quality management systems in medical laboratories have been introduced into national legislation (Huisman et al., 2007). In the future it may become mandatory for all clinical laboratories to be accredited particularly in areas such as clinical biochemistry, haematology, histopathology and molecular biology. Countries that have affirmed mandatory accreditation of accreditation of laboratories for all areas of laboratory medicine include Hungary and France (Boursier et al., 2016).

In the last decade ISO15189 accreditation has been significantly impacting national, regional and international legislation. If clinical laboratories worldwide are to attain full ISO15189 accreditation, government commitment is of critically importance in assisting the process through making available adequate financial resources for the purchasing of up-to-date laboratory equipment as well as effective and opportune procurement of laboratory supplies and instrument maintenance services. It is noted that in some countries ISO15189 accredited medical laboratories have contracts with health insurance companies and government agencies are better reimbursed (Zima, 2017). Therefore in the future health insurance companies are more likely to conduct business with accredited laboratories as ISO15189 accreditation may become a prerequisite for reimbursement.

Today, although more medical laboratories are becoming ISO15189 accredited, there are still significant amount of unaccredited laboratories, especially in resource-limiting settings. Therefore in the future, ministry of health through their public health laboratories, professional medical and laboratory associations, national and international donor agencies and all health stakeholders must work together to ensure that ISO15189 becomes a high priority. There should be the promotion of structured and harmonized approaches to incorporate accreditation programs into national health programs, policies and planning, and the overall development of the health sector (Alemnji et al., 2014). In addition there is a role for public-private partnerships where combined financial and other resources to advance laboratory accreditation, sustain improvements in the quality management system and laboratory efforts, and improving the skills and competence of personnel (Alemnji et al., 2014). In the future, there need to be the creation of more national laboratory networks and a unified and integrated laboratory strengthening methodology to guarantee better management and efficient utilization of existing resources.

CONCLUSION

This review has demonstrated that there is increasing acknowledgement of the usefulness of accreditation of clinical laboratories globally as a means of improving quality, patient care, and safety in laboratory medicine. ISO 15189 is the most suitable and valuable standard for the accreditation of medical laboratories as it distinguishes the significance of each step of the total testing process. There are significant variations in approaches to accreditation of clinical laboratories. This is also a need for uniformity in the implementation of the concept globally using ISO 15189.

The experiences and outcomes of the implementation of the SLMTA program in developing countries described in this review demonstrate that it is able to attain international accreditation. The accreditation of clinical laboratories in both developed and developing countries has resulted in high quality test results, reduction in the frequency of laboratory errors at the different stages of the testing process, and improved patient care by supporting the accuracy and timeliness of medical decision making. Therefore, it is critical that the accreditation of public medical laboratories be given high priority by national agencies such as ministries of health. Programs of accreditation should be integrated into their planning, policy, legislation, and any healthcare system strengthening initiatives.

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KEY TERMS AND DEFINITIONS

Accreditation: Accreditation relating to medical laboratory is a procedure by which there is formal recognition of technical competence to perform particular types of clinical testing, calibration of equipment and measurement thereby creating confidence in results.

Competence: In relation to medical laboratory it is the capacity to execute activities according to well defined procedures resulting in testing results that are timely and accurate.

ISO15189: ISO 15189 Medical laboratories - Requirements for quality and competence is an international standard that stipulates the quality management system particularly the management and technical requirements of clinical laboratories. It is used to assess the competence of medical laboratories by regulating authorities, accreditation bodies and healthcare providers.

Medical Laboratory: A medical or clinical laboratory is a place where tests on biological samples are performed in order to obtain information about an individual health's relating to screening, diagnosis, therapeutic monitoring and disease prevention.

Quality: Quality as it relates to laboratory is defined as accuracy, precision, reliability and acceptable turnaround time of test results.

Strengthening Laboratory Management Toward Accreditation (SLMTA): A structured task-based laboratory program which train and mentor managers in resource-limiting settings to establish practical quality management systems yielding accurate and reliable results which support optimal patient care.

Chapter 38
Education Leaders' Utilization of Information and Communication Technology for Development in Nigeria

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ABSTRACT

The sample is comprised of principals, vice-principals, headmasters, and teachers as educational leaders in primary and secondary schools in Nigeria. The study adopted quantitative research design of the survey type to determine education leaders' perceptions on the adoption of information and communication technology. The quantitative approach in this study involves the use of research instruments consisting of closed-ended, on-line, and paper-based questionnaires (single version sent to multiple respondents). The study found out that education leaders have low perception on the adoption of information and communication technology for dissemination of information, utilization of virtual learning environments among teachers. The study also found out that lack of awareness on e-learning software and inadequate use of internet-enabled technologies or applications were highlighted as challenges in adoption of ICTs for development in Nigeria. The study recommended that educational leaders should make ICT adoption needs known to appropriate authorities.

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INTRODUCTION

Nigeria is one of the most populous African countries and its influence spread well beyond sub-Saharan Africa. Many of the developmental challenges experienced within the country are not unconnected to the level of Information and Communication Technology (ICT) usage. There have been a number of studies on ICT in Nigeria, most of which have focused on importance of ICTs in various sectors such as ICT in Nigerian legal system, ICT in the health sector system among others (Adeyeye & Iweha, 2005; Bamodu, 2004; Idowu, Ogunbodede, & Idowu, 2003; Olatokun, 2006). If ICT are imperative for teachers as well as enhances the quality of education, as Kwache (2007) and Akpan (2008) argued, the question, therefore, arises on the role of educational leaders in the use of ICT. In other words, is there any role being played by educational leaders on ICT usage in primary and secondary schools? Information and communication technology are electronic resources or media that are used to disseminate, receive, store and retrieve information, educational and learning content irrespective location and time. These media resources are the facilitators of educational delivery in the 21st century re-defining the specific of roles educational leaders especially in the primary and secondary levels of education.

Educational leadership is conceptualized in this paper as the involvement of school leaders and administrators in primary and secondary schools (Principals, Headmasters and Teachers) in facilitating relevant, timely, effective and equitable education. The position of educational leaders can be further seen in the context of local, national, and global changes and challenges of the 21st century. The role of educational leadership especially in primary and secondary schools have been modelled along seven critical roles, which are: facilitators of change, architects of school culture, leaders of learning, leaders for professional development, links to parents and communities, strategic communicators, and data-based decision makers (Alas, Tafel, & Tuulik, 2007; Bell & Chan, 2005; Bezzina, 2002; Deal & Peterson, 1999; English & Steffy, 2005; Fullan, 2001; Leithwood, 1996; National Policy Board for Educational Administration, 2008; Normore, 2004; Organization for Economic Cooperation and Development, 2008). The indispensable role that ICT play in world is not limited to the economic sector, the field of education has also been affected by the penetrating influence of new ICT such as phones, email, and the World Wide Web. Apart from enhancing teaching and learning through its dynamic, interactive, and engaging content; ICT also provide real opportunities for individualized instruction (Yusuf, 2005) bringing about new modes of instructional delivery system and bridging digital divide. ICT can make schools more efficient and productive by providing opportunities to communicate through email, mailing lists, chat rooms, learning management systems and so on. ICT also offers faster and easier access to broader and current information, and it can be used to compute mathematical and statistical calculations (Kirschner & Woperies, 2003; Yusuf & Onasanya, 2004).

Background

ICT in Nigeria brought significant changes to almost all aspects of the peoples' lives in recent years. It has transformed activities such as the way people work, communicate, shop, travel, and even enjoy leisure time. The rate of change does not indicate any sign of slowing down rather, developments of ICT and its applications to areas such as education are continuing to grow, albeit, not at a fast rate as expected. However, in a relatively short period of time, acquisition of ICT skills in Nigeria have become as fundamental to living as being able to read, write, numeric ability (Okafor & Malizu, 2014). One of the most central concerns in the current drive for ICT development is the role of school leaders in

enriching environments for teaching and learning through utilization of information and communication technologies. This is underpinned on influx of ICT in the African environment in general as reported by Ponelis and Holmner (2015), Africa had an estimated 63% mobile-cellular penetration as of 2013, 16% of Africans are using the Internet; 7% of African households have Internet access; annual household Internet access growth stands at 27%; less than 10% of wired broadband subscriptions have speeds of 2 Mbps or more; mobile broadband penetration has increased from 2% in 2010 to 11% in 2013. This further underscore the significance of exploring how educational leaders through ICT can help in the development of Nigeria.

Education and Development Through Information and Communication Technology

Education is seen as one of the areas that is deeply affected or influenced by technological advancement (Kozma, 2005). Technological advancement in the area of education has ensured that quality education can be given in an effective and efficient manner through digitalized pedagogical curricula (Oluwasusi, 2014). It is also seen as a determinant for economic and social development worldwide (Leach, 2008). ICT promotes human capital development and allows for improved physical development and prompt access to information about the availability and management of natural resources (Oluwasusi, 2014). Socially, it ensures efficient connectivity and an opportunity to network and communicate with those not within immediate reach, thereby, not making distance an obstacle to communication.

The demand for ICT literacy is increasing in Nigeria schools because teachers realize that computers and other ICTs can enhance efficiency on job performance. On the other hand, teachers have also realized that ICTs can be a threat to their jobs, and the only way to enhance job security is to be literate in ICT (Adomi & Kpangban, 2010). It should be noted that developments in the Nigerian education sector indicate some level of ICT application in the secondary schools.

This is because the Federal Government of Nigeria in her national policy on education recognizes the important role of ICT in the modern world, and has integrated ICT into education in Nigeria. The National Policy on Education document states that government will provide basic infrastructure and training at the primary school and the junior secondary school (Federal Republic of Nigeria, 2004). Furthermore, computer education which have ICT as a topic is made a core-subject in the new science and technology curriculum. The government also aims at providing necessary infrastructure and training for the integration of ICT in the secondary school system (Federal Republic of Nigeria, 2004). For education to develop through information and communication technology, it has to go through two foundation stages; ICT for education and ICT in education. ICT for education also known as the ICT emerging phase refers to education leader's attendance seminar workshops and symposium potentials of integration ICT into the process of education, strategic steps to be taken for full integration of ICT in educational process. ICT in education refers to the infusion stage. This is the level at which education leaders are willing and ready to deliver instructional content through the use of ICT. At this point, ICT is not perceived as hinderance to delivery rather a catalyst for efficient and effective delivery of contents, Kingsley (2017). In discussing the status of ICT in schools in Nigeria, Ololube (2006) examines the impact and uses of information and communication technologies (ICTs) as well as issues underlining the integration of ICTs in teacher education programs in Nigeria. His findings suggested that, the respondents were frustrated with the lethargic use and integration of ICT in both states and federal government owned institutions in general and teacher education programs in particular. In another research which focused on Nigerian

secondary schools' teachers' usage of ICTs, the findings showed that most teachers regard ICT as very useful in teaching and learning easier. However, there is a need for professional development policies that support ICT related teaching models especially those that strongly encourage both teachers and students to play an active role in teaching activities (Hennessy, Harrison, & Wamakote, 2010). Achimugu, Oluwagbemi, and Oluwaranti (2010) described how ICT diffusion has affected the education sector in Nigeria noting that the challenges facing ICTs utilization or diffusion in Nigerian schools include: inadequate infrastructure, inadequate skilled manpower, resistance to change, and inadequate funding. It is important to note that, the researchers did not report total absence of ICT in the Nigerian education sector rather the facilities are not sufficient for adequate and optimal utilization. This gap calls for the assessment of the education leaders' utilization of ICT in Nigeria for development.

Conceptual Framework

The conceptual framework for this study is drawn from the study of Bagozzi (1989) stating that, for stakeholders to use any information or communication technology, the individual perception of usefulness and perception on ease-of-use are important factors to be considered. Perceived usefulness is the extent to which individuals or stakeholders' belief that using the technology is useful for their job performance while perceived-ease-of- use is considered as the degree to which the same individual or stakeholders' belief that using the technology does not require much effort, physically, mentally, financially among others external variables that could influence perception on usefulness and ease-of-use. Contextualizing this model within the Nigerian context requires a review as it cannot be applied as developed because of the Nigerian dynamics in the utilization of ICT among education leaders. Therefore, this study is modifying perceived usefulness with perceived utilization of ICT (internet), this views education leaders perception that, they are using the internet within the confines of the school environment for e-mailing among others. Perceived ease of use is modified with perceived use of email services. These modifications are essential because Nigeria is still within the emerging phases of ICT for education, this is a state in which the utilization is still limited, to the education leaders: teachers, principals, headmasters are still attending symposia, seminars and workshop on ICT.

Research Objectives

The aim of this study is to investigate educational leaders' utilization of ICT in schools. The specific objectives are:

1. To examine educational leaders utilization of ICT (internet) within their schools (Schiller, 2003; Ertmer & Ottenbreit-Leftwich, 2010; Kim, Kim, Lee, Spector, & DeMeester, 2013; Aldunate & Nussbaum, 2013; De Smet, Bourgonjon, De Wever, Schellens, & Valcke, 2012; Kruse & Buckmiller, 2015).
2. To examine the perception of educational leaders on the utilization of electronic mail (e-mail) and telephones in school (Garton & Wellman, 1993; Huang & Lin, 2009; Lightfoot, 2006; Weber, 2004).
3. To investigate of educational leaders perception on Virtual learning environment for school growth and development (Fetaji, Loskovska, Fetaji, & Ebibi, 2007; Jaligama & Liarokapis, 2011; Ketelhut & Schifter, 2011; McLuckie & Wesel, 2010; Semradova & Hubackova, 2013).

Method

The study used quantitative method, this involved the use of research instruments consisting of both online and paper-based questionnaires. Data were gathered by means of a survey questionnaire that was sent via Google Form link and paper-based questionnaire, the Google Form link and paper-based questionnaire were employed in other to cover the respondents across the specific regions of the federation and to also cater for access to emails, the paper-based questionnaire was employed. The questionnaire focused on demographics and subscales measuring the variables in the study: internet usage in school, use of electronics mails and telephones electronic mails and Virtual learning environment for school growth and development. A statistical test was used to assess the internal consistency of the ICTs adoption scale in Nigeria primary and secondary school context. The research objectives for are answered using means scores at 3.00 level of significance and Pearson Correlation.

Participants and Data Collection

Participants were teachers and head teachers from different parts of Nigeria. One hundred and thirty-two (132) respondents, representing a response rate of 86.4%, completed the questionnaire. Twenty questionnaires were discarded due to incomplete information. Among these participants that completed information online (Google Form) and on paper, 62% are teachers while head teachers stand at 38%. In terms of geographical location of the respondents 37% from the North West, 14% from North Central, 2% from North East, 42% from South West, 2% from South East and 5% are school leaders who are on study leave to pursue a postgraduate degree in another country. Based on Federal Ministry of Education (2015) report, Nigeria has 61,305 schools. The National Bureau of Statistics 2014 report showed that there are 574,579 teachers in primary schools and 170, 628 teachers in public secondary schools. This figure includes that of head teachers. The target population for this study is the addition of teachers in primary and secondary in Nigeria public, which is 745, 207 teachers and head teachers in public schools. According to Krejcie and Morgan, for a population of 1 million, 384-sample size is adequate. A stratified random sampling technique was adopted to select emails of 400 teachers and head teachers from the school directory based on six geo-political zones in Nigeria. However, only a handful of 152 entered the survey, while only 132 completed the survey after weeks of follow-up. Therefore, the study relies on the data collected from the online survey rather than the estimated sample size. More so, none of the printed copy of the survey that was sent via post was returned. A clear instruction about the aim and objectives of the study was written on the questionnaire. Equally, participants were informed that they have the right to withdraw during or after the data collection.

Instruments

A self-report questionnaire was developed for the survey. The survey measured three constructs and a total of 27 items on use of internet in school, use of electronic emails and telephone and virtual learning environment. Respondents were asked to indicate the items on a five-point Likert scale ranging from strongly disagree (1), disagree (2), Neutral (3), to agree (4) and strongly agree (5). The questionnaires were distributed and collected within four weeks. The questionnaire approximately took participants about 20 minutes to complete. Each item was coded so that the higher the score, the more positive the level of entire constructs would be. These items were adapted from previous literatures and were found

to be reliable. To test for the internal consistency of the questionnaire, a pilot study was conducted using 30 in-service teachers in two secondary schools in Lagos state. The test shows an impressive result, for instance, the items measuring the use of internet in school use of electronic emails & telephone and virtual learning environment showed Cronbach alpha of 0.505, 0.762 and 0.777 respectively. The overall Cronbach alpha for the entire 27 item that represents ICTs adoption in schools is 0.849. The scale appeared to have good internal consistency, all the items appeared to be worthy of retention.

The research instrument was structured into four parts, namely; Demographic information and school profile, Perception of internet usage for School growth and development programs, Use of electronic mail (e-mail) and telephones electronic mails, Virtual learning environment for school growth and development. It is important to note part of the questionnaire used for this study was also adapted from Bolu (2012). The research objectives for the study are answered using means scores and Pearson Correlation. The research objectives for are answered using means scores at 3.00 level of significance and Pearson Correlation.

Results

This section outlines the findings from the questionnaire and is presented according to the main themes: Perception of internet usage for School growth and development programs; Use of electronic mail (e-mail) and telephones electronic mails; Virtual learning environment for school growth and development.

Table 1. Perception of internet usage in school

	N	Mean	Std. Deviation
The Internet is a distraction that schools should stay out of.	132	3.826	1.0593
The School does not have enough money or human resources to use the Internet effectively.	132	3.205	1.2524
The School can reach people on the Internet.	132	1.879	.8998
If a School just communicates well, people inside and outside the school will get excited with what is happening and are connected with others in the community?	132	1.871	.7141
If a School is after quality, people inside and outside the School will figure out everything, they need to know and be connected with others.	132	1.818	.6970
In Nigeria, more people are turning to the Internet to find personal, social and educational information.	132	1.621	.7866
The Internet is where people now spend a large proportion of their leisure time.	132	1.538	.7557

The result from Table 1 shows the perception of internet usage in school amongst education leaders in Nigeria educational institutions. This result shows that the leaders have a negative perception towards adoption and usage of internet in schools. This is very glaring as the average score on most of the items is below the anchor point of 3.00. For instance, the leaders disagreed with the statement that "The School can reach people on the Internet" (Mean=1.879, SD=0.8998). Similarly, the principals and school administrators were asked, "The Internet is where people now spend a large proportion of their leisure time" the Mean score for this statement was 1.538 with standard deviation 0.7557. This shows that the school leaders are not willing or do not believe in the adoption and usage of internet for

communication in school. On the other hand, the school leaders do agree with the statement that "The Internet is a distraction which schools should stay out of". It seems to be quite unusual in this digital age that school leaders in Nigeria are still trapped in the myth that technology is harmful to education progress—a belief, which has been de-authenticated in several countries in the world. This point to the reason why many graduate in Nigeria schools lack the basic computer skills.

Table 2. Use of electronics mails and telephones electronic mails

	N	Mean	Std. Deviation
School telephone is Internet-enabled	132	3.886	1.0459
School leaders normally communicate with parents, visitors or staff members by e-mail?	132	3.364	1.0504
School have email directory of members?	132	3.174	1.1558
School leaders can communicate using the telephone chat services?	132	3.091	1.2009
School leaders communicate with members through emails?	132	2.939	1.1172
School provide email addresses for School staffs?	132	2.894	1.2185
School leaders have specific email for school functions such as teaching/learning, counseling, enquiries, etc?	132	2.545	1.0141
School have specific telephone numbers for school functions such as academic, non-academic, enquiries etc?	132	2.061	1.1172
School normally reach all visitors and/or staffs by telephone call or SMS?	132	1.879	1.1461
School have an official email address?	132	1.598	.9317
Staffs have personal e-mail addresses?	132	1.568	.9180

The result from Table 2 shows the perception of the use of electronics mails and telephones electronic mails amongst education leaders in the selected Nigeria schools leaders. The findings reveal that leaders have adverse perception towards of electronics mails and telephones electronic mails in schools. For instance the leaders disagreed with the following statements that "School leaders communicate with members through emails (Mean=2.939, SD=1.2185), "School leaders have specific email for school functions such as teaching/learning, counseling, enquiries" (Mean=2.545, SD=1.0141), "School normally reach all visitors and/or staffs by telephone call or SMS" (Mean=1.879, SD=1.1461). In contrary to this, the leaders agree with statements that "School telephone is Internet-enabled" "School leaders normally communicate with parents, visitors or staff members by e-mail". This may seem to be a contradictory result, but leaders disagreed with most of the statements mentioned under the use of electronics mails concept as the mean score for most of the items are below the anchor point of 3.00. This indicates that the school leaders are wary about the adoption and usage of internet for communication in school.

As described in table 3, the sets of school leaders' perception towards the adoption of a virtual learning system in school, was explored in this study. Nine virtual learning items were chosen. For most items, respondents' ratings varied from strongly disagree (1) to strongly agree (5). For all the nine statements. Most of the mean ratings were below the threshold point of 3.00, which indicate that overall there were more respondents who "disagreed" than "agreed" with all of the virtual learning perception items. The lowest mean rating (1.492) was for an item of "Virtual learning on the Internet assist in teaching and learning of students and staffs." The highest mean rating (3.871) was for the item "Teaching and learn-

Table 3. Virtual learning environment for school growth and development

	N	Mean	Std. Deviation
Teaching and learning on the Internet more of a nuisance/cost than an asset for school growth and development?	132	3.871	1.2132
Leaders upload the assignments, classwork, quizzes, etc on the school website for people to download.	132	3.250	1.0869
School have a Learning Management System for staffs.	132	2.962	.9761
School leaders heard of / or used any e-learning software?	132	2.871	1.0730
School leader plan to use google apps for education, class on the web, Moodle, blackboard, etc e-learning software.	132	2.864	1.2092
School have a computer-based Learning system.	132	2.689	1.0421
School open up a number of channels in format of forums, discussion threads, polls, surveys – instant feedback either as a group or individually.	132	2.545	1.0066
Virtual learning on the Internet assist in teaching and learning of students and staffs.	132	1.568	.7930
Virtual learning on the Internet assist in the process of acquisition of knowledge.	132	1.492	.6934
Valid N (listwise)	132		

ing on the Internet more of a nuisance/cost than an asset for school growth and development." These results seem to be rather unusual, given the fact that there is a massive global transformation in education and schooling system. It is quite absurd to find out that education leaders (teachers and senior teachers) in Nigeria primary and secondary schools still have a strong attachment to the face-to-face traditional teaching methods. One can infer from these results that virtual learning systems are lowly perceived to be of importance by Nigerian education leaders in secondary schools.

Generally, the distributions school leaders' perceptions of ICTs adoption items were moderately normal. The values of skewness and kurtosis are within acceptable value -1.05 and -0.87, -0.34 to -0.73, and -0.45 and -0.87 respectively. Correlations for the summated items for internet usage, use of electronics emails and virtual learning are shown in Table 4. Use of electronics emails and virtual learning were strongly positively correlated, r (132) = .709, p< .05. Internet usage and virtual learning are weak but positively correlated, r (132) = .294, p <.05. Internet usage and use of electronics telephone are weak but positively correlated, r (132) = .217, p <.05. The correlations among three variables measuring

Table 4. Correlation analysis

		Mean	Std.	Perception Internet usage	Use elect mail telefon	Virtual learning
Pearson Correlation	Perception Internet usage	2.2511	.39632	1.000	.217	.294
	Use elect mail telefon	2.6364	.59183	.217	1.000	.709
	Virtual learning	2.6793	.61331	.294	.709	1.000
Sig. (1-tailed)	Perception Internet usage			.	.006	.000
	Use elect mail telefon			.006	.	.000
	Virtual learning			.000	.000	.

perception of ICTs adoption in school are relatively moderate, ranging from 0.217 to 0.709. However, among the three variables, the correlation between virtual learning and use of electronic telephone email is high (0.709), but correlations between internet usage and use of electronic email and internet usage and virtual learning are quite weak (0.217 and 0.294). Although correlations between these variables are weak; however, the pattern was consistent with our design.

In summary, the results of correlation analysis indicate a positive relationship among the indicators measuring perception of ICTs adoption among Nigeria school leaders. Although, the perception is weak. For instance, if the leaders' perception of the need to use electronic telephone and mail in school increases, it will lead to increase in positive perception on adoption of the virtual learning system. Similarly, an increase in perception on internet usage will reinforce the degree of perception of the use of electronic email.

DISCUSSION

The result on the perception of school leaders on the usage of ICT showed a negative perception. This could be attributed to the fact that; the school leadership have large number of subscribers or student enrolment in government owned schools. This might prompt the negative perception on the use internet to reach substantial number of clients. Interestingly, the respondents agreed that, the internet is not a source of distraction which school leaders should not deploy to render services.

On the use of emails and telephone, majority of the respondents agreed that, the internet, there is an official email address but there is no officially-designated email addresses to individual school leaders. This will ultimately lead to lack of dissemination of information through the use of email services to within and outside the school premises. However, the respondents have preference for telephone calls originating from parents and guardians of respective students and preferred to use SMS to communicate with the parents and guardians because it is the most cost effective.

The use of virtual learning environment is school can be a catalyst for the exponential development of students as well as the environment in which they study. A sizeable number of respondents observe that their school open up channels in the format of forums, discussion threads, polls, surveys – instant feedback either as a group or individually. This can help speed up communication process and aid learning significantly. However, not many indicated that they have a computer-based learning system; this is a serious drawback. Since a computer-based learning system provides an opportunity for multiple learning styles and can be effective to certain students in aiding their learning capabilities. In addition, there is also an indication of the result of this study that learning Management System for staffs is not often taken seriously; this hampers the development of the school and the country as a whole. In fact, not many school leaders are aware of the opportunity inherent in virtual learning in terms of uploading assignments, class work, etc. This is inconsistent with finding of Hashim, Bakare, & Hassan (2015). They indicated a lack of awareness of e-learning software such as googleapps for education, classontheweb, moodle, blackboard etc. However, a substantial number of educational leaders made it quite clear that virtual learning can assist in teaching and learning of students and staffs as well as in the process of acquisition of knowledge. This shows that the problem may be a lack of facilities and utilities that can aid the use of virtual learning such as constant or stable power supply. This assertion is further confirmed by the significantly low number of the respondent who agrees that teaching and learning on the internet are more of a nuisance/cost than an asset for school growth and development.

Also, the comparison between primary and secondary school leaders on adoption of ICT components indicate that the perception of leaders at both levels (primary and secondary) are not different. The leaders do not support the introduction of the virtual learning system, electronic mail and use of the internet to aid teaching & learning as well as administrative functions of the school. This supports the argument of Yusuf (2005) that the backwardness of the African continent is as a result of a hostile attitude towards ICT adoption initiative.

FUTURE RESEARCH DIRECTIONS

Future studies could include hypothesis in this study. Also, because we are not testing a model, we believe the research question and research objective are sufficient. Moreover, the research here was conducted exclusively on school leaders, therefore, there is need to explore other context, in order to know if the same types of understanding and considerations apply to them. Lastly, this study did not make any attempt to use multiple regression through latent construct, i.e. structural equation modeling because this may change the direction of the research with assumption that construct validity has not been conducted at all. Specifically, this may again shift the main goal of investigating the perception of school leader towards the use of ICT to development of instrument for measuring ICT use in Nigeria schools. Therefore, future studies could explore the development of instrument for measuring ICT use in Nigeria schools and to what extent are they utilized for progressive change in the country. This will help in confronting various developmental challenges affecting different strata of the country.

CONCLUSION

The present study contributes to the growing discourse on the effectiveness of ICT and educational leadership. It assesses the impact of communication on the management of schools and school leaders and highlights the issues that are pertinent to the educational development in Nigeria. It also provides justification that there are significant roles to be played by educational leaders in developing and encouraging an ICT environment for schools for growth and development. At the same time, Information and Communication Technology must be seen as a strategy to bring about development. In order to tackle the issue, a more holistic approach is required to ensure computer literacy for teachers and students and to extend school outreach for wider impact.

The findings demonstrate the school leaders in Nigeria still moored to the perception that technology is harmful to education progress. It is plausible that this perception contributes to the low level of ICTs literacy among Nigeria pupils as argued by Aduwa-Ogiegbaen & Iyamu (2005).

The study has implications for policymakers to support the allocation of more spending on communication facilities and to consciously observe structural shifts in communication strategies. This will help in bridging communication gap and ensure effective information management system among educators in the nation. More so, adoption of ICTs use policy in school by the policy maker will further inculcate the spirit of decency and progressive education and will enhance the employability skills of the students in schools.

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KEY TERMS AND DEFINITIONS

Communication: It is the act of conveying meanings from one entity or group through the use of mutually understood signs, symbols, and semiotic rules.

Development: It is the process by which the well-being and quality of life of a nation or region are improved.

Information: This is facts provided or learned about something or someone. It could also mean what is conveyed or represented by a particular arrangement or sequence of things.

Nigeria: It is officially the Federal Republic of Nigeria. Also, it is a federal constitutional republic comprising 36 states and its Federal Capital Territory, Abuja. Nigeria is located in West Africa and shares land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north.

Technology: A sum of techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives.

Utilization: The action of making practical and effective use of something.

Chapter 39
Redefining Chemical Engineering Education in Romania Between Massification, Atomization, and Performance

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ABSTRACT

Chemical engineering and higher education profile in Romania have a prestigious tradition. Declared a national priority, Romanian higher education has developed and has become a mass education. There was an extension and uncontrolled chemical engineering education, especially environmental engineering. In addition to traditional chemical engineering, education has appeared in places without a university tradition; new universities and faculties of study in this area and other universities and colleges have expanded the frontiers of research in education for green engineering. The study majorly focused to explore extent of chemical engineering career intention and to explore the relationship exist between engineering environment intentions with selected independent variables. The results show that demographic decline, decreased social inertia, and brain drain made the interest in chemical engineering and environmental study decline. In these circumstances, the present competition between providers of education in chemical engineering and environment is tough.

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INTRODUCTION

Revolution from December 1989 brought to Romania prospect of great change (Moldovan, 2012). By 1990, heavy industry was a real "engine" of the economy was centralized and seconded closely by the chemical industry; with the transition to a market economy, the situation has changed dramatically for the chemical industry (Oprean, 2007). Unable to adapt to new conditions, many chemical plants were closed and therefore employment opportunities in chemical engineering have declined severely.

In Romania, education is declared a national priority, meaning that the Romanian higher public education is free, during the legal duration of studies. In 1989, in the higher education system were 46 public universities, which numbered a total of 164 507 enrolled students. Currently, the number of students increased almost fourfold and universities (public and private) reached the number of 103. The number of students has tripled in the last decade, reaching almost one million, while the exact number of students in private universities is not known, many of them refusing to report on all entries (Nicu, 2016). Unfortunately for Romania a sad phenomenon "brain drain" of highly qualified human resources leaves the country to work on much higher salaries in the Occident. This way, the investments in such human resources who decide to emigrate have no purpose for the Romanian state (Kozma, 2008).

International experience has shown that the funding of the public higher education system in order to meet present needs is the following mixed nature: a core funding from budgetary allocations, to ensure free access to education, the quality and consistency of the learning process, an additional funding obtained by the institution through their own efforts and resources other than the State Budget (Waters-Adams, 2006). Thus, education can be supported through scholarships, study loans, fees, donations, sponsorships, own sources and other legal sources (Creswell, 2008). The financing of education is made from the following sources: state budget (central or local), sources of population shares of companies for education and education (transportation, supplies, uniforms), donations, sponsorships, own income of educational institutions (research, rent, tuition fees etc.) and other external resources (grants, external loans granted by foreign financial institutions).

Meanwhile, a milestone in the reform process was the replacement of the financing of budgetary chapters with the global finance of the university based on institutional contracts with the Ministry of Education. This change was a way to get better performance in education and research through a better management of financial resources. Thus, the financing of public universities will also be determined by performance and by efficiency criteria. Thus, since 1999, the means of financing higher education have changed, and it passed to a methodology for allocating the budget allocations based on formula (quantitative component) and based on the fundamental principle "resources follow students." Since 2002, the methodology for allocating the budget allocations for base university funding was complemented by a qualitative component, continuously updated during 2003 - 2015. However, the state budget is the main source of funding for education (Damian, 2012).

Regarded as educational and training activity, education is materialized in two forms, closely related: first as a process of transmission - reception of information and then a lengthy process of storing and checking them gradually. In other words, on short term, education is a consuming activity of National Income and on long term an investment in human resources process (Dobbins, 2011).

In order to get a full picture of the chemical engineering educational system in Romania, we could state that there are four major universities (located in major university centers: Bucharest, Timisoara, Cluj-Napoca and Iasi) preparing graduates in areas of chemical engineering: Inorganic Chemical Technology and Environmental Protection, Organic Chemical Technology, Technology of Macromolecular

Compounds, Technology silicate and oxide compounds, and exclusively in Iasi in addition Textiles and Leather chemistry; To these are added and two specialized centers exclusively on academic preparation in Chemistry Oil and Gas (Ploiesti) and Food Chemistry (Galati).

Currently in Romania higher education institutions chemistry and environmental engineering course has been offering but in the country number of graduating students in various discipline increases from time to time where government organization cannot hire all of them. It is not exceptional also in the case of chemical engineering under graduating students. The students prefer engineering as their career option when they have chemical engineering career intention. This is due to the fact that an chemical engineering career intention is primary step to pursue engineering career. In previous studies, factors which affect the chemical engineering career intention has mostly been studied in higher education institute considering different fields together in Romanian context and the finding leads to have mixed result of the chemical engineering career intention. Little is known in the case of engineering under graduating students. Thus this study aimed to fill this gap so that the finding broaden our insights about chemical engineering career intention of the undergraduate engineering students in Romania According to this study the major objective is to determine the extent of chemical engineering career intention moreover to know the relationship between some selected independent variable and chemical engineering career intention of engineering students.

BACKGROUND

At the beginning of 1990, an explosive growth occurred in economic sciences and legal entities. Thus, if in the academic year 1990-1991, over 56% of students studying in technical Romania, in 2012-2013 reached a rate of only 21% of all students (including private education). Even if the market it was saturated by economists, however inertia society was extremely high, there is a high demand for this area. In the absence of any strategic directions labor employment, most young people have turned to areas of preparation time dictated by the interests of the market. Nobody knows but the market needs to be 5-10 years and what will happen to young people trained in a system without contact with the labor market (Nicu 2016).

Few newly established university with specializations that include profiles of chemistry and environmental engineering received ratings D and E, the worst, being at the top universities in Romania tail. Most of them had a poor teaching and research infrastructure (Geven, 2010). However, they have managed to become attractive because it allowed easy access to a diploma (Soltys, 2015).

Many studies on the labor market in recent years have shown that employers are wary of new university and private graduates appeared and of questionable quality (Fairweather, 2005; Goyette & Mullen, 2006; Nicolescu 2007; Roksa, 2005; Geven, 2010; Jay, Rose & Milligan, 2017). Universities that graduate out very easily destroy competitiveness and create an imbalance in the labor market, and this is reflected in a high unemployment rate (Burke & Onwuegbuzie, 2004) . Another study on assessment of chemical engineering career intention of undergraduate students revealed that there is significant relationship between the chemical engineering career intention and attitude toward environmental support (Espenshade, Hale & Chung, 2005).

To put it in a nut shell, the massification higher education is another consequence of change (Ezekil, 2005). The evolution of traditionally elitist higher education towards mass higher education is a reflection of new technological developments, democratic values, and the requirements of the new knowledge-

based society. Beyond the advantage of broad public access to higher education, this phenomenon poses a major problem to universities, especially as this trend is associated with another, which emphasizes the problems raised by the first: the decline of public funding for universities. How will these institutions succeed in coping with a massive student population, primarily from a financial point of view? Government financial support is no longer enough even in developed countries to support the education of so many students.

RESEARCH METHODOLOGY

Under these complex and uncertain conditions, an overview on the chemical engineering education in Romania can be shaped by conducting a qualitative study that could bring together the defining profile of higher education. For the purpose of this study is identifying the main issues related to chemical engineering education (motivations, resources, support groups, obstacles, etc.) a direct research of the current stage.

The type of research followed for this study was descriptive in nature and include analytical study where inferential design was employed. The major objective of the study was to assess the extent of the chemical engineering career intention which was carried out at Romanian University (Table 1). The preliminary study showed that the total population was 935 students (Table 1). The major respondents were male which constitute 68% and 32% females participated in the study. The primary data was collected from January 2018 until March 2018 through distributions of a pretest structured questionnaire from the selected participants.

Table 1. Characteristic of respondents (n=935)

	University	Faculty	Respondents
1	”Aurel Vlaicu” University of Arad	Faculty of Food Engineering, Tourism and Environmental Protection	325
2	„1 Decembrie 1918”University of Alba Iulia	Faculty of Exact Sciences and Engineering; Environmental Engineering	185
3	“Constantin Brancusi” University of Targu Jiu	Faculty of Engineering, Environmental Engineering, programs of study: Engineering and Environmental Protection Industry	98
4	„Valahia” University of Targoviste	Faculty of Science and Arts, Department of Environmental Engineering and Food Science (Engineering and Environmental Protection in Agriculture)	110
5	„Stefan cel Mare” University of Suceava	Faculty of Food Engineering	217

Both quantitative and qualitative data analysis employed for the study using statistical package for the social sciences (version16). The data was collected using self-administered structured questionnaire was analyzed by computing mean scores, percentages. Cronbach’s alpha method was used to determine reliability of the scales is a measure of internal consistency, that is, how closely related a set of items

Table 2. Reliability analysis

Scale	Cronbach's Alpha	Number of Items
Chemical engineering careerl intention	0.758	8
Support given from government as well as family	0.739	6
All variables - overall convenience of environment (availability of infrastructure, utility, willingness to assume risk, premise)	0.7482	10

are as a group and when the result is generally above 0.5 (or 50%), it is considered to be reliable (Table 2). Analysis revealed that for all variables the scale is reliable by 74.82%.

Table 3. Chemical engineering career intention, risk taking ability and convenient of environment (n=935)

Item	Mean	Std. dev.
I will exert the necessary effort to establish own business	3.5631	1.02642
I have a strong desire to continue my studies abroad	3.8205	.82817
I am ready to assume risk in my chemical engineering career	3.5193	1.02510
People who are important to me think that I should pursue chemical engineering career	3.6245	.92326
I believe it is worthwhile for me to start a business	3.7403	.91561
After graduation I will prefer to pursue chemical engineering career	3.0501	1.06145
Over all there is convenient environment to pursue chemical engineering career	3.5745	1.02524
The main reason underlying the chemical engineering career choice is economic	3.4073	.82183

Table 3 indicates the results of overall chemical engineering career intention of students related to their desire, certainty and extent of effort on establishing own business. By measuring their view on a five point Likert scale, there were four items that measured respondents view on their preference to pursue chemical engineering career, desire and certainty of becoming engineer, the study revealed that the mean score for all variables was above 3.5 indicates participants' had positive attitude on the chemical engineering career in the sense that under graduating engineering students chemical engineering career intention is high where after completion of their study students prefer to be self-employed.

The results also show the attitude to risk of the chemical engineering career. Attitude to risk was measured and the study result showed that the mean score was above 3.5 represents majority of respondents are ready to assume moderate risk while pursuing other career. Regarding the overall convenient of the environment related to availability of infrastructure, premise and utility to pursue chemical engineering career, the mean score was 3.08 that means respondents were not well satisfied with the existing availability of infrastructure, premise and utility that affects the chemical engineering career intention.

The finding of the study indicates that the mean score result above 3.5 on measurement of willingness to assume risk indicate that under graduating engineering students did not lack the confidence to start their own business. That means students' are ready to assume moderate chemical engineering career intention.

Further the study found that the preference of pursuing chemical engineering career rather than seeking jobs in other organization is rated slightly higher in rural areas than urban areas where the finding of this study indicate that under graduating engineering students from rural area have greater intentions.

After testing spearman correlation between the chemical engineering career intention and some selected independent variable it can be conclude that government should pay special attention to improve the facilities that affects the chemical engineering career intention of students'.

SOLUTIONS AND RECOMMENDATIONS

Beside the overall diminution of the Romanian school population, higher education has undergone an intense massification process after 1990. Thus, for example, in just ten years, from 1998 to 2007, the population of students has increased almost 3 times. This extremely fast increase of student population has at least two characteristics:

- The massification process has not been correlated with a proportional increase in resources (under-funded system);
- The massification process has not been uniform in the study fields: some fields had an inflation of candidates, while others faced depopulation.

These two features of the massification process generated a number of contradictory effects on the system.

First, there was an overall gap between the number of students and the number of academic staff. The increase in the number of students was much faster than the increase in the number of teachers: in 16 years, the average number of students per teacher almost doubled.

Secondly, universities have developed at least two types of behavior. Some chose massification because of under-funding, to cover their costs by attracting more students paying fees. Some faculties which experienced depopulation have chosen, mainly because of underfunding, to apply for research grants. Of the two described behaviours, it appears that the dominant one is attracting fee-paying students.

Thirdly, because of depopulation, the majority of universities chose to relax the admission conditions for candidates in order to fill the places brought to competition.

The reality point out that "current production students" in our country exceeds the capacity of the economy and socio-cultural activities there is use. The urban environment has become increasingly tired of specialists, highly educated, looking first job, while the village seems increasingly poorer class intellectuals who get involved. Unemployment among young age is about 25% and those who do not find their place in the city prefer to leave the country.

Research seems unattractive for many universities also for financial reasons: the incomes generated by research do not supplement the budgetary allocations in the same manner as the fees paid by students and have a lesser effect on the individual incomes of researchers; about 20% of the Romanian universities have collected more than 90% of the research funds through competition.

The hierarchy of universities on the basis of the research funds received is associated with the distribution of the number of articles indexed in international databases.

It can be appreciated that the priorities in achieving operational objectives in chemical and environmental engineering are: the balanced development of the national network of higher education institutions;

increasing synergy and coherence of the whole system of higher education; the reorganization of the educational process; improving performance in the work of teachers and students; improving university infrastructure; correlation better higher education and labor market; stimulate Romanian integration into the European higher education.

FUTURE RESEARCH DIRECTIONS

The authors recommend for further research considering engineering students from other universities which can helps to get better accuracy of the students' feedback and enable to generalize the research outcome. It is better also to include the opinions of stakeholders: financial lenders, institutions that provide assistance in various ways for establishing enterprises and others. A comparative study can be undertaken to determine whether difference exist on the chemical engineering career intention among various programs.

For chemical engineering education in Romania universities the process of restructuring from the point of view of the curricular offer, but especially by the reorientation and rethinking of the financial problems and the financial management, insisted on the insufficient budget financing, the creation of an efficient and effective flexible financial system represents the only viable solution to deal with an uncertain economic environment where spending control by using cost norms is an alternative to be taken into account.

The explanation of the downward trend of the educational demand curve with the decreasing returns on investment in human capital (as the number of school years increases), aside from the reduction in yields, and on the other hand, an increase in costs and a corresponding reduction benefits. This is because it can be assumed that a company-like individual combines the quasi-available resources (which, in principle, stem from its genetic dowry) with educational inputs (variables) to generate outputs corresponding to the different types of qualifications required on the labor market. As in any other situation where a variable input (here the number of years of tuition) is added to fixed inputs, the result obtained in the plan of increasing the "quantity of human capital produced" will reduce the marginal rate of return on investment in education. In addition, universities that graduate out very easily destroy competitiveness and create an imbalance in the labor market, and this is reflected in a high unemployment rate.

In the next years, the authorities will manifest in a desire to accelerate change, near the University of Society and not its total separation and recovery of the advantages that the firm may have a higher education performance tomorrow, research university focused on identified priorities.

CONCLUSION

At the current stage of economic and social development, the development of education appears as a requirement of the overall progress of the society (Coffin & O'Halloran, 2008). However, the education contributes to the economic development, stimulates progress and raises the population's living standard. On long term, education contributes to the economic development, stimulates progress and raises the population's living standard. To achieve these objectives are necessary but some conditions: education must be well tailored, rationally organized, adapted and adaptable to current and future needs of society, driven by professionalism and competence.

On the other hand, Romania follows the aging and population decline global trends reported in Europe and worldwide. Against this background, the role of higher education is crucial in enhancing employability on the labor market, not only for youth, but also for adults (Herteliu 2007).

The results of this study reveal that investing in 'human capital' contributes significantly to a rise in productivity and it represents an attractive investment, compared to alternative spending, on microeconomic as well as social level. Approaching investment in education cannot be done without the 'subject' of education in the absence of which it would make no sense – human capital.

In conclusion, higher education in Romania grew chaotic. Development of industrial chemistry and engineering education environment has not considered any economic development or social order. The unprecedented extension of Romanian higher education in chemical engineering and environmental engineering was detrimental to quality. It was a significant decor relation between what universities prepare and the labor market. And the reality is that "current production students" in our country exceeds the capacity of the economy and socio-cultural activities you use. Design Romanian higher education in a given time horizon involves a certain risk, because the forms that clothed existing distortions and especially because contradictory dynamics of economic life.

Highly qualified human resources specialized in chemical and environmental engineering leave the country to work on much higher salaries in the Occident. This way, the investments in such human resources who decide to emigrate have no purpose for the Romanian state.

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KEY TERMS AND DEFINITIONS

Education: Is fundamental to the knowledge triangle, to boosting jobs and to growth the economy.

Environmental Characteristics: The external factors that may limit or support a company's activities.

Investing in Education: Strategic pieces for a nation's destiny and factor of multiplication and development of human capital.

Managerial Characteristics: Properties of managers who make business decisions

Organization: A system, which includes employers and employees aiming at achieving common objectives.

Technological Change: A term that is used to describe the overall process of invention, innovation and diffusion of technology or processes.

Training Activity: Tool which can be used in formal or informal training to help students improve their essential skills.

Section 5
Learning Theories

Chapter 40
Knowledge Sharing Mediating Information Technology Student Innovation

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ABSTRACT

Research has identified factors promoting innovative behavior (IB) among employees in organizations. However, the effect of knowledge sharing behavior (KSB), self-regulated learning (SRL), and course design characteristics (CDCs) in developing IB among information technology (IT) students in universities is not well understood. The purpose of the study was developing a structural equation model (SEM) of the drivers of IB among IT students. As very little research simultaneously explores the determinants of undergraduate students' IB, one of the study objectives is to plug the literature gap by examining how SRL and CDCs act as antecedents of IB, via the mediating action of KSB. The findings are summated in a KSB-IB SEM. The results largely support all the hypotheses and suggest a significant indirect relationship between SRL and IB, fully mediated by KSB. The indirect relationship between CDCs and IB was significantly and fully mediated by KSB. The results of the study reveal that both CDCs and SRL act as drivers of KSB and IB among IT students.

INTRODUCTION

Some studies draw attention to the individual and contextual conditions under which the promotion of employees' Innovative Behavior (IB) are likely to take place (e.g. Maritz et al. (2014)). Although innovative behavior has been associated with Self-Regulated Learning (SRL), the effect of knowledge sharing, SRL and Course Design Characteristics (CDCs) in the development of innovative behavior among

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Information Technology (IT) students in universities is not well understood. To answer this research gap, this study developed a Structural Equation Model (SEM) of the individual and contextual drivers of individual innovative behavior among IT students.

At the end of a university program, "graduate outcomes or competences could be widely defined as the final product or result of the whole university experience, and innovation is one of those expected graduate outcomes" (Martín, Potočnik, & Fras, 2015, p. 2).

In this context, Martín et al. (2015) explored the antecedents of innovation among university students, highlighting autonomy and cognitive demands as significant drivers of innovation. Although universities have thus developed strategies to stimulate students' innovative competencies, to date no measure exists of the innovativeness of students undertaking undergraduate studies. Further, as very little research exists exploring the individual and contextual determinants of undergraduate students' innovative behavior, this field could greatly benefit from an expansion of coverage into all aspects of organizational research. One of this study's aims is therefore to plug the mentioned literature gap by examining how self-regulated learning and course design characteristics act as significant individual and contextual antecedents of innovative behavior, via the mediating action of Knowledge Sharing Behavior (KSB).

This study also offers insights related to key topics, such as organizational structure, strategic leadership and IT management. It will be comprised of content that highlights major breakthroughs, discoveries and authoritative research results, which, when used in partnership with the wider community, could ensure shared knowledge and create extended opportunities pertaining to aspects of organizational growth and development (Goosen & Van der Merwe, 2015).

The subjects of the cross-sectional, quantitative, explanatory survey were 248 undergraduate students enrolled in Information Systems (IS) and Technology related programs from seven (7) public universities in Kenya. Data was collected through a questionnaire. A 2,000-bootstrap sample was generated to test the standardized total, direct and indirect effects.

The findings were summated in a knowledge sharing-innovative behavior structural equation model, with the aid of Analysis of Moment Structures (AMOS) software. The results largely supported the objectives (see below). The findings also lent support to the positive effect of course design characteristics in fostering Information Technology students' innovative behavior. The results further suggested a significant indirect relationship between self-regulated learning and innovative behavior, that is fully mediated by knowledge sharing behavior. Secondly, the indirect relationship between course design characteristics and innovative behavior was significantly and fully mediated by knowledge sharing behavior. The results of the study revealed that both course design characteristics and self-regulated learning act as significant drivers of knowledge sharing and innovative behavior among undergraduate Information Technology students.

This chapter provides key recommendations for researchers, educators, students and professionals, on how to leverage the attributes of self-regulated learning and course design characteristics at individual as well as at contextual level, triggering innovative behavior.

In light of the undeniable rapid acceleration of both human-centered and technology-oriented advancements, as well as the general perspective of the chapter described, the objectives of this chapter will specifically be stated to determine to what extent (if any):

1. Self-regulated learning is positively related to Information Technology students' knowledge sharing behavior;
2. Course design characteristics is positively related to Information Technology students' knowledge sharing behavior;
3. Knowledge sharing behavior is positively related to Information Technology students' innovative behavior;
4. Knowledge sharing behavior mediates the relationship between the interaction of innovative behavior and self-regulated learning among Information Technology students; and
5. Knowledge sharing behavior mediates the relationship between the interaction of innovative behavior and course design characteristics among Information Technology students.

BACKGROUND

The following section provides broad definitions and discussion on the topic of knowledge sharing mediating Information Technology student innovation. It incorporates the views of other studies into the discussion, in terms of a literature review, to support the authors' position on the topic.

Innovative Behavior

Although literature abounds with attempts to define the elusive concept of innovation, there does not seem to be convergence on a standard definition (McKinley, Latham, & Braun, 2014).

Literature shows that studies conducted in developing countries explored several determinants of innovative behavior (Reynard, Discamps, Badenhorst, Van Niekerk, & Henshilwood, 2016). However, in Kenya, most of the studies that have explored the concept of innovative behavior have been at the organizational level. For instance, Michael and Ngugi (2016) investigated the influence of intrapreneurial strategies on the performance of state corporations in Kenya.

The concept of *idea generation* in the innovation process has been widely researched (e.g. Chulvi, González-Cruz, Mulet and Aguilar-Zambrano (2013) and Duverger (2012)). In line with the latter authors, the process of idea generation requires one to have prior knowledge about a need or a problem. According to the definition of De Jong and Den Hartog (2010, p. 24), idea generation encompasses "the entry of new markets, improvements in current work processes, or in general terms, solutions to identified problems".

On the other hand, *idea championing* is a component of the innovation process that comes after idea generation. Černe, Kaše and Škerlavaj (2016, p. 53) defined idea championing as a "contemporary descending construct with an emphasis on the creative process". It involves the promotion of ideas "as they often do not match what is already used in their work group or organization" (De Jong & Den Hartog, 2010, p. 24). Idea championing refers to the effort by a student to popularize a creative or innovative idea by seeking financial, technical, legal and logistical support to move the idea to adoption.

In the context of Information Technology students, the *idea implementation* stage may imply the involvement of the student in the actual development of technological innovations, by testing and modifying the innovation to suit market realities (Goosen & Ngugi, 2019a).

Knowledge and Knowledge Sharing Behavior

Bartol and Srivastava (2002, p. 65) defined knowledge as "information, ideas, and expertise relevant for tasks performed by individuals, teams, work units, and the organization as a whole". Amidst the many definitions of knowledge, Polanyi (1966) philosophized on knowledge, and distinguished between tacit and explicit knowledge.

Tacit and Explicit Knowledge

Mahmood and Shahbaz (2011, p. 40) distinguished between explicit and tacit knowledge by proposing explicit as "being the documents and records within the organization and tacit being the know-how and experience of the knowledge worker". The next subsections provide more information on tacit and explicit knowledge.

Tacit Knowledge

The origins of the words 'tacit knowledge' can be attributed to the influential work of Polanyi (1966). The latter author (Polanyi, 1966, p. 156) theorized "that tacit knowing is the fundamental power of the mind, which creates explicit knowing, lends meaning to it and controls its uses". According to Polanyi (1966, p. 7), "all knowledge is either tacit or rooted in tacit knowledge". Further, tacit knowledge is described as "skills, ideas and experiences that people have in their minds and are, therefore, difficult to access because it is often not codified and may not necessarily be easily expressed" (Chugh, 2015, p. 128). Similarly, Mahmood, and Shahbaz (2011) assert that tacit knowledge is the experiences, situations and conditions as perceived by the owner of the knowledge. More recently, Chugh (2015) conducted a study in the context of university education that investigated the role of academic supervisors in facilitating tacit knowledge transfer with respect to innovation.

Explicit Knowledge

Whilst tacit knowledge refers to the 'know-how', explicit knowledge is described as the 'know-what'. According to Deng (2008, p. 1175), explicit knowledge "can be articulated as patterns of rules for problem solving and is usually susceptible" to codification and replication. Explicit knowledge can also "be expressed in words and numbers and shared as data, scientific formulae and specifications" (Nonaka & Konno, 1998, p. 41). However, in this study, no attempt is made to distinguish between explicit and tacit knowledge in the context of Information Technology students - rather, the focus is on how the two types of knowledge is shared by IT students. This now brings into focus the related concept of knowledge sharing behavior.

Knowledge Sharing Behavior

Bartol and Srivastava (2002, p. 65) defined KSB as "individuals sharing organizationally relevant information, ideas, suggestions, and expertise with one another". Further, KSB, according to Yi (2009, p. 68), referred to "a set of individual behaviors involving sharing" within one's organization. In addition, Van Den Hooff and De Ridder (2004) stated that every KSB process consists of bringing or donating knowledge and getting or collecting knowledge. Apart from those cited in Goosen and Ngugi (2018),

other studies that have examined the concept of KSB include Liao (2006), MacCurtain, Flood, Ramamoorthy, West and Dawson (2010) and Yi (2009).

Knowledge Sharing Behavior at Universities

As the IT professionals of the future, programming students need to master skills regarding sharing knowledge (Goosen & Mentz, 2008). Previous studies, which provided empirical evidence to suggest that KSB is a significant mediating variable of innovation, included Duverger (2012), Kasemsap (2016) and Shahsiah and Sepahvand (2016). These studies suggested that there is a variety of mediating factors in the service idea generation process towards innovation, by creating product innovation strategies through knowledge management in global organizations and studying the mediating role of knowledge sharing and market orientation to enhance the intellectual capital effect on organizational innovation.

Self-Regulated Learning

Robles, Angulo and De La Serna (2014) used a federated e-rubric service to facilitate self-regulated learning in an European university model. Further, Joo, Joung, and Kim (2014) explored structural relationships among self-regulated learning, learning flow, satisfaction and learning persistence in the context of cyber universities. In addition, Yang and Kim (2015) investigated the effect of learners' digital literacy on SRL skill in a university e-learning environment. Ning and Downing (2015) compiled a latent profile analysis of SRL strategies among university students, while even more recently, McBride, Altunsöz, Su, Xiang and Demirhan (2016) investigated self-regulated learning and perceived health in the context of university students participating in physical activity classes. More detail relating to motivation, metacognition and affective aspects of learning can be accessed in Ngugi and Goosen (2019).

Self-Regulated Learning and Knowledge Sharing

The present study hypothesized that SRL is a significant antecedent of KSB for Information Technology students (Ngugi & Goosen, 2018). Bednall, Sanders and Runhaar (2014) found empirical evidence positively associating reflection on daily activities and knowledge sharing with colleagues with innovative behavior, using a sample of 238 employees from 54 work teams.

Self-Regulated Learning and Innovative Behavior

This study further hypothesized that SRL is a significant antecedent of IB for Information Technology students (Ngugi & Goosen, 2018). The hypotheses were informed by the available literature, which suggested that self-regulatory skills are a significant predictor of academic achievement, and by extension, IB. Examples of these include Za, Spagnoletti and North-Samardzic (2014), who looked at the generative role of digital tools in informal organizational learning practices as an emerging process, while Bednall, et al. (2014) investigated the effects of perceptions of performance appraisal quality and Human Resource Management (HRM) system strength on stimulating three (3) informal learning activities. The latter two-wave study found that performance appraisal quality was positively associated with increased participation in each of these activities over time.

Course Design Characteristics

As the knowledge and skills of students as relative novices "are significantly different from those of experienced programmers" (Goosen, Mentz, & Nieuwoudt, 2007, p. 270), they need to develop the practical skills, which they will need to utilize their knowledge in the workplace (Van Heerden & Goosen, 2012). Thompson, Strickland and Gamble (2014) expounded on four (4) key questions or stages regarding course design in the instructional process. In the context of technology education, course design tailored to the typology suggested by Thompson, et al. (2014) should in effect lead the student from examination of their present knowledge (Where are we now?), to a level of identification, of having arrived at the destination (How will we know when we get there?). The need to structure the course thus becomes critical.

RESEARCH METHODOLOGY TOWARDS SOLUTIONS

The current section of the chapter expounds the research methodology, which informed the solutions discussed in the next section. It highlights the research context and setting, details regarding the research measures, as well as data analysis procedures. Finally, it provides a brief description of the SEM analysis. Further information regarding the research design, data collection instrument, population, sample and sampling technique, validity and reliability, as well as data analysis, can be obtained from Ngugi and Goosen (2017). Particulars on the pilot study can be accessed in Goosen and Ngugi (2019b).

Research Context

There have been isolated initiatives aimed at nurturing the innovative capacity of undergraduate Information Technology students, such as the iHub at Strathmore University and the Kenyatta University Chandaria Business Innovation and Incubation Centre (2017).

The great challenge for these initiatives is for students to align their individual capacities with the expected demands of their future jobs. Future jobs will demand a shift from manual and routine jobs, to generic complex competencies that require skills in information analysis, critical thinking, problem solving, global contextual analysis, creativity, teamwork/collaboration and communication (Salmi, 2016).

Research Setting

In general, public chartered universities have over time invested in physical and human resources. Further, such universities receive financial grants from government institutions to support the programs on offer. In addition, all the programs on offer at Kenyan universities are regulated by the Commission for University Education (CUE, 2014), based on regulations, standards and guidelines developed and agreed with universities.

The placement of students in public universities is a function of the Kenya Universities and Colleges Central Placement Service (KUCCPS, 2014). Further, the KUCCPS categorizes the domains of subject areas in university education. Based on the KUCCPS classification of programs, 31 programs in 15 universities have a component of IT in their course names.

Demographic Measures

This study had a limited number of demographic measures. These measures included gender, year of study and program of study. The lack of emphasis on the demographic measures was premised on the fact that there was general uniformity in the age of the sample, based on joint admission criteria of KUCCPS (2014). Further, the demographic characteristics were not hypothesized to influence any of the variables in this research.

To ensure confidentiality, the names of universities and students were not expressly used in the study, as suggested by Palys and Lowman (2014).

Reliability of Instruments

Reliability refers to the degree to which measures yield consistent results, which are free from error (Wilson, 2014) and have repeatability and internal consistency (Schumacker & Lomax, 2010). In terms of instruments, Nadler, Weston, and Voyles (2015), as well as Blouin (2010), have done extensive studies on the use, effect and interpretation of mid-points in items on questionnaires.

Validity

According to Pallant (2005), exploratory factor analysis can be used to assess the construct validity and dimensionality of constructs, and further presented a guideline as basis for item reduction. The relationships between latent constructs and the items measured were examined for construct, internal and external validity. Since the latent constructs were measured using multi-item variables, Confirmatory factor analysis was employed to investigate the *convergent* and discriminant validity of the constructs.

Content validity was achieved by using measures available from literature that have suitable psychometric properties (Kline, 2015).

For variables that measure the same construct, convergent validity is evident when their inter-correlations "are at least moderate in magnitude" (Kline, 2015, pp. 71-72).

Bootstrapping

Bootstrapping is very useful when sample sizes are moderate or small (Cheung & Lau, 2017). In retrospect, since the sample size was 248, the bootstrapping method proved to be a suitable analytic strategy for testing objectives 4 and 5, on direct and indirect effects. This analysis also involved an examination of the 95% Confidence Interval (CI) for the population indirect effect, to compute the statistical significance.

Bootstrapping With Bias Corrected (BC) Confidence Intervals

Multiple authors have applied the bootstrapping method in studies related to innovation behavior (Nisula & Kianto, 2016; Sahrom, Tan, & Yahya, 2016; Yeniaras & Unver, 2016).

Justification for Using a Structural Equation Model

The study utilized the Analysis of Moment Structures 18 program to perform the SEM analysis (Arbuckle, 2010). AMOS has been widely used in SEM research that includes missing data, as it provides estimates that are efficient and consistent, due to its use of FIML estimation (Arbuckle, 2010; Kline, 2015). The use of AMOS software is based on its ability to handle missing data issues well, as it does not to impute or replace values for missing data (Schumacker & Lomax, 2010).

Secondly, there is an implied assumption of errors in the measurements when indicators are used to measure latent variables (Camelo-Ordaz, García-Cruz, Sousa-Ginel, & Valle-Cabrera, 2011). Consequently, SEM provides a measurement of the validity and reliability level of indicators.

Thirdly, since the study required simultaneous analysis of the relationships between latent variables, SEM provided a way to measure the consistency between data provided and the generated model causal relationships (Bollen, 1989).

Fourthly, SEM research is able to "show how models that better match the theoretical relations among variables can enhance interpretability and lead to quite different conclusions" (Grace & Bollen, 2005, p. 283). Lastly, SEM enabled testing of scale reliability and validity. Schumacker and Lomax (2010, p. 114) suggested "that the measurement model provides an assessment of convergent and discriminant validity, and the structural model provides an assessment of nomological validity". Reliability analysis in SEM research overcomes the challenges imposed by the traditional multiple regression analysis, as SEM "was developed to incorporate measurement error adjustments into statistical analyses" (Schumacker & Lomax, 2010, p. 137).

Testing Mediation

Estimation of Indirect Effects

The question of how to test hypotheses using SEM by an examination of the model fit is perhaps the penultimate aim of most studies, and also for the present study. Moshagen and Erdfelder (2015) posited that, without confidence that the model under investigation provides an adequate description of the data, interpretations of the purported factor structure, or of the relationships between latent variables, become meaningless at best, and misleading in the worst cases.

SOLUTIONS AND RECOMMENDATIONS

The next section discusses results and recommendations in dealing with the issues, controversies and problems presented in the preceding sections, together with other authors' perspectives of these.

Solutions and Results

Accuracy of Input

Out of Range Values

Checking the accuracy of input involved the identification of all values outside the permitted range, with the aid of the descriptive and frequencies analysis commands in the Statistical Package for Social Sciences (SPSS) version 18 software. All values were plausible, and no problems were detected that could distort the statistical analysis. Further, care was taken to score in reverse order all negative-worded items, which had the net effect of having higher values representing higher levels of agreement with the questionnaire items (Pallant 2005; Wan, 2016).

Data Screening

Data issues present additional problems and concerns in Structural Equation Modelling, as the technique is very sensitive to the soundness of the dataset. Hence, data screening methods, including measurement scale, missing data, outliers, linearity and non-normality, were addressed, as recommended by SEM literature (Kline, 2015; Schumacker & Lomax, 2010).

Köse (2014) examined the effect of missing data on goodness of fit indices and proposed the use of Full Information Maximum Likelihood (FIML) imputation for Confirmatory Factor Analysis (CFA).

Missing Data Analysis

The problem of missing data has been well-documented in texts such as Little and Rubin (2014). No exact guidelines exist on the level of missing values for exclusion. However, according to Tabachnick, Fidell and Osterlind (2001), such decisions should be built on theoretical and empirical arguments. The analysis of missing data was therefore informed by guidelines provided by Tabachnick et al. (2001) and Hair, Anderson, Tatham and Black (1998).

Kline (2015) provided a cut-off point of 10% for missing data, and provided three (3) methods of handling missing data, namely

§ Deletion
§ Replacement (imputation) with estimated scores and
§ Modelling the distribution of missing data.

Little and Rubin (2014) categorized the pattern of missing data based on randomness into three (3) groups, one of which is Non-Missing At Random (NMAR), showing an association between variables with missing data and those with values.

Literature like Little and Rubin (2014) and Kline (2015) suggested that there is no statistical means to alleviate the problem of missing data. Tabachnick et al. (2001) posited that if the missing data are NMAR, any techniques to treat the problem could yield biased results.

Identifying Outliers

The most common cause of outliers emanates from data entry errors. Schumacker and Lomax (2010, p. 27) defined outliers as "data values that are extreme or atypical on either the independent (X variables) or dependent (Y variables) variables or both". Further, Kline (2015) defined outliers as cases displaying unreasonable characteristics and which are distinctively different from the rest in the dataset. Outliers refer to cases that have significant differences in terms of the actual value provided for an independent variable and the predicted value (Hair et al., 1998).

Univariate Outliers

Outliers can be categorized into two types: univariate and multivariate. A univariate outlier is a case whose value falls beyond the ranges of the distribution of a single variable. Although there is no single judgement for an extreme value, "a common rule of thumb is that scores (outside) more than three standard deviations may be outliers" (Kline, 2015, p. 51). Literature suggests that outliers occur when the observations with standardized variable values exceed ± 2.5 for small samples (80 or fewer observations) and 3 to 4 for larger sample sizes (Hair et al., 1998). The identification of a univariate outlier was carried out by inspecting z-scores' frequency distributions (Kline, 2015).

Multivariate Outliers

A multivariate outlier, on the other hand, is a case, which has "extreme scores on two or more variables, or its pattern of scores is atypical" (Kline, 2015, p. 54). Multivariate outliers are inspected with the aid of Mahalanobis distance (D2), which is "the distance in standard deviation units between a set of scores (vector) for an individual case and the sample means for all variables (centroid), correcting for" intercorrelations (Ibid, p. 54). The Mahalanobis distance is from the gravity center, the centroid of the sample, determined by the means of the variables, or chi-square distributed, with degrees of freedom (df) = number of variables. Each Mahalanobis distance is compared to a critical chi-square value ($\alpha = 0.001$).

Cases with a Mahalanobis distance exceeding this critical value represent multivariate outliers and were discarded (Tabachnick et al., 2001). A value of D2 with a relatively low p-value may lead to rejection of the null hypothesis that the case comes from the same population as the rest. Kline (2015) recommended a very conservative value of $p<0.001$ for statistical significance.

This study applied this rule of thumb, using the SPSS program to obtain Mahalanobis distances. By calculating the Mahalanobis distance for each variable, the multivariate outliers were thus identified. This involved performing a regression analysis for all the exogenous and endogenous factors, with the response number as the dependent dummy variable, as suggested by Tabachnick et al. (2001). A separate score for each subject was created in a new column at the end of the data file.

An examination of Cook's distance value determined whether the uniquely positioned cases had any undue impact on the result of regression analysis. As suggested by Pallant (2005), values that were greater than 1.0 presented a potential problem and such cases were candidates for exclusion. However, the study data did not have influential outliers, as the Cook's distances were .02812 and .02594, and met the criterion of being less than 1.0. Hence, this was not a major problem and consequently, the two cases were retained.

Checking Multivariate Assumptions

Multivariate assumptions related to normality, linearity, homoscedasticity, multicollinearity and independence of residuals can be presented (Harlow, 2014).

Normality of Data: Skewness and Kurtosis

According to Hair et al. (1998, p. 70), normality refers to "the shape of data distribution for an individual metric variable and its correspondence to the normal distribution". Measurement of normality involves computation of the skewness and kurtosis, which provide a measure of shape of the distribution or the data symmetry (Saunders, Lewis & Thornhill, 2009; Tabachnick et al., 2001). Skewness refers to the "balance of the distribution; that is, is it balanced to one side (or is" centered "and symmetrical with about the same shape on both sides" (Hair et al., 1998, p. 70). On the other hand, kurtosis refers to the "relative peakedness or flatness of a distribution compared with the normal distribution" (Ibid, p. 70). Hence, "positive kurtosis indicates heavier tails and a higher peak and negative kurtosis indicates just the opposite, both relative to a normal distribution with the same variance" (Kline, 2015, p. 60).

Kline (2015) pointed out that variables with absolute values greater than 3.0 in the skew index are described as 'extremely' skewed, whereas 'extreme' absolute values are considered for index values between 8.0 and 20.0.

Chi-Square

The chi-square p-value is a measure of the minimum sample discrepancy function and is used to test the hypothesis that the model has a good fit for the population. Further, "a significant χ^2 value relative to the degrees of freedom indicates that the observed and implied variance–covariance matrices differ" (Schumacker & Lomax, 2010, p. 85). Hypothesis testing using SEM seeks to generate an insignificant result, with the chi-square value not being significant at a (>.05) level, for an acceptable model fit. Such a result indicates that the theoretical model accounts for all the measured items covariances. Further, a "nonsignificant χ^2 value indicates that the two matrices are similar, indicating that the implied theoretical model significantly reproduces the sample variance–covariance relationships in the matrix".

In this study, the p-value of .084 was not significant, as it surpassed the critical value of 0.05, hence providing plausible evidence of the model fit, and the model could not be rejected. Attaining an insignificant p-value was a major step in the hypothesized model modification process, since, from literature, models serve as useful approximations, and do not fit the population perfectly (Arbuckle & Wothke, 2006).

Root Mean Square Error of Approximation

Models with Root Mean Square Error of Approximation (RMSEA) values greater than .10 should be rejected (Arbuckle, 2010). In the present study, the model suggested a close fit, as the RMSEA value was .062.

Recommendations

The present study attempted to provide theoretical contributions in the field of knowledge sharing and innovative behavior among students. The purpose was to carry out empirical research on the possible drivers of innovative behavior and the mediating role of knowledge sharing behavior in those relationships. Consequently, a few recommendations are made on possible extensions to this study.

Martín, et al. (2015) suggested that educators should consider designing tasks and assignments that require higher autonomy from students as part of their curricula. The latter authors also recommended that educators consider implementing tasks involving higher cognitive demands, to further enhance student innovation.

Further, the results suggested that in order to stimulate IB, curriculum designers should ensure that the instructional process and methods of delivery allow for greater autonomy for students, to guide how they carry out tasks. In addition, there is a need for facilitating a conducive environment that promotes knowledge sharing. If university curriculum designers aspire to enhance knowledge sharing, as well as innovative behavior, one recommendation is to ensure that the tasks identified in courses engage students' imagination and provide an environment that stimulates and nurtures opportunities for students to explore new ideas and stimulate idea generation.

FUTURE RESEARCH DIRECTIONS

This section discusses future and emerging trends and provide insights about the future of organizational knowledge, administration and technologies, focusing on knowledge sharing mediating Information Technology student innovation. The viability of a specific paradigm, model, implementation issues of proposed programs, etc., may also be included in this section. Future research opportunities within the domain of knowledge sharing mediating Information Technology student innovation are also suggested.

From the available literature, the closest study to exploring innovative behavior among students was conducted by Martín, et al. (2015). Their results suggested that differences in Information Technology students' levels of IB may be explained in part by the differences in their KSB with their fellow students. The current study findings confirmed the prior research by Martín, et al. (2015), who contended that students, who share knowledge among each other, responded with higher levels of IB. Hence, the results provided evidence that the relationship between the individual and contextual antecedents and IB was stronger among students with a readiness to share knowledge with others. These findings are crucial, because continuous innovation ensures sustained competitive advantage, and the best way to inculcate innovative behavior is by encouraging students to share knowledge.

Practical Implications

University Management

The development of a knowledge sharing culture can be achieved in that managers may build the institutional or class-level learning community by using off-line based educational and training programs and/or task-related seminars among Information Technology students. This should promote a shared culture of knowledge in the organization (Van Engen, Van der Leeden, & Willemsen, 2001). It is expected that

such leverage would enable universities to prepare students for the dynamic and changing nature of jobs for the future. By placing greater emphasis on the extrinsic and intrinsic motivators of knowledge sharing, this could create a conducive environment for creativity and innovation in universities.

In the case of Kenya, the specific university education regulator (referred to by Ngugi and Goosen (2018)) is the Commission for University Education (2014), which developed the Universities Standards and Guidelines, as well as university regulations to inform the curriculum development process, in terms of "how the knowledge, skills and attitudes", which students "need, can be taught effectively" (Goosen, 2004, p. 76).

Additional Individual and Contextual Factors Explaining Students' Knowledge Sharing Behavior and Innovative Behavior

The inclusion of additional antecedents could help to generate a poll of antecedents of both KSB and innovative behavior, as well as provide an opportunity to increase the total variance explained by the predictor variables of students' innovative behavior. Further, the inclusion of additional factors would help to empirically test a more complete framework. In addition, future research could address other contextual antecedents of innovation and hence provide novel insights, standards, and guidelines for course design in universities, based on the triggers of undergraduate students' innovative behavior.

CONCLUSION

This concluding section provides discussion of the overall coverage of the chapter and concluding remarks. The study suggested an important conclusion with regard to the linkage between self-regulated learning and innovative behavior: It found an indirect link between self-regulated learning and innovative behavior that is fully mediated by knowledge sharing behavior. This is an important finding, as it points to the critical role that the knowledge sharing behavior of IT students play in mediating the relationship between self-regulated learning and innovative behavior. Strategic leverage of self-regulated learning by enhancing its various dimensions, such as metacognition, self-regulation, critical thinking, elaboration, organization and rehearsal, should ultimately yield returns of a critical mass of students, who have developed innovative tendencies.

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KEY TERMS AND DEFINITIONS

Course Design Characteristics: Refers to the perception of students about the range and breadth of knowledge and task requirements of a technology course.

Idea Championing: Refers to the effort put in by a student to popularize a creative or innovative idea by seeking financial, technical, legal and logistical support to popularize and move the idea to adoption.

Idea Generation: Refers to the cognitive transformations involved in seeking out new answers and solutions to ill-structured technological problems.

Idea Implementation: Refers to the effort and energy a student exerts in the pursuit of operationalization of an idea to full-scale application.

Innovative Behavior: Refers to the distinctive and unique cognitive abilities and endowment that develop and mature in a student over the study period that distinctively mark them out from their peers and enable them to generate novel ideas and solutions to ill-structured technological problems.

Knowledge Sharing Behavior: Refers to the process of students reciprocally providing and receiving both tacit and explicit knowledge.

Self-Regulated Learners (SRL): Plan and set personal and/or learninggoals and timing, and adapt these on an ongoing basis, as needed according to their progress.

Structural Equation Modelling (SEM): Permits the researcher to statistically model and test complex phenomena.

Chapter 41
Effective Integration of Technology in Inquiry Learning: Themes and Examples

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ABSTRACT

For education leaders (teachers, professors, curriculum designers, and administrators), there are well-documented benefits to using inquiry learning in a wide variety of grade levels, content levels, and contexts. Besides promoting deep learning and critical thinking, inquiry learning is readily adaptable to 21st century skills such as information and communication technologies literacy. However, the combination of sophisticated pedagogy and cutting-edge technologies can be overwhelming to education leaders when planning an inquiry learning curriculum. Faced with a wide variety of technology options, education leaders have little research-based guidance for choosing the ones that are best suited to an inquiry learning curriculum. This chapter reviews recent findings on the use of technology in inquiry learning and provides suggestions and guidelines for incorporating technology in inquiry learning in order to maximize the pedagogical affordances of technology.

INTRODUCTION

Educational technology is a large and rapidly growing global business with investments of more than $8 billion in 2017 (Adkins, 2018). However, barriers to the adoption of educational technology persist; namely, that many educators are skeptical of the effectiveness of new technologies (Bill & Melinda Gates Foundation, 2015). One reason for this is a lack of research and recommendations for pairing cutting-edge technology with the most effective pedagogies; in too many educational settings, technology continues to be used for less effective learning activities like memorization (Lawless, 2016). In order to fully realize the educational potential of technology, it must be paired with excellent pedagogy that maximizes learning. One such pedagogy is inquiry learning. **Inquiry learning** is learning that is motivated by curiosity, often guided by a question: why do things sink or float? How was the Constitution written? How do we

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know? As will be shown in example studies, inquiry learning is flexible across different content and skills, and any number of technologies could be used in inquiry learning. This same flexibility can be overwhelming to education leaders when planning an inquiry learning curriculum. Faced with a wide variety of technology options, education leaders have little research-based guidance for choosing the ones that are best suited to an inquiry learning curriculum. The purpose of this chapter is to review some of the most recent findings on the use of technology in inquiry learning. This chapter will provide suggestions and guidelines for incorporating technology in inquiry learning in order to maximize the pedagogical affordances of technology.

BACKGROUND

For education leaders (teachers, professors, curriculum designers, and administrators), there are well-documented benefits to using inquiry learning in a wide variety of grade levels, content levels, and contexts (Barrows & Tamblyn, 1980; Dochy, Segers, Van den Bossche, & Gijbels, 2003; Hmelo-Silver, 2004; Hmelo-Silver, Duncan, & Chinn, 2007; Walker & Leary, 2009). Besides promoting deep learning and critical thinking, inquiry learning is readily adaptable to **21st Century Skills** such as information and communication technologies (ICT) literacy (Trilling & Fadel, 2012). Thus, curricular resources are maximized as students learn about a content area, practice thinking and reasoning skills, and practice using technology, all within the context of an inquiry learning setting.

Inquiry learning is learning that is driven by curiosity, the intrinsic desire of a learner to know something. It does not necessarily require technology to enact, and it has existed for at least a century (Barrow, 2006; Dewey, 1913). Inquiry learning begins with a question and requires students to develop solutions, ask more questions, solve problems, and actively build their knowledge (Savery, 2006). Ideally, inquiry learning uses an authentic, relevant question; students work collaboratively to investigate by collecting data, developing explanations or solutions, and communicating their ideas; the teacher in this setting is a facilitator of learning, not a sole source of knowledge (Hmelo-Silver et al., 2007). The specific procedures of inquiry learning vary across contexts. For instance, in project-based learning, the goal is to develop a pre-determined artifact, such as a computer program; students may be free to choose what the program should do and will solve problems along the way to developing it (Savery, 2006). Problem-based learning takes a slightly different approach: students receive a problem and the goal is to solve it, but the solution can take any form. One group might design a computer program as a solution, while another designs a board game (Savery, 2006). In all cases, the questions or scenarios used in inquiry learning are meant to inspire curiosity and drive the process of inquiry, and a key feature is that students build knowledge in an active role rather than passively receiving it.

Inquiry learning has yielded many positive effects: it has been shown effective in promoting the acquisition of skills, especially problem-solving skills, more so than facts and rote knowledge (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Hmelo-Silver, 2004). Inquiry learning has been especially successful in science, technology, engineering and mathematics (STEM) subjects, where inquiry is not merely a means to an end but a skill in its own right (Minner, Levy, & Century, 2010; NGSS Lead States, 2013). Similarly, the contextual use of technology can be viewed as a skill in its own right, as well as being an enhancement to inquiry learning and the specific content or skills being learned. Researchers have outlined the ways technology can be used to support inquiry learning, such as providing support to students, providing background information, and overcoming some of the practical limitations of

the classroom (Furtak, Seidel, Iverson, & Briggs, 2012; Hmelo-Silver, 2006). Additionally, along with the problem-solving skills and core content knowledge that are developed in inquiry learning, technology literacy is a crucial skill for living and working in a modern, technology-rich society (Trilling & Fadel, 2012). Inquiry learning and educational technology are a natural match. Inquiry learning has the potential to leverage the most impactful affordances of technology because it situates technology in a relevant problem-solving context. Technology can enhance inquiry learning, and inquiry can enhance technology learning.

Although the use of technology with inquiry learning is promising, it is unproductive to insert technology haphazardly into inquiry pedagogy. Teachers, educational leaders, instructional designers, and planners must think carefully about how to integrate the target content (e.g., science, mathematics, or writing), the pedagogy (in this case, inquiry learning), and the technology being used (Koehler & Mishra, 2005; Lawless, 2016). Prior research has established frameworks and design principles for integrating technology in education. One strong framework is technological pedagogical content knowledge (TPCK), which recommends weaving together the course material under study (content), the methods for teaching it (pedagogy), and the technological tools that support the content and pedagogy (Mishra & Koehler, 2006). Crucial to the framework are the areas of overlap between technology and pedagogy (knowing the affordances of educational tools for teaching) and between technology and content (appropriate tools for content, such as word processing for writing); and between technology, content, and pedagogy. These elements must be considered simultaneously, not in isolation, in order to use educational technology effectively, and changes in any one element may require recalibration of the other elements to maintain an effective instructional design. **The purpose of this chapter is to highlight several examples of technology that are used in inquiry learning and to discuss how technology supports and integrates with the content and pedagogy in order to accomplish educational goals.** Examples will show that there are three major themes across successful uses of technology in inquiry learning.

THEMES OF EFFECTIVE INTEGRATION OF TECHNOLOGY IN INQUIRY LEARNING

Foreground the Learning Objectives

In inquiry learning, students are guided to first consider the problem thoroughly, then consider solutions. Similarly, educators should first consider the learning objectives, which are the knowledge or skills that students should master (Wiggins & McTighe, 2005). Only after the learning objectives are determined should technological and curricular choices be made. This is an effective principle in any type of curriculum planning at any scale; it is as applicable to a primary school unit about shapes ("students will use geometric shapes to solve problems") as to a graduate program curriculum ("students will develop a professional research program"). Learning objectives are not inquiry questions; however, they are the first, and arguably most important, step toward designing an inquiry question and an inquiry learning unit (Hung, Jonassen, & Liu, 2008).

Determine the Inquiry Learning Challenge(s) That Technology Can Address

Researchers have identified numerous design principles for inquiry learning (Hmelo-Silver et al., 2007; Hung et al., 2008; Savery & Duffy, 1995), including the design of technology to scaffold inquiry learning (e.g., Hmelo-Silver, 2006). Edelson (2001) listed five challenges in inquiry learning, any of which can threaten a successful inquiry learning unit:

1. Motivation. Because inquiry learning requires a high level of engagement, it is crucial that students feel motivated and interested in the learning scenario.
2. Accessibility of investigation techniques. Students may not be familiar with the specific disciplinary practices relevant to their inquiry scenario.
3. Background knowledge. Asking questions requires a certain level of background knowledge which students may not have.
4. Management of extended activities. Students may not be accustomed to collaborative work, especially extending over a long period of time or covering a wide content area.
5. Practical constraints of the learning context. Traditionally, classroom constraints included physical space and blocks of time, which may not be ideal for complex, extended, wide-ranging inquiry learning.

This chapter will show that once challenges to inquiry learning have been identified, there are many ways technology can address these challenges.

Give Adequate Attention to "Low Tech" Components of the Curriculum

Edelson writes that the same five challenges listed above, which can be addressed using educational technology, can also be addressed using curricular design (2001). For instance, if students lack background knowledge, this can be addressed by giving them access to an online encyclopedia to use as needed (technology) or with a mini-lesson to introduce content (curriculum). Most K-12 and in-person university classrooms involve face-to-face settings. The interactions that occur offline, or without technology, can also address the challenges of inquiry learning and should not be neglected in pursuit of exciting new technology. Furthermore, there are potential downsides to using technology (or benefits to using traditional, non-digital tools) where certain activities are concerned. Studies have shown that students remember material better when they take notes by hand (Mueller & Oppenheimer, 2014) and that electronics can be distracting to students and others around them (Sana, Weston, & Cepeda, 2013). The nuances of this research are outside the scope of this article, but educators are well advised to choose the instructional activities and tools (digital or non-digital) that best match their learning goals and the challenges posed by inquiry learning.

EXAMPLES OF EFFECTIVE INTEGRATION OF TECHNOLOGY IN INQUIRY LEARNING

The use of technology in inquiry learning dates back to the early days of computing on university campuses in the 1960s, and has burgeoned in the last decade as digital tools have become smaller, cheaper,

and more user-friendly. There are numerous tools available today with a variety of flexible affordances for inquiry learning. Many technologies that are well established in the business and consumer markets are still emerging in educational research. The examples below are current technologies that show promise at the forefront of inquiry learning and are supported by recent research on their educational effectiveness. Each example will be discussed briefly in relation to the three themes listed above.

Augmented Reality

At the time of this writing, **augmented reality** is most widely known as the technology that supports Pokémon Go and Snapchat filters that put fun virtual masks on a user taking a selfie. Augmented reality is technology that overlays virtual information on the real world; for instance, an augmented reality map of Chicago could allow a user to scan buildings though their smartphone camera and display "floating" information above each building listing the year it was built, the architect, and other details. The appeal of the part-real, part-virtual world is readily apparent, as is its potential for creating rich learning environments.

Researchers in Taiwan gave mobile devices to 4th graders, half with augmented reality and half without (Chiang, Yang, & Hwang, 2014). The unit was an inquiry learning experience about ecology in which students sought out aquatic plants and used mobile devices (with or without augmented reality) to learn about the plants, take photographs, and build a "portfolio" of plants. The augmented reality program overlaid relevant information about the plants students scanned through the device camera. The mobile inquiry activity was bookended by an introduction in the classroom and a final sharing of students' findings. Students who used augmented reality had better learning outcomes than the control group, as well as higher levels of motivation and engagement. The authors speculate this is because the students who were not using augmented reality may have struggled to coordinate sources of information on their mobile devices or on paper.

This project is an excellent example of the theme of using technology to address the challenges of inquiry learning: it appears to have bolstered motivation, and it also helped students manage a complex, extended activity with different information sources. The designers also used "low tech" curriculum components to address challenges: the classroom introduction provided students with the necessary background information to begin their investigation. In terms of practical constraints of the classroom, the designers used a very simple solution—going outdoors.

Wikis

Inquiry learning is often carried out in collaborative student groups, and the collaboration itself requires both social tools (e.g., leadership and cooperation) and material tools (e.g., a way to track shared information). **Wikis** are an ideal technology for collaborative inquiry because they distinctly address the interaction between personal knowledge and group knowledge (Moskaliuk, Kimmerle, & Cress, 2009). Faculty at the University of Turin used a wiki to streamline a collaborative writing project (Trentin, 2009). Wikis streamline collaborative writing because they provide a framework for co-writing that does not require a single student to act as editor and compiler of information; unlike offline word processors, wikis are flexible in structure and allow each group member to view and edit all parts of the document. Instructors did not assume using the wiki was self-evident; they provided students with a step-by-step process for prereading, planning, developing the wiki, creating links among pages, and peer review. Faculty in

this project calculated separate metrics for each student's contribution at each step in the wiki, supplemented with subjective evaluations by teacher and peers (which are more traditional ways of evaluating collaboration); this takes advantage of another benefit to a wiki platform, the retention of interactions, including the planning and revision interactions, that may not appear explicitly in the final product.

Thus, wikis address several issues with the collaborative aspects of inquiry learning: first, the question of how students should coordinate their knowledge so that all benefit and all are contributing to the final product; second, the question of how instructors can assess individual contributions to a group project. Depending on the learning objectives, an instructor may want to suggest a structure for the wiki; alternatively, figuring out how to structure the wiki might be part of the inquiry. While the technology facilitates the logistics of collaboration, especially in a distance-learning scenario, a wiki does not automatically erase the social challenges of collaboration. This can be a challenge, for example when students "lurk" rather than actively posting in an online environment, just as they might do in a classroom (Lundin, 2008). However, it is also a benefit of using wikis as an environment where students must learn to cooperate and communicate, just as they would need to in a traditional classroom (Williams, Woodward, Symons, & Davies, 2010). Wikis show promise in addressing two of the challenges posed by Edelson (2001): management of extended activities and practical constrains of the classroom, especially in distance learning settings.

Communication Platforms

Wikis are a good solution for communication and collaboration within a group. However, in some inquiry learning situations, communication takes place among groups, as in the simulation of negotiations across groups that may be in different classrooms and different geographical locations. ICONS is a platform that allows communication across groups in a closed, supervised environment, typically for the purpose of role-playing international negotiations (ICONS Project, n.d.). GlobalEd 2 used the ICONS platform to conduct a large socio-scientific inquiry unit with several middle-school classrooms across two states (Brown, Lawless, & Boyer, 2015). Each classroom represented a country, and within each country, students formed groups for issue areas like health and economics. All of the countries and groups were tasked with investigating and proposing solutions to a potential global water shortage. Teachers were provided with curriculum materials—both online and offline—and students spent several weeks working with their classroom teams to investigate the issue before they logged in to the communication platform to begin discussions. Thus, the ICONS technology supports some but not all of the learning activities. More importantly, ICONS erases a major practical constraint of traditional classrooms: it allows long-distance communications across classrooms, both asynchronous in messaging and synchronous in live chats, with the additional benefit of anonymity (students do not know the race, gender, or geographic location of the other participants), which would not be possible without the aid of technology.

Modeling

Sometimes inquiry questions involve phenomena that are impractical to observe because they are, for example, too fast or slow (nuclear reactions) or too large or small (nanoparticle interactions). Computer modeling allows scientists and students to access these phenomena and even test their hypotheses for how different parameters will affect them. However, modeling is not limited to the natural and physical sciences; it is also applicable to social sciences. NetLogo is a free, customizable modeling engine that

allows students to model anything from how a virus spreads in a population to how people interact at a party; it also allows designers to create their own models (Wilsensky, 1999). Researchers at Northwestern University created a NetLogo simulation to create a social policy unit: students define a desired urban outcome (e.g., reduced pollution) and design a way to accomplish this using zoning and infrastructure (Hjorth & Wilensky, 2014). Students then run the model to see how simulated citizens live and travel within their city. When the simulation is completed, they can reflect on their design choices, make changes, and rerun the model. Although the pedagogy used for this unit was not described extensively (e.g., what background information was presented to students or how their learning was assessed), it is worth noting the pedagogical decision to have students set a goal and design principles *before* they began working with the modeling software. In this way, the technology and the model are not a toy or game, but rather serve the scientific purposes of testing hypotheses and observing phenomena that would otherwise be unobservable.

The modeling technology was used effectively to address two major challenges of inquiry learning: practical constraints and accessibility of investigation techniques. Modeling as a scientific practice is designed to overcome practical constraints not just of the classroom but of the observable world. Therefore, modeling provides a meta-lesson about the very real barriers to scientific investigation. Further, it introduces students to a sophisticated type of scientific investigation. By creating NetLogo as a user-friendly modeling application, students can use models in their learning without having to know the extensive technical details involved in creating computer models.

Coding

For many technology tools, learning to use the technology is secondary to learning the skill the technology facilitates. For instance, if elementary school students are composing essays in a word processing program, most people would agree that it is beneficial to learn to use a word processor, but the more important learning outcome in this scenario is writing. Coding is an exception to this principal: coding requires computational thinking, a type of problem solving based on the concepts of computer systems (developing algorithms, iterative design, etc.), which is an important learning outcome in its own right (Wing, 2006). However, teaching coding in a traditional setting can pose difficulties: isolated coding assignments may be boring, and syntax errors frustrate novice coders' efforts. In order to overcome such challenges, the information technology program at a university in Turkey added a problem-based learning unit using Scratch to its coding curriculum (Topalli & Cagiltay, 2018). Scratch is an interactive coding environment that uses visual drag-and-drop elements to build programs; by eliminating typed syntax, it allows students to focus on the problem solving and computational thinking aspects of coding (Maloney, Resnick, Rusk, Silverman, & Eastmond, 2010). In this supplemental activity, students used Scratch to develop learning games for elementary school students, with the assistance of domain experts in science and English. Students who had participated in the problem-based learning activity with Scratch performed significantly better on their final senior programming project than did students who followed the normal curriculum. In this study, problem-based learning and a coding tool were used in concert as a twofold approach to a single problem: students were too distracted by coding syntax to focus on problem solving in coding. The problem-based context pushed students to practice conceptualizing a problem and developing a solution; Scratch allowed them to continue focusing on high-level problem solving as they developed a program. In this way, the technology solved several challenges. Lack of background knowledge (i.e., not knowing coding syntax) was largely removed as a barrier. At the same time, Scratch

made the investigative technique of coding more accessible to novices. With the steep learning curve flattened a bit, students were able to build successes early and frequently, which bolsters motivation.

SOLUTIONS AND RECOMMENDATIONS

Educational leaders and practitioners who are grappling to integrate technology meaningfully into educational units and institutions should know that they are not struggling alone. Despite the wide availability of increasingly sophisticated technology, educational applications remain largely limited to practice drills (Gray, Thomas, Lewis, & Tice, 2010). The challenge is to simultaneously consider content (what students are learning), pedagogy (how they are learning it), technology (the tools they use), and the relationships among all three (Koehler & Mishra, 2005). The studies reviewed in this chapter offer several specific examples of thoughtful use of technology in inquiry learning:

Foreground the learning objective. A fundamental of educational design is to "begin with the end in mind" (Wiggins & McTighe, 2005). In the example of using Scratch to support programming curriculum, the authors appear to have followed this procedure (Topalli & Cagiltay, 2018). They identified that students were having trouble with problem-solving and were distracted by syntax errors in their coding, and they proposed inquiry learning with Scratch as a support that would help students concentrate on problem-solving in the early stages of learning to write code. The end they had in mind was to achieve understanding of coding concepts first, before requiring students to learn specific code.

Determine the Inquiry Learning Challenge(s) That Technology Can Address

Inquiry learning brings with it numerous challenges for students, teachers, and educational designers (Edelson, 2001). Furthermore, a single technology can play different roles in different learning scenarios. For instance, many instructors use wikis as the final product in inquiry learning; the point of the learning activity is to build a wiki. However, a wiki could also play a supporting role. If students were creating a sophisticated software program, the wiki could serve as internal documentation. If students were conducting a community service project, the wiki could be for shared reflections and lessons learned. The nature of the technology does not necessarily dictate how it should or must be used in inquiry learning. Therefore, it is imperative that educators decide what role the technology will play and how it will serve the curriculum and learning objectives.

Give adequate attention to "low tech" components of the curriculum. In most K-12 and in-person university classroom settings, there is no reason that every aspect of a project must take place online or with technology. For instance, in GlobalEd 2, cross-group communications take place online, but intra-group communication may be face-to-face in the classroom; research resources are online, but teachers and students are also free to use textbooks if they prefer (Brown et al., 2015). This allows students to learn about a variety of resources and tools and to get support from their peers and teachers directly when needed, especially if they are struggling to learn the technology.

FUTURE RESEARCH DIRECTIONS

There is no question that as technology advances and increasingly sophisticated tools become affordable and widely available, educational leaders and practitioners, and perhaps most of all students themselves, will ensure that technologies are used and adapted for learning. At the same time, the tools and devices will continue to evolve; therefore, in order to accrue knowledge over years and decades, research should focus on technology and learning *principles* rather than specific tools. Researchers should be specific in describing the role of technology in their inquiry curricula, in order to understand how it works, for whom it works, and in what situations it works. This will help the learning technology research stay relevant after the hardware and software have become obsolete.

Future research should, when possible, attempt to isolate the impact of a specific technology. For example, Chiang, Yang, and Hwang conducted an inquiry activity wherein some students had mobile devices and others had mobile devices with augmented reality, to study the specific impact of augmented reality over and above the inquiry activity and devices (2014). This is useful because it suggests the specific way in which augmented reality promotes learning. Conversely, when inquiry learning with technology is compared to no learning unit or a non-inquiry learning unit, it is not clear whether the technolgoy, the inquiry learning, or both are responsible for learning outcomes.

In reports of technology in inquiry learning, the intended and resultant learning objectives should be presented. Technology affords new and creative ways of assessing activity and learning, as demonstrated by the example of using wiki data to measure students' contributions to collaborative work (Trentin, 2009). However, not every researcher must dedicate several pages to developing metrics as Trentin did, and inquiry learning should be expected to have a wide range of outcomes and wide variety of assessments. Inquiry learning is designed to foster students' continuous, interactive, and personalized assessment of their own learning and their progress toward a goal at the individual and group levels (Hung et al., 2008). This type of assessment could be seen at odds with the conventions of educational efficacy research, which dictates that assessments be individual and ideally standardized in some way (e.g, What Works Clearinghouse, 2017). However, many researchers have found effective ways to measure learning in inquiry units. For instance, Hmelo-Silver (2004) described a study that found positive learning outcomes for students in inquiry learning, "provided that the assessments measure knowledge in problem-solving contexts." (p. 250). Hmelo-Silver additionally points out that increases in attitude measures such as interest and self-efficacy are important and relevant outcomes for inquiry learning. Therefore, there is no reason for researchers to avoid measuring outcomes; rather, researchers should identify the learning and/or attitude outcomes they wish to affect and choose or construct appropriate assessments for inquiry learning. Given limited time in school and the cost of innovative technology, it is crucial to know how technology contributes to the end goals of learning.

CONCLUSION

The promise and potential of educational technology can only be realized if educators have sound, research-based guidance for pairing the best new technologies with the best pedagogy. Inquiry learning is an effective pedagogy that is a natural companion to innovative technology: inquiry learning is motivated by students' innate curiosity and encourages them to think, investigate, and problem-solve in

innovative ways. However, making the best use of educational technology in inquiry learning requires a delicate balance of technology, pedagogy, and content knowledge in the design of instructional units.

Example studies show that across age groups, content areas, and technologies, there are three major themes that emerge from successful integrations of technology and inquiry learning: foregrounding learning objectives, determining the inquiry learning challenge(s) that technology can address, and giving adequate attention to "low tech" components of the curriculum. These themes, together with existing research on instructional design and inquiry learning, can guide educators to combine inquiry learning and educational technology to build creative, unique, effective inquiry learning curriculum.

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ADDITIONAL READING

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KEY TERMS AND DEFINITIONS

21st Century Skills: The necessary knowledge and competencies for success in a world of constant change and lifelong learning: life and career skills (e.g., cross-cultural skills), learning and innovation skills (e.g., critical thinking and problem solving), key subjects (e.g., language arts, mathematics), 21st century themes (e.g., global awareness), and information technology skills (Trilling & Fadel, 2012). Note this term is sometimes used to refer to a specific framework and sometimes more generically to refer to modern literacies and competencies.

Augmented Reality: An experience that contains elements of the physical world and context-relevant virtual/computer-generated elements (Wu, Lee, Chang, & Liang, 2013). Unlike virtual reality, in which the user is immersed in a completely computer-generated scene, augmented reality includes and interacts with perceptual information from the real world.

Computational Thinking: Uses the terminology of computer systems (algorithms, iterations, etc.) to express the skill of conceptualizing a problem, developing a solution, and testing and refining the solution (Wing, 2006). Computational thinking refers to a cognitive skillset and does not necessarily require computers or any other technology.

Inquiry Learning: Learning that is driven by the learner's need to know. Specific definitions vary, but generally inquiry learning includes steps of conceptualizing a problem or question; generating, testing, and evaluating solutions, and reflecting upon learning.

Scaffolding: In education, scaffolding refers to support that a person receives in doing a task they are learning. In most cases, the support is temporary and is gradually removed (or "faded") as the learner becomes proficient. An example is a child and adult reading together, with the adult available to help with difficult words; as time goes on the child only needs help with the most difficult words and eventually needs no help at all. Scaffolding is crucial to effective inquiry learning (Hmelo-Silver et al., 2007).

TPCK (or TPACK): Technological pedagogical content knowledge is the integration of tools, teaching methods, and subject matter that is required for teachers, leaders, and instructional designers to effectively use technology in educative settings (Koehler & Mishra, 2005; Mishra & Koehler, 2006).

Wiki: An information website that is shared among users, who continually and collaboratively update and add to it. An important feature for education is that wikis track revision history, which allows students and teachers to view and discuss the processes of writing and knowledge building.

Chapter 42
Disruption and Innovation in Global Higher Education as Viewed Through the Lens of Complexity Theory

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ABSTRACT

The focus in 21st century society is knowledge-based: learning is critical, and information will continually become obsolete. The success of global higher education institutions will demonstrate their ability to manage networks of knowledge and to collect, document, and analyze data involving complex systems, thereby exhibiting adaptability and agility with complexity. In addition, technical innovations will alter the skills and knowledge needed to succeed in the workplace and society. Yet disruption and innovation are often the menu of the day, creating chaos and disorder. Complexity theory impacts all the critical aspects of global higher education.

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INTRODUCTION

Global higher education leaders must manage enormous complexity especially when dealing with disruption and innovation as viewed by complexity (Altbach, 2016; Mense, Lemoine, Garretson, & Richardson, 2018). Therefore, three dimensions of management are critical for success: (1) Global higher education organizations are increasingly rigid and less autonomous and bound by their own institutional policies and procedures as well as state and federal laws (Christensen, Gornizka, & Ramires, 2019; Qureshi & Nair, 2014); (2) Global higher educational organizational environments are increasingly complex, less able to adapt and be agile (Cheng, Cheung, & Ng, 2016; Heckroodt, 2016); and, (3) Global higher education organizations are increasingly dependent on technology (Tekleselassie, Roberts, & Richardson, 2014). Along with increasing global competition, technology adds complexity and uncertainty to the organizational environment, often driven by disruption and innovation (Finardi & Rojo, 2015). Increasing global interdependencies and the accelerating pace of change demand more flexible, adaptive, and agile global higher education institutions (Gornitzka & Maasen, 2014).

A new management approach based on complexity science advocates a shift from the "command and control" style of management to a "sense and response" style. This implies a shift from building skills to predict and control outcomes to prescient abilities to be forward-thinking and responsive in recognizing patterns and adapting quickly (Carlisle & McMillan, 2017). Thus, the focus needs to be on flexibility, learning and development of new knowledge instead of specific management solutions (Ramus, Vaccaro, & Brusoni, 2017).

Technology has disrupted the traditional, formal processes of higher education, particularly in the global marketplace. The twin forces of technology and globalization have created an environment of increasing complexity for leaders in higher education (Siu & Garcia, 2017). Colleges and universities have long been contributors to the knowledge economy and as such have been at the same time acted upon by global forces and have been actors on the global stage in providing services through cross-border initiatives that are often comprised of sites located not within the institutional nations of origin but at locations throughout the world, even on other continents (Stafford & Taylor, 2016). That those cross-border initiatives can be provided through distance learning technologies opens the possibilities for vast new markets, with the promise to cut costs while providing services to tremendous numbers of students worldwide (Wilkins & Juusola, 2018; Youssef, 2014).

The combined forces of technology, new generations of students, uncertainty in the job market and economy, globalization, and all that they imply for global higher education have created a landscape of tremendous complexity with strategic directions difficult to predict (Zhu, 2015). The fact that these forces interact on a global scale creates non-linear change with the appearance of chaos owing to the many degrees of interdependence and interconnectivity (McChrystal, Collins, Silverman, & Fussell, 2015). This increase in complexity in the higher education sector implies a need for leaders who have the cognitive complexity to lead strategic design and implementation initiatives in the coming years (Buller, 2015; Everhart & Seymour, 2017).

Background: Globalization and Higher Education

Globalization has influenced and been influenced by institutions of higher education that have been involved early and often in the promotion of cross-border communities that revolve around the creation and the sharing of knowledge (Amin, 2016)). Additionally, globalization has created a need for universi-

ties to make curricula and instruction relevant to students who must work and live in an interconnected world (Bass & Eynon, 2017).

The globalization of higher education is characterized by the complex interaction of global, national, and local forces with complexity implied by the interconnectivity (Breslauer & Hazelkorn, 2016; Wihlorg & Robson, 2018). Developing nations presently view global competitiveness through a lens that includes the development of higher education as an innovation strategy to develop local economic capacity (Lemoine & Richardson, 2019). The fact that governments are working toward the development of world-class institutions has implications for institutions that have cross-border initiatives featured prominently in their strategies for growing enrollment and internationalization (Pucciarelli & Kaplan, 2016).

Increasingly the focus of global higher education policymakers has shifted to the third mission of universities so that, beyond the basic functions of teaching and researching, universities are required to contribute to society through the creation, transfer, and exchange of knowledge and technologies (Bourn, 2018; Cheng, 2016). Consequently, many universities have evolved from traditional institutions characterized as an 'ivory tower' to an 'entrepreneurial university' with strong links to industries and a more active role in promoting knowledge transfer to society (de Wit, 2015; McClure, 2016).

There are two disruptive changes to the missions of institutions of global higher education that enter the global market. First, the services of such institutions are shaped by market rules where the institutions will compete with other institutions for students (Kemp, 2016). Second, the university mission to convey cultural (national) values to students on behalf of the states or other stakeholders who fund them is modified to meet the needs of emerging international markets (Di Stasio, Bol, & Van de Werfhorst, 2016). The market forces cause state institutions to act in ways similar to proprietary institutions and private institutions that are able to shift or enhance their missions to meet the needs of students in other countries (Bendixen & Jacobsen, 2017; Mense, Garretson, Lemoine, & Richardson, 2018). Thus, institutions of higher education are exploring emerging markets by taking their product to new markets in other countries. Demand for higher education in emerging markets has resulted in offsite services and the use of ubiquitous technology (Woodard, Shepherd, Crain-Dorough, & Richardson, 2011). Although institutions are often faced with issues related to cultural and regulatory differences owing to changes created by the ubiquity of technology, the demand continues to outstrip the supply (Verger, Steiner-Khamsi, & Lubienski, 2017)). Institutions of higher education often look for economies of scale that exist when locating in nations with political and economic systems that are similar and often work to establish partnerships with existing institutions in order to leverage relationships with partner institutions (Bagley & Pornoi, 2014; Marshall, 2018).

Complexity Theory

Morrison (2006) described complexity theory as a theory of change, evolution, and adaption, with a focus on survival, with factors of both cooperation and competition. Complexity theory does not comport with cause-and-effect models, or predictability, but replaces it with an organic, non-linear and holistic approach that focuses on understanding the interconnectedness of networks, particularly in global higher education (Mischen & Jackson, 2008). Interestingly many of the key components of complexity theory are not new, but the merging of multiple constructs into a grand unified theory provides the power behind the theory's attraction and acceptance among many (Watkins, Earnhardt, Pittenger, Roberts, Rietsema, & Cosman-Ross, 2017).

For this discussion, the authors define **complexity as a process that examines the interconnectedness of systems, processes, products and people in the organization.** Turner and Baker (2019) specified that complexity theory is the study of the dynamic interactions between seemingly independent and adaptive agents exposed to pressures both external and internal to the individual or group. Larson (2016) reported that organisms scan and sense changes in their external environment and make internal adjustments to survive in this ever-changing environment. This continuous evolving between the organism and the environment provides the organism the ability to survive by creating its own highly evolved niche in an ever-changing world (Stacey, 1996b). It is through the creation of this uniqueness that the organism is less threatened than those species which attempt to threaten its survival. In addition, Uhl-Bein, Marion, and McKelvey (2007) reported that complexity directly impacts leaders as a result of its effects on decision making and management processes due to imperfect knowledge of conditions and an inability to develop solutions in a formal, linear format. It is clear when there is little to no data the probability of making mistakes increases significantly (Stacey, Griffin, & Shaw, 2000).

Bento (2011) explained two perspectives associated with complexity. The first perspective is termed strategic choice, which assumes that organizations adapt to external changes by restricting themselves in an intentional and rational manner. The second perspective, competitive selection, makes the assumption that all similar organisms are involved in the same evolutionary cycle where either they must adapt or disappear. Complexity theory builds on the principle of equifinality, which suggests that a result may be equally explained by alternative sets of causal conditions (Cilliers, 2000). Complexity theory involves reframing the organization as a complex system and recognizing that interactions between individuals in subgroups can generate novel ideas that drive innovation for the organization (Geer-Frazier, 2014). Rather than attempting to control such unpredictable interactions, complexity theory proponents advocate recognition of the powerful resource such interaction represents (Zurek, 2018).

Interestingly, Morrision (2006) makes the point that complexity theory does offer an explanation for institutional change and evolution in some circumstances that are basically a *post hoc* with limited *prospective* or *predictive* utility. Complexity is good at describing what has happened or what is happening but not what will take place in the future (Corcoran & Duane, 2019). Complexity theory can be and has been used to proscribe actions and situations which promote change and or development through the increased use of creativity, openness, diversity, building relationships and increased networking with all members of the organization (Albert, Kreutzer, & Lechner, 2015).

The increase in complexity in a global economy is driven by the constant increase in variables impacting global universities (Lowell, 2016). Complexity is a feature of reality in organizations that involve a non-linear approach to its study and global higher education accurately describes a non-linear approach (Raynard, 2016). Complexity "is determined by the number of interactions among the parts of an organization inside its boundary and additional ones in its operational (customers, suppliers, competitors, etc.) and extended environment" (Dervitsiotis, 2012, p. 997). The fact that the operational and extended environment is international for most organization increases the complexity exponentially (Lewin, 1999).

Applying complexity theory to a human, complex, and evolving system provides a unique way of viewing patterns of interaction and the relationships in each university (Richardson, 2008). Complex evolving systems established by Mitleton-Kelly and Land (2012) applied complexity theory to new ways of viewing and managing organizations and offer one way of viewing organizations where they are considered to be complex evolving systems (CES). Mitleton-Kelly and Davy (2013) suggested that through creating the necessary conditions within the organization, 'organizational fitness' can be achieved.

'Organizational fitness' refers to the ability of an organization to survive through interactions with their complex environment (Kauffman, 1993).

Components of complexity that impact global higher education include the following: (1) complex systems cannot be comprehended by means of reductionism, i.e. by splitting the whole into component parts and adding them up, as they are made up of elements that make sense only within the integrity of the system; (2) Complex systems evolve unpredictably (except for a short period of time); (3) Complex systems can undergo sudden changes in state (bifurcations); (4) Complex systems have different aspects depending on the scale of analysis; (5) Complex systems do not evolve in an unpredictable manner; and (6) Complex systems are characterized by evolution and dynamics (Anderson & Meyer, 2016; Daryani & Amini, 2016).

Further, Jackson (2018), extrapolated these additional attributes of complexity that describe relationships between global higher education and complexity: (1) The relationship between the components and variables are nonlinear relationships; i.e., each cause is the effect of another cause; (2) under conditions of complexity organizations are unpredictable; (3) complex organizations demonstrate continuous evolution and transformation; (4) There is an unstable balance within the system and the system with the environment; (5) There is no guarantee to ensure the long-term and even medium-term planning; (6) Organizations consist of opaqueness, ambiguities and contradictions; (7) Management and leadership are vulnerable; and (8) Sometimes change in one component leads to fundamental changes in the whole system, namely the butterfly effect. All these characteristics are critically demonstrated in today's global higher education environment and help explain some of the actions or non-actions taken by these organizations (Mason, 2008).

Complexity theory provides the most useful insights into the behaviors of complex institutional social systems (Cseh & Coningham, 2019). Global higher education systems are complex and dynamic and continually adapt and change in complex and unpredictable ways in response to many internal and external pressures and stimuli (Koopmans, 2017). A large, rapidly expanding, culturally diverse, multi-purpose global higher education system is by definition complex and traditional ways of managing change that were devised for more stable times and environments are inadequate for the current environment (Proches & Bodhanya, 2015). Complexity theory addresses the issue of learning and adapting (changing) in unstable and uncertain conditions. The paradox of complexity is that it makes things exceedingly difficult, while the answer lies within its natural dynamics – dynamics which can be designed and stimulated in the right direction but can never be controlled (Kuhn, 2009).

In complex environments the real management task is that of coping with and even using unpredictability, clashing counter cultures, dissensus, contention, conflict and inconsistency (Stacey, 1996a). Complexity theory can help make sense of change in an infinitely complex systemic environment because complexity uses the fundamental properties of nonlinear feedback networks and particularly of complex adaptive networks (Tong & Arvey, 2015).

The objective of complexity theory is to interpret and perhaps even to anticipate the behavior of systems and multiple phenomena built on some general themes of complexity, including emergence, networked structure, unpredictability, autonomous agents, self-organization, and chaos (Ashmos, Duchon, & McDaniel, 2000; Marion & UhlBien, 2001). Such systems are often characterized as more horizontal and cross functional organizations which are adaptable and flexible and may also exist within complex environments evidenced by multiple agents and continuous change (Uhl-Bien & Marion, 2009). For example, global higher education constantly adapts to fluctuating consumer demand as well as the cross

currents of competition which are impacted by government regulations, economic conditions, and student concerns (Westhorp, 2012).

Complexity Driven by Disruption and Innovation

Current expectations of global higher education value efficiency, differentiation, and creativity and adaptation organizations (Altbach & Reisberg, 2018). However, creative destruction is forcing institutions of higher education out of their comfort zone and into a new, uncharted era of innovation and disruption (Liubov, 2016). As a response, some higher education institutions have cut tuition, decreased graduation track requirements, and placed emphasis on increasingly diversified demands of students and industry (Allais, 2017). While many global universities have embraced change with strategic plans to pioneer ambitious movements, others have remained fiercely intransigent. Regardless, creative destruction is driving change in global higher education whether it is welcomed or not because creative destruction can turn the biggest giants of today into tomorrow's distant memories (Avdeeva, Kulik, Kosareva, Zilkina, & Belogurov, 2017).

Survival for global universities means adaptation in this innovation and disruption driven climate. Traditional educational paradigms have changed, and the physical university is now a combination multidimensional education model: physical and online, or online (Glor, 2015; Jongbloed, 2015). Universities are using technology as one of the primary means for initiating and maintaining contact with a diverse student population looking for anywhere, anytime learning (Bista, Sharma, & Gaulee, 2018; Chan, Hackett, Lemoine, & Richardson, 2016; Gallardo-Exheniqe, Marques-Molias, Bullen, & Stribos, 2015).

Globalization, the revolution in information technology, the changing educational demands, and the rapidly increasing competition have compelled global universities to change (Lemoine, Hackett, & Richardson, 2016). Global universities have to focus on being faster, and being more flexible, particularly when responding to developing and changing market conditions in an ever-growing competitive market (Richardson, Jenkins, & Lemoine, 2017; Tierney& Langford, 2016). However, because both market demands and technological capacity constantly change, innovation efforts will always be uncertain (McKelvey, Guido Buenstorf, & Anders Brostrom, 2018). The ability of the global university to innovate is therefore influenced by three factors. First, those global universities best able to monitor this changing technological landscape have advantages to move quickly in response to opportunities (de Wit, 2017). Second, global universities that are closely connected to, and able to understand the needs of, their customers can identify potential marketplace gaps that invite or demand innovation (Froumin & Lisyutkin, 2018). Third, strong, imaginative leadership is essential if global universities intend to identify, bridge, and then act on these technological and market-based possibilities (Said, Ahmad, Mustaffa, & Ghani, 2015).

Since the 1980s, universities, in response to government pressure, have become more business-like and enterprising to take advantage of the opportunities presented by the so-called global 'knowledge economy' and 'information society' (Chow & Leung, 2016; Sorensen, Bloch, & Young, 2016). This process of corporatization of higher education has extended through all phases of higher education creating disruptions through innovation (Wadhwa, 2016). Lemoine and Richardson (2019) examined the factors that drive innovation and disruption for global higher education institutions: (1) Increasing demand for higher education; (2) Globalization of higher education; (3) Increase in the number of institutions in the global marketplace; (4) Restructuring of knowledge; and (5) New expectations for university. They

concluded that all the factors expressed the rationale and reasons for global university response to innovation and disruption.

Global Higher Education and Complexity

Globalization adds to the layers of complexity and ambiguity for leaders in higher education. Bosire and Amimo (2017) define globalization as "a process in which arrangements--be they economic, political, and cultural—become disembedded from their territorial context" (p. 143) and are "driven by the transnational flows of people, products, money and ideas, while at the same time encouraging those flows to become more massive and intense" (p.145). As contributors to the knowledge economy, universities and colleges have long served local and national interests and beginning in the 1990s began serving the international market (Marginson, 2017).

Technology made global communication vastly more convenient enabling higher education to serve as the provider of knowledge throughout the world at a pace that is almost instantaneous, creating new markets but at the same time adding multiple levels of complexity to the missions of institutions of global higher education (Fenwick & Edwards, 2016). Constant change in technology and in global economies and the relationships required by those economies have added increasing layers of complexity (Gerybadze, 2020). Because of these layers of complexity, leaders in institutions of higher education are called upon to lead through change in an era of uncertainty where the risks of decisions are difficult to calculate pragmatically (Hackett, Lemoine & Richardson, 2017).

Higher educational institutions are forced to reshape, respond to, and adapt to a constantly and rapidly changing environment, a process resulting from learning, adaption, and development (Lemoine, Jenkins, & Richardson, 2017). Global universities increasingly find themselves being pushed towards a business model of management increasingly characterized by predetermined outcomes (Kruss, McGrath, Peterson, & Gastrow, 2015). Certainly, the distribution of technology has put teaching and learning reforms on the agenda in many global universities, offering opportunities for rethinking pedagogical practices to serve students. With the diversification and massification of the student body, universities have increasingly shifted their educational philosophy from a notion of 'one size fits all' to a concept of tailored, flexible learning which brands the global university as a borderless, networked organization (Goodman, Melkers, & Pallais, 2019; Li, 2018) . This restructuring process of global higher education is characterized by an ongoing struggle between disruption and innovation in which the increasing complexity and uncertainty disrupting global higher education in a cloak of innovation is creating volatility and change (Barrett, 2017).

Technology and Complexity: An Intricate Relationship

Technology is a process, a tool and a philosophy. Along with increasing global competition, technology adds complexity and uncertainty to the organizational environment of global universities (Dennis, 2018). Increasing global interdependencies and the accelerating pace of change demand more flexible, adaptive, and agile higher education organizations driven by technology, making the use of technology a necessary condition of doing business in higher education (Conceicao, 2016). Information needs incessantly drive the demands for increased technological capabilities and progressively more advanced technologies are being utilized in new sophisticated ways by global higher education, often in efforts to overcome competition. Some leaders suggest technology is the solution to the increased complexity and uncertainty of the global higher education environment (Englund, Olofsson, & Price, 2017).

The increasing global interdependencies and the accelerating pace of change demand more flexible and adaptive organizations increasingly reliant on technology (Leon & Price, 2016). Since global universities face increasing complexity and turbulence, they need to process information and make decisions quicker and with more accuracy, typically with the assistance of technology (Gie, Slabbert, & Haydam, 2017).

Two major world changes, moving from a manufacturing-based economy to an information-based economy and the globalization of education, including the shrinking of the world's workforce to compete globally, have led to many innovations in global higher education, particularly the adoption and utilization of technology. In recent years nothing has impacted global higher education as profoundly as the advent of technology and its uses in the organization. Computers have become universal and the depth, diversity, and value of computer information continues to grow at an incredibly rapid pace (Goldin & Katz, 2018)).

The importance of technology cannot be overlooked (Chan, Mense, Crain-Dorough, Richardson, & Lane, 2013)). In the last two decades, the focus of learning has shifted from using linear interactions (for ex. face to face instruction) into cooperating and collaborating communities, driven largely by online programs and course offerings (Flavin, 2016b).

New technologies, especially the Web 2.0, virtual and social networking tools, enabled learning to be a phenomenon of participated and shared intelligence. Thus far, researchers and technology advocators have focused on finding new tools and technologies in their quest to control the data, information or knowledge (Jacob & Gokbel, 2018). However, focusing and understanding the social informatics perspective of technology is very important as it directs the research attention towards social and organizational contexts of learning, within which the new technologies are deployed (Flavin, 2016a).

A change in perspective, strength and usage of current and futuristic technologies seems to be inevitable. New technologies are creating virtual environments endorsing networking in virtual worlds and using other forms of learning that are both innovative and disruptive (Altmann, Eberberger, Mossenlechner, & Wieser, 2018). Economic and technological changes driven by disruption and innovation are occurring at an accelerating rate in the knowledge society, making life-long learning for everyone a necessity. This is particularly the case in the transition period from industrial production to a knowledge and communication-based society driven by technology within an environment of complexity (Chiva, Ghauri, & Alegre, 2014).

Complexity and the Changing Nature of Teaching and Learning

As global higher education leaders continue to struggle with change, technology has disrupted the traditional, formal processes of teaching and learning in higher education largely through online learning. These disruptive technologies are essentially developed to deliver learning in new configurations rather than disrupting the content of education. Therefore, continuous change is necessary for postsecondary education institutions to remain viable in the delivery of education, particularly through online learning; university leaders want to participate in this global society but must confront the rising costs of technology with the need to avoid obsolescence (Foss & Gibson, 2015).

So, what role does complexity play in this new teaching and learning environment? Complexity is concerned with the interrelationships of organizational actors, in this case the university, the faculty and the students. University administrators want to use online education largely for financial reasons. First, online students do not need classrooms, so costs associated with maintaining a campus are reeducated. Second, online provides a vehicle for increasing enrollment and therefore revenue, particularly in the

global environment. Third, part-time faculty are often used to instruct in the online environment thereby reducing faculty expense. From the faculty perspective online may not be the best answer. Many faculty resent being replaced by part-time faculty and often causing the loss of revenue for the full-time faculty. Second, many faculty are not committed to the new style of learning because they have been accustomed to seeing their students in a face-to-face environment and many are not sure of the educational value of online education (Moodie, 2016). From the student perspective online learning is a viable alternative to going to campus and affords them convenience. Regardless of issues, technology use for instruction is the current mode of operation.

Global higher education faculty are teaching students how to live successfully in a future that is increasingly ambiguous and fast-paced. That is a formidable task for every faculty member, especially for a faculty member who may not be comfortable in the quickly changing world of technology, driven by complexity, alien to their teaching style and being asked to implement an innovation that might not work (French & O'Leary, 2017). Always before, teaching involved imparting knowledge and teaching students to think. Today faculty are asked to make a paradigm shift; in addition to teaching students to think they now must help students understand where and how to find knowledge (Rege Colet, 2017). Faculty must prepare students to find the information they need and the knowledge of how to analyze appropriately and not just to regurgitate facts as often happened in the past.

Computers and all the technological innovations that are at an educator's disposal are just tools to help educators and students find and analyze information. These tools are important to learning, not just because they are so prevalent, but because they can provide a service to students and the global higher education institution (Kumar, Kumar, Jain Palvia, & Verma, 2017). In some cases, educators have become so enamored with technology that it is often an end in itself without a vision for its complex role in teaching students, improving learning and engagement with society (Van Nyhuis, 2018). What is required is to produce a viable, robust, adapting organism that would survive and prosper in an unknowable variety of future environments, running on a few simple principles and values (Zhao, 2015). Thus, the focus needs to be on flexibility, learning and development of new knowledge made assessable by technology instead of specific solutions focused only on technology (Caspersen, Frolich, & Muller, 2017).

Faculty usually begin teaching with what they already know or have learned through experience--with their own knowledge rather than the knowledge that students bring with them to higher education (Flavin, 2017b). As a result, students sometimes experience a clash of cultures where technology is often an add-on that is routinely misused, underused, or completely absent from classrooms (Tyilo, 2017)). A new approach to learning implies a shift from building skills to predict and control outcomes to the ability to recognize patterns and adapt quickly. As technical capabilities continue to increase, costs continue to decline, and as humans improve their abilities to utilize new technology tools, a new era in instructional applications appears imminent. Capitalizing on disruptive technologies in ways that mitigate the disruption while ensuring quality will require global higher education to change by reconceptualizing the use of technology in teaching (Flavin, 2017a).

Complexity and Quality Assurance

Universities change, implement new initiatives, and encounter comparative evaluations in some basic functions and implementations that motivated global universities and compelled them to become entrepreneurs, to produce information, technology, innovation and to build more relationships with the society often through cross-border initiatives (Austin & Jones, 2018). Because cross-border initiatives

and internationalization initiatives are affected by so many variables, quality assurance is a key concern to institutions of global higher education that have made a strategic decision to enter the global market. Concerns related to quality exist given the ubiquity of providers and the ease with which a knowledge product can be brought to market (Stura, Gentile, Migliaretti, & Vesce, 2019). Because of those concerns, there is a need for strong quality processes for both instructional and operational aspects related to instruction. Institutions developing such strategies will need to consider that quality assurance (the new accountability) is at the top of the agenda for many governments (Youssef, 2014) that view competition and expansion of higher education as providing opportunities for their citizenry and for the expansion of local and national economies (Prakash, 2018).

Again, complexity plays a vital role using the concept of interrelatedness. Global higher education institutions are faced with the accountability paradigm of quality assurance largely because of the concerns about quality (retention and graduation rates) for online students who are not as productive in retention and graduation as face-to-face students. Governments and agencies then became involved because there were few international accreditors to check quality, particularly for online students. So, to save the financial rewards outlined earlier, quality assurance became a major concern for global higher education administrators, faculty whose teaching was being called into question, and the governments who wanted to know how their tax dollars were being used.

Global higher education institutions are increasing and to stay ahead universities need a competitive edge. Global universities are now competing with their reputation and quality of learning and looking at satisfying standards assigned by internationally, nationally, regionally or state recognized accreditation agencies (Beerkens, 2015b). Although accreditation is relatively new in global higher education, it is becoming a necessity that most universities are adopting in order to stay competitive (Salto, 2018; Stensaker, 2008).

Recently, the increase in high expectations has given rise to additional demands for more accurate assessment of educational institutions in terms of processes, organizational infrastructure, achievements and productivity of faculty and graduates (Blanco Ramírez, 2013). In addition, the function of global higher education institutions as their own arbitrators of quality has been eroded due to deteriorating confidence of policymakers in the ability and competence of these institutions to effectively assess and validate acceptable standards (Davis, 2017). The ultimate goal of accrediting agencies is to improve the education level offered by institutions of global higher education (Bendermacher, Oude Egbrink, Wolfhagen, & Dolmans, 2017). An increasingly viable question is how to deduce whether the global higher education institution has effectively graduated qualified students that are deemed as effectively capable of entering into the job market and pursuing a particular profession; such a performance is judged by the competencies and success of graduates, not just instructors (Schmidt, 2017).

Quality assurance is deemed a resource to make global higher education institutions more competitive, a strategic move that enables the nations where they are located to become more viable economically and educationally. According to Lagrosan (2017) this move to quality assurance is as essential to an institution working toward assuring its own competitiveness in the global higher education landscape as it is to ensure the development of the nation(s) it serves. Paliulis and Labanauskis (2015) propose benchmarking as a means to assure quality in the present atmosphere of complexity "globalization and constant change" (p. 140).

Quality enhancement offices at global higher education institutions are working diligently toward ensuring and enhancing quality using two major mechanisms: self-assessment and institutional performance evaluation (Agasisti, Barbato, Dal Molin, & Turri, 2017). Institutional quality assurance is

becoming more important to policymakers as global universities are moving toward public as well as political attention (Scott, 2018). New roles, tasks and functions of global higher education institutions have developed that go beyond the simple function of research and teaching (Shah & Jarzabkowski, 2013).

Quality assurance has twin objectives, i.e., quality improvement of global university products and making the institutions accountable to the public (Beerkens, 2015a; Mampaey, 2016). An issue highlighted in quality assurance literature is a growing focus on accountability driven compliance leading to diluted attention on improvement led quality enhancement. (Salto, 2018). In addition, a paradigm shift has occurred where quality assurance is more directed toward getting accreditation and is therefore treated as a strategic objective (Beerkens,2018). However, some institutions have reported more of a focus on quantity over quality of performance, an outcome of formal compliance referred to as "overt compliance and covert resistance" (Kenny, 2017). This could also imply that global universities are attempting to prove themselves against standards, forgetting the main objective is improvement (Dunkerly & Wonh, 2017).

Leadership for a Complex Environment

There is a need for new types of leadership in the global higher education landscape given the layered complexity of a global environment where economic interdependence, rapidly changing economies and cultural interface, are all driven by technological change including rapid acceleration of the power of technology, with all that implies (Evans, 2018). The waves of transformation sweep through global universities at an alarming rate making the complexity of the human and organizational stakes associated with these transformations difficult and filled with traps for global university leaders (Hazy & Uhl-Bien, 2015).

Leaders who see the world through the lens of complexity, as opposed to predictable and linearly, are more inclined to probe, sense, and respond than to force comfortable, but inadequate, solutions. A need for leaders who display cognitive complexity is implicit in the complexity leadership arena given the demands of leadership in a global economy (Ng, 2015).

Global higher education leaders must manage enormous complexity. Three domains of administration are critical for success: (1) Global higher education organizations are increasingly rigid and less autonomous and bound by their own institutional policies and procedures as well as state and federal laws; and (2) Global higher educational organizational environments are increasingly complex, less able to adapt and be agile; and, (3) Global higher education organizations are increasingly dependent on technology. To achieve success the global higher education leader must be flexible and use the creativity provided by technology (Raisio & Lunstrom, 2015).

Global leadership can be defined as a leader who operates on a global stage with the global mindset in an environment that is complex and diverse with competencies that include networking and flexibility (Obolensky, 2014). Aydin (2014) outlined seven future tendencies for global higher education that will necessitate a management model driven by tendencies toward autonomy, transparency, accountability, and vision, i.e., complexity. The seven tendencies include: (1) expansion of university services into new markets that are driven by changing economic needs and the demands of those economies; (2) a movement toward a market-driven approach to providing services that is marked by international competition between service providers; (3) a move toward "academic capitalism" driven by "privatization"; (4) new leadership strategies implied by changing landscapes; (5) increased movement toward collaboration with business and government; (6) focus upon emerging communication technologies; and (7) the movement toward bringing about cross-border initiatives.

Changing leadership practices are being integrated in university settings throughout the world, particularly in light of the increasing complexity of the higher education environment (Baltici & Balci, 2017; Bird & Mendenhall, 2016). Interestingly, Burns (2004) discussed leadership as it relates to a global landscape saying that "(t)he paramount question facing all the peoples of the world is the global organization and management of conflict—how to shift the axis of conflict so that needs and aspirations could be appealed to and aggregated on a worldwide basis" (p. 453), words that seem prescient in light of the discussion in this chapter.

Uhl-Bien, Marion and McKelvey (2007) indicated that most leadership models have focused on top-down, bureaucratic structures which no longer work in complex contexts. A different paradigm focused on adaptive outcomes (with an emphasis on context) is needed. Traditional leadership is losing relevance and developing the competence of complexity leadership is critical for effective success (Watkins, Earnhardt, Pittenger, Roberts, Rietsema, & Cosman-Ross, 2017). Complex leadership provides a systems view of leadership that moves away from a linear view of the world and focuses leaders on the complex and dynamic nature of the environment (Marion & Uhl-Bien, 2001). Complex leadership occurs through solving complex challenges (requiring new learning, innovation, and patterns of behavior) and not through technical problems (Arena & Uhl-Bien, 2016).

FUTURE RESEARCH DIRECTIONS

Moving from a manufacturing-based economy to an information-based economy coupled with the flow of technology, economy, knowledge, people, values, and ideas across borders has created an environment of change for global higher education that should be studied in more depth. Since global higher education today confronts its greatest combinations of challenges: economic uncertainty, quality assurance and globalization shrouded by emerging technologies that are daunting to learn and intimidating to administer future research should help determine the extent to which global higher education has responded to the challenges. Global higher education institutions are attempting to develop the capacity to adapt and modify to the new models of knowledge and information driven by technology in an environment of complexity (Schneider, Wickert, & Marti, 2017) and their success or failure should be the subject of further research. Additional research should examine how global universities are creating new revenue sources in scarce times, how they are creatively using current resources, how successfully they are competing for market share and students, and how they are able to provide access to more diverse students while maintaining their academic mission. Consequently, researcher should determine whether global higher education are adapting to the new challenges of complexity.

CONCLUSION

1. Increasingly the only sustainable competitive advantage for global higher education is continuous innovation, the application of new knowledge.
2. Global higher education must meet new standards of quality assurance that are being demanded by an increasingly technological and diverse society.
3. Global higher education will continue to operate in a continually fluid and uncertain environment expressed as complexity.

4. For global higher education, change is constant, difficult to predict without predetermined outcomes. and often produces results that are not intended.
5. In the complexity environment, global higher education leaders must be flexible and agile to both create and maintain competitive advantage.
6. During the next decade, technical innovations will alter the skills and knowledge needed to succeed in the global workplace and society.
7. The goal of global higher education is sustained individual and institutional performance through ongoing learning, unlearning, adaptation, and change.

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KEY TERMS AND DEFINITIONS

Change: Is the result of alteration, modification, or action that creates a new paradigm.

Complexity: A process that examines the interconnectedness of systems, processes, products and people in the global higher education organization.

Disruption: Anything that creates change in the normal operational behavior of the global higher education institution.

Global Higher Education: Is the development and delivery of higher education programs and services in a global context for global consumers.

Innovation: Techniques, new ideas, new and different solutions that are used by global higher institutions to create value or competitive advantage.

Chapter 43
Emotional Design in Multimedia and Measuring Learning Emotions

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ABSTRACT

Cognitive learning theories have extensively been used for designing effective and efficient multimedia materials. Yet, these theories have been limited to cognitive aspects of learning. With the introduction of the recent cognitive-affective theories, emotional and motivational factors are generating considerable interest. Recently, emotional design approach has been introduced by the researchers. Emotional design refers to manipulating visual appeal of a product or a learning material in an effort to induce positive emotions and thereby learning. Although emotional design approach is interesting, the research on the issue is at the beginning. What is more, studies mostly adopted paper-based measures that are based on self-report to detect learning emotions. Given this rationale, the aim of this chapter is to introduce emotional design approach used in multimedia, to mention different techniques for inducing positive emotions, and to address research on the topic. It also discusses objective tools identifying learning emotions with a focus on emWave emotion recognition technology.

INTRODUCTION

Cognitive theories of learning have dramatically affected the design and development of multimedia learning. However, common multimedia theories were criticized as dealing mostly with the cognitive elements of the design, whilst underestimating the non-cognitive (Astleitner & Wiesner, 2004). "Although it is well known that metacognitive, affective, and motivational constructs are central to learning, they have not been the focus of cognitive load research" (Brünken, Plass, & Moreno, 2010, p. 262). This

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maybe because of the cold cognitive approach, which underestimates the role of affective design and regards using these elements in multimedia as a source for extraneous processing (Park, Flowerday, & Brünken, 2015). Accordingly, recent cognitive theories adopted a more integrative perspective. For example, Cognitive Affective Theory of Learning with Media (CATLM) (Moreno, 2006) and Integrated Cognitive Affective Model of Learning with Multimedia (ICALM) (Plass & Kaplan, 2016) postulate that cognitive and affective processing are entwined and affect mediates learning by increasing or decreasing cognitive engagement. With this in mind, emotional design in multimedia has been presented (Plass, Heidig, Hayward, Homer, & Um, 2014; Um, Plass, Hayward, & Homer, 2012) and defined as "redesigning the graphics in a multimedia lesson to enhance the level of personification and visual appeal of the essential elements in the lesson" (Mayer & Estrella, 2014, p. 12). The fundamental idea of emotional design is that if affective design elements in multimedia are used carefully, they may induce positive emotions which increase cognitive engagement and learning. Although the approach is of considerable interest, research on this issue is still at the preliminary stage (Heidig, Müller, & Reichelt, 2015). Furthermore, studies have mostly adopted subjective measures to detect emotions. The aim of this chapter is to discuss the emotional design approach used in multimedia, to refer to different design techniques for inducing positive emotions, and to address the recent research on the topic. Finally, the chapter discusses objective tools identifying learning emotions with a focus on emWave emotion recognition technology.

BACKGROUND

Cognition, emotion, and motivation are all associated with learning (Schiefele, 1987). The limitation of the pure cognitivist approach is that they regard mind and thinking as solely objective, cold, mechanical, and rational (Dai & Sternberg, 2004). However, it is recognized that emotions and thinking are inseparable and that everything we do is linked with emotions (Barry, 1997; Norman, 2004). Hence, a more integrative approach dealing with affective issues in multimedia is needed (Park, Flowerday, et al., 2015). In this section, motivational and emotional issues in multimedia learning are discussed.

Cognitive Theory of Multimedia Learning

Cognitive Load Theory (CLT) (Paas & Sweller, 2014) and Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2009) assume that cognitive resources should be optimally used for effective learning (Mayer, 2009). If information to be processed exceeds the WM capacity, then a cognitive load effect may occur (Paas & Sweller, 2014). The total capacity is decided by three types of cognitive processing (Park, 2010): Extraneous cognitive processing indicates nonessential processing accounted for by poor instructional design; Essential cognitive processing refers to intrinsic complexity or difficulty of the material; and Generative cognitive processing refers to "cognitive processing that contributes to learning" by "…motivating the learner to exert effort toward understanding the material" (Mayer & Moreno, 2010, p. 133). According to CTML, the goal of instructional design should be eliminating extraneous processing, managing essential processing and fostering generative processing (Mayer, 2009). Previous work on multimedia have been limited to extraneous and essential processing. However, efforts so as to eliminate extraneous processing and manage essential processing have been limited in certain situations. For instance, if learners have insufficient levels of learning interest and motivation, they may not engage in generative processing and not exert the necessary amounts of cognitive effort in order to learn

the material. This is also referred to as generative underutilization problem (Mayer, 2014b). This limitation was addressed by CATLM, which extends CTML by incorporating affective mediation assumption into the model. Affective mediation assumption states that "motivational factors mediate learning by increasing or decreasing cognitive engagement" (Moreno, 2006, p. 151). In the same manner, ICALM argues that affective processing is entwined with cognitive processing and that they are inseparable. If affective design increases cognitive engagement, then how can we incorporate it into multimedia? In other words, what kind of approaches can be adopted in order to ensure that students engage in generative processing? Recently, one approach has been to use emotional design in multimedia (Mayer & Estrella, 2014; Plass et al., 2014; Um, Plass, Hayward, & Homer, 2012) for this aim. Before proceeding to look at emotional design, the term "emotion" first needs to be clarified. After that, the relationship between emotion, motivation, and cognitive processing will be discussed.

Emotion Motivation and Cognition

Emotion is a tendency to move forward or away from specific objects or facts (Plass & Kaplan, 2016). Emotion can also be described as "individuals' judgments about the world that are evoked as a reaction to and an interaction with certain stimuli" (Park, Knörzer, Plass, & Brünken, 2015, p. 31). Emotions can be categorized based on their valance (positive vs. negative) and the degree of their stimulation or activation (activating vs. deactivating). For example, enjoyment is activating positive emotion, whereas relaxation is deactivating positive emotion (Pekrun, 2006). Research on multimedia mostly focused on the valence dimension of learning emotions (Mayer & Estrella, 2014; Münchow & Bannert, 2018; Park, Knörzer, et al., 2015; Plass et al., 2014; Um et al., 2012).

The influence of emotion on cognition can be explored under two hypotheses: suppression hypothesis and facilitation hypothesis. Suppression hypothesis asserts that emotions suppress cognitive processing by depleting cognitive resources that are otherwise supported and reserved for learning (Oaksford, Morris, Grainger, & Williams, 1996). To test this hypothesis, Seibert and Ellis (1991) used different mood induction procedures to induce happy, neutral and sad moods in college students. They found that happy and sad students produced greater amounts of irrelevant thoughts and exhibited impaired cognitive task performance than students in a neutral state. In a set of experiments inducing different emotions among individuals, Oaksford et al. (1996) concluded that positive moods depleted precious working memory resources and suppressed central executive task performance. Other research on cognitive psychology showed that positive emotions facilitate cognitive processing. Also known as facilitation hypothesis, positive emotions broaden the degree of attention, cognition, and action that contribute to building physical, intellectual, and social resources (Fredrickson, 1998). For example, Fredrickson and Branigan (2005) showed different video films to students in order to elicit different emotions such as amusement, contentment, anger, anxiety, and neutrality (control group). It was found that positive emotions broadened the scope, attention, and thought action repertoires when compared to the neutral state. More recently, Yang, Ji, Chen, and Fu (2014) used a face recognition task to test if positive affective learning has an impact on memory. It was found that the participants recalled more when a neutral face was paired with positive information, than when a neutral face was paired with negative information.

Research demonstrated that positive emotions also fostered intrinsic and extrinsic motivation. For example, in a study by Isen and Reeve (2005), it was found that positive mood induction fostered students' intrinsic motivation to carry out an interesting puzzle task. In the same study, it was also demonstrated that positive affect facilitated extrinsic motivation as reflected by involvement with an uninteresting yet

important task that needed to be done. Pekrun, Frenzel, Goetz, and Perry (2007) reported that positive activating emotions (e.g., learning enjoyment) may increase interest and thereby motivation, whilst negative deactivating emotions (e.g., hopelessness and boredom) may hamper motivation. However, in some circumstances, negative activating emotions (e.g., failure related anxiety) can increase motivation, as students may exert more effort to avoid failure (Pekrun et al., 2007). From the perspective of Human Computer Interaction, emotional outputs are also considered to be significantly important. Students feel enjoyment when the systems are perceived as being helpful to them. On the other hand, they may be disappointed if their expectations are not confirmed. In such situations, they may not exert sufficient effort in order to learn the presented material (Yang et al., 2014).

FOCUS OF THE ARTICLE

Emotional Design in Multimedia

The purpose of this section is to present emotional design in multimedia, which has recently been addressed within the literature on multimedia. The term emotional design has been initially used for industrial design and refers to the idea that attractive things work better (Norman, 2004). To be more precise, within the context of multimedia, it is assumed that using attractive and emotionally sound design elements in multimedia can draw students' attention to the material, and stimulate their interest and curiosity. This idea prompted researchers into thinking that multimedia could be designed in a manner that is compatible with emotional design. Emotional design is a relatively new concept and differs from the former efforts to make multimedia more interesting. More specifically, previous research on multimedia considered the use of additional interesting but irrelevant affective design elements as "seductive details" (Harp & Mayer, 1997, 1998). According to this research, although affective design elements may stimulate learning emotions, they may also interfere with learning by increasing extraneous cognitive processing. As a result, instructional designers should focus their attention on eliminating extraneous processing as much as possible through managing essential processing and fostering generative processing. Contrary to the research on seductive details, emotional design concentrates on using interesting and relevant affective design elements, which aim to minimally change the number of design elements within an instructional material and are thereby assumed to minimally affect cognitive load (Brom, Stárková, & D'Mello, 2018). Emotional design approach does not add too much extraneous detail to the learning material, but attempts to manipulate intrinsic design elements (Heidig et al., 2015). Emotional design assumes that positive emotions augmented by emotionally designed multimedia may broaden the degree of cognitive processing and lead to more cognitive resources devoted to the learning task. Based on this assumption, emotional design should induce positive activating emotional states such as enjoyment and interest in learners without leading to extraneous cognitive load that may inhibit learning (Brom et al., 2018). Taking the viewpoint of Pekrun's (2006) activity emotions framework, students desire positive activity emotions such as enjoyment and interest rather than negative activity emotions such as boredom and frustration whilst learning with multimedia. Generally, in educational studies, emotional design included anthropomorphism (using human-like features for non-human beings) with appealing colors, whereas neutral design included only grayscale colors or simple black and line drawings. These are explained in further detail as follows.

Design Techniques for Emotional Design

In order to induce positive emotions and enhance learning, different techniques can be applied. Appealing colors, anthropomorphism, cartoon-like characters with baby faces, interesting sounds, emotional text design, and decorative pictures are to name a few. The effect of colors on emotions and behavior is well documented in the literature. Cool colors (blue, green and purple) are considered as restful, while warm colors (red, yellow and orange) as stimulating (Kaya & Epps, 1998). Saturated, bright and warm colors make certain elements perceived more easily. Therefore, in order to capture attention to the important parts of the instruction, using these colors can be considered (Lohr, 2007). However, caution should also be given, as in some situations colors can be distracting (Lohr, 2007). Furthermore, some studies even found that colorful designs are no more effective than neutral design in terms of inducing positive emotions (Plass et al., 2014) and learning achievements (Clark & Lyons, 2010).

Anthropomorphism refers to using humanoid features for lifeless objects (Mayer & Estrella, 2014). In Mayer and Estrella's (2014) study that focused on "how a virus causes a cold," the host cell was depicted as feeling surprise and fear of being infected by a virus entering the body. Consider teaching gravitational potential energy. A lifeless object could be depicted as having humanoid facial expressions. When the energy increases, the object could have a happy facial expression, while it turns to a sad one when the energy decreases (Uzun & Yıldırım, 2018). That is, expressive anthropomorphism can act as signaling cues to remember instructional elements (Brom, Hannemann, Stárková, Bromová, & Děchtěrenko, 2016). On the other hand, use of anthropomorphism sometimes may lead to anthropomorphic distraction. It may be difficult to decide, which humanoid features should be used for lifeless objects, as they have different bodies than people. If the person's expectation of anthropomorphism is not met, anthropomorphic distraction may occur. Microsoft Paperclip constitutes as an example, although it is no longer used (Wensveen, Overbeeke, & Djajadiningrat, 2002). Sometimes anthropomorphic graphics may also distract learners' attention away from the content (Brom et al., 2016).

Using cartoon-like characters with baby faces is another technique to enhance positive emotion. Designs with baby-like features such as short chins, large eyes, small noses and high forehands affect the perception of cuteness more than designs with mature qualities (Lidwell, Holden, & Butler, 2003). Students could understand scientific concepts easier with the help of cartoons. Through enjoyment provided by these characters, students' attention and interest could be captured towards the material, and "allow them to travel with their mind in a world of imagination and amusement while they are learning" (Dalacosta, Kamariotaki-Paparrigopoulou, Palyvos, & Spyrellis, 2009, p. 741).

Interesting sounds may be used to make multimedia more interesting. Previous research on multimedia used interesting background music and environmental sounds. Background music was provided as an instrumental soft music during learning (Moreno & Mayer, 2000). Environmental sounds were played in congruence with the various stages of animations. For example, a thunder voice was heard when the animation was illustrating a lightning event (Moreno & Mayer, 2000), and a cartoon sound effect of friction sound was played when an animation illustrated the concept of frictional force (Uzun & Yıldırım, 2018). Research results on interesting sounds are mixed. Generally, although interesting sounds augment positive emotions, they may lead to seductive details effect when context independent (e.g., background music), and do not lead to seductive details effect when context dependent (e.g., environmental sounds) (Rey, 2012).

The effect of decorative pictures, which have little or no association to the text, on emotion and learning was also tested. Decorative pictures may both hinder and foster learning depending on the context.

For example, Magner et al. (2014) showed that decorative pictures may be detrimental for students with low prior knowledge. Schneider, Nebel, and Rey (2016) found that decorative pictures related to learning context fostered learning in contrast to pictures related to leisure context, and positive pictures foster learning more than negative pictures. To induce positive emotions, Astleitner and Leutner (2000) proposed "pleasure increase" strategies including "enhancing well-being," "establishing open learning opportunities," "installing play-like activities" and "using humor" (p. 499). Enhancing wellbeing could be achieved by effective, efficient and user-friendly interfaces. Establishing open learning opportunities could be ensured by providing learners control and freedom on the elements of instruction. Installing play-like activities such as computer games could be another way to increase pleasure. Finally, use of humor may be used to increase levels of exhilaration. Comics, stories and cartoons may be used for this purpose (Astleitner & Leutner, 2000). Humorous introductions or analogies to explain and summarize may also be used to motivate learners. However, humor should be used with care, as too much may lead to distraction (Keller, 1987, 2010).

Studies on Emotional Design

Studies on emotional design were initiated by Jan L. Plass and his colleagues (Plass et al., 2014; Um et al., 2012). Um et al. (2012) designed two forms of multimedia materials on the topic of immunization; one with an emotional design that used anthropomorphism with round faces and saturated warm colors, and the other with a neutral design that used grayscale coloring. Their results demonstrated that emotional design induced positive emotions and increased comprehension and transfer. Replicating the study, Plass et al. (2014) also demonstrated that emotional design induced positive emotions in learners. However, it increased comprehension but not transfer (Experiment 1). In addition, when the effect of different emotional design techniques were decomposed, it was found that both shape and color increased comprehension separately. However, transfer was increased only by the shape (Experiment 2). In the study of Mayer and Estrella (2014), students watched a multimedia on "how a virus causes a cold" either with or without emotional design. In the case of emotional design, the objects had appealing colors with specific emotions, and a significant effect of emotional design on retention was found, but not on transfer. However, the authors of the study did not address the effect of emotional design on learners' emotions. In Heidig et al. (2015)'s study, students were exposed to different websites that adopted different color combinations. It was found that while objective differences in design did not influence emotional states, subjective evaluations did. In addition, emotions had a small effect on learning compared to motivation. Park, Knörzer et al. (2015) found that anthropomorphism did not induce positive emotions in learners, nor did it lead to improved learning achievement, although it has an attention capturing effect. Uzun and Yıldırım (2018) found that induced positive emotions generally tended to increase as the amount of emotional design increased. Yet, only the colorful design group showed better recall scores compared to the neutral group and transfer of learning was not found to be significant. Münchow and Bannert (2018) found that emotional design including bright-saturated colors and rounded anthropomorphic faces did not lead to any superiority effect. Due to these inconsistent findings, recently Brom et al. (2018) conducted a meta-analysis on the effect of anthropomorphism and pleasant colors on learning and affective-motivational states. Their study found strong evidence that emotional design enhanced learning outcomes as measured by retention, comprehension and transfer. However, the evidence that emotional design had an influence on affective-motivational states was not strong.

Measuring Emotions

In order to measure learning emotions, pencil and paper-based measures and objective measures were used in studies, where multimedia research mostly utilized pencil and paper-based measures. Positive Emotions Inventory (PEI) (Johnson & Fredrickson, 2005), Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988), and Positive Activation, Negative Activation, and Valence (PANAVA) (Schallberger, 2005, as cited in Stark, Brünken, & Park, 2018) are the most used scales in multimedia research. However, these measures have been criticized for depending on self-reporting and for being subjective. Therefore, objective measures have been suggested to detect emotions (Mayer & Estrella, 2014). Emotions function through neurotransmitters that chemically affect special regions of the brain and body (Norman, 2004), and objective measures work on the basis of these changes. Types of objective methods are well summarized by El-Nasr et al. (2010). Heart Rate (HR), Blood Volume Pulse (BVP), Electrocardiogram (ECG), Heart Rate Variability (HRV), Electromyography (EMG), Functional Magnetic Resonance Imaging (fMRI), Functional Near-infrared Spectroscopy (fNRI), Positron Emission Tomography (PET), Electroencephalogram (EEG), Electro Dermal Activity (EDA), and Respiratory Sinus Arrhythmia (RSA) could be given as examples of objective methods. Some types of methods are based on the valance dimension of the emotion (i.e., positive or negative) (e.g., HRV, EMG), whilst some are based on the arousal dimension (i.e., activating or deactivating) (e.g., HR, BVP, ECG, EDA, RSA), and some are based on both valence and arousal dimensions (e.g., EEG, fMRI, PET, fNIR). Devices capable of detecting both dimensions of the emotion may be labor intensive, as they require more complex and expensive technical equipment compared to devices that measure either valance or arousal dimension (El-Nasr et al., 2010). EmWave Emotion Recognition Technology is a unidimensional cardiovascular measure, which uses Heart Rate Variability (HRV). In order to detect emotions, cardiovascular measures utilize the association between the circulatory and autonomic nervous systems. The two indices used in cardiovascular measures are Heart Rate (HR) and Heart Rate Variability (HRV). HR is based on the arousal aspect of the emotion (e.g., activating or deactivating), whereas HRV is based on the valance aspect of the emotion (e.g., positive or negative) (El-Nasr et al., 2010). HRV refers to "a measure of the beat-to-beat changes in heart rate" (Rozman, McCraty, & Tomasino, 2008, p. 196). HRV-based measures have many advantages compared to those based on HR. As HR-based measures only detect arousal, they are unable to differentiate between positive and negative emotions. In addition, HR-based measures calculate average HR values and do not calculate the relationship between beat-to-beat intervals throughout the session (Rozman et al., 2008). As emotional design in multimedia mostly concerns with activating positive emotions and thereby learning, one can assume that using HRV would be a more reasonable choice to gauge positive emotions. The next section of the study is dedicated to an introduction of emWave Emotion Recognition Technology, which is working based on the HRV.

EmWave: Emotion Recognition Technology

EmWave Desktop is an Emotion Recognition Technology (see Figure 1) and stress detector developed by the HeartMath Institute (Chen & Wang, 2011). The system includes an ear sensor connected to a computer via a standard USB port. Depending on the rate of blood passing through the earlobe, the sensor measures the HRV value, which is used as an index to calculate changes in the Automatic Nervous System (ANS). This in turn is used to detect emotions, as changes in the Automatic Nervous System (ANS) are widely recognized to affect both heart rate and emotions (Hasan, Bègue, & Bushman, 2013).

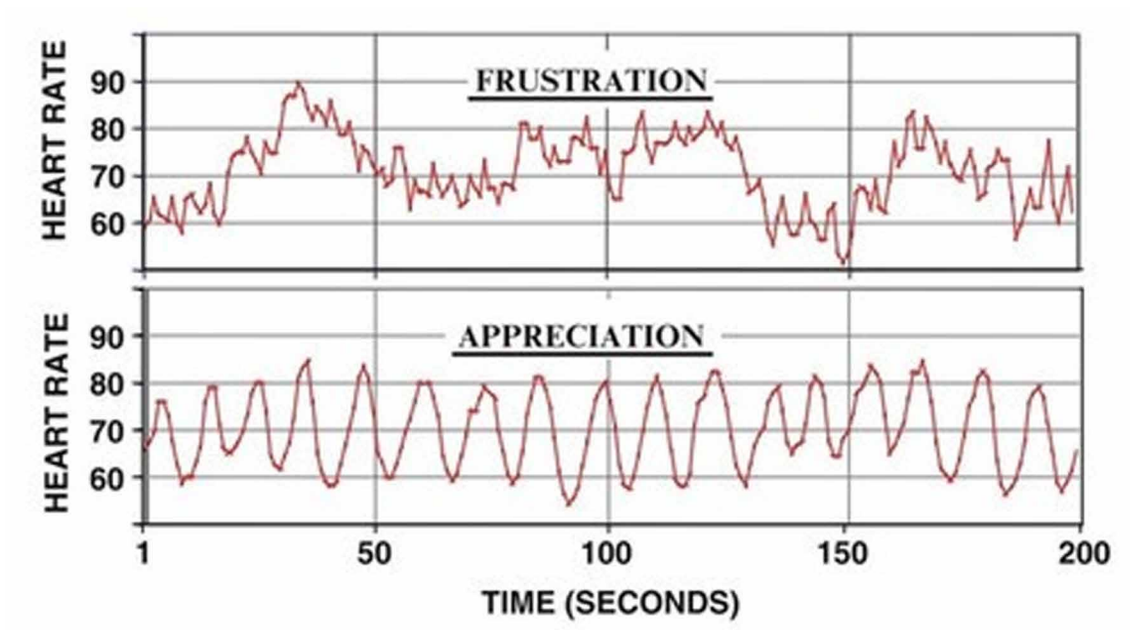
Figure 1. EmWave emotion recognition technology

ANS has divided into two subsystems working in contrast: The Sympathetic Nervous System (SNS) and the Parasympathetic Nervous System (PNS). As an analogy, SNS works like an accelerator, whereas PNS works like a brake (Hasan et al., 2013). Lower heart rate is associated with higher PNS activity, which is advantageous for relaxation; whereas, higher heart rate is associated with higher SNS and is required to energize the body performing at high-speed. For optimal performance and behavioral change, harmony between relaxation and energy is needed (Rozman et al., 2008). In such situations, people feel positive emotion reflecting an increased synchronization or harmony between SNS and PNS, which is also termed as "coherence" (Rozman et al., 2008). In contrast, incoherence or imbalance and decreased synchronization or harmony between SNS and PNS are seen when people are in a negative emotional state (Childre & Cryer, 2004, as cited in Hasan et al., 2013).

Heart rhythm coherence is influenced by many factors including breathing patterns, physical or mental activities, and thoughts and emotions. Research has shown that emotions affect HRV (emWave, 2016; Hasan et al., 2013). Based on HRV analysis, when humans feel stress or negative emotions such as frustration, boredom, anxiety or depression, higher levels of fluctuation in the heart rate and irregular or disordered heart rhythm pattern are observed (see Figure 2, frustration). In such conditions, synchronization between parasympathetic and sympathetic of the automatic nervous system is limited, which leads to suppression of cognitive functioning and increase in stress and instability. On the contrary, when positive emotions such as love, joy, care or appreciation are experienced, harmonious, ordered sine

wave-like coherent heart rhythm pattern is seen (see Figure 2, appreciation). In such situations, emotions are coherently related to cognitive functioning, which involves higher perception attention, memory, creativity and problem solving (Fredrickson & Branigan, 2005; Isen, 1999; Rozman et al., 2008).

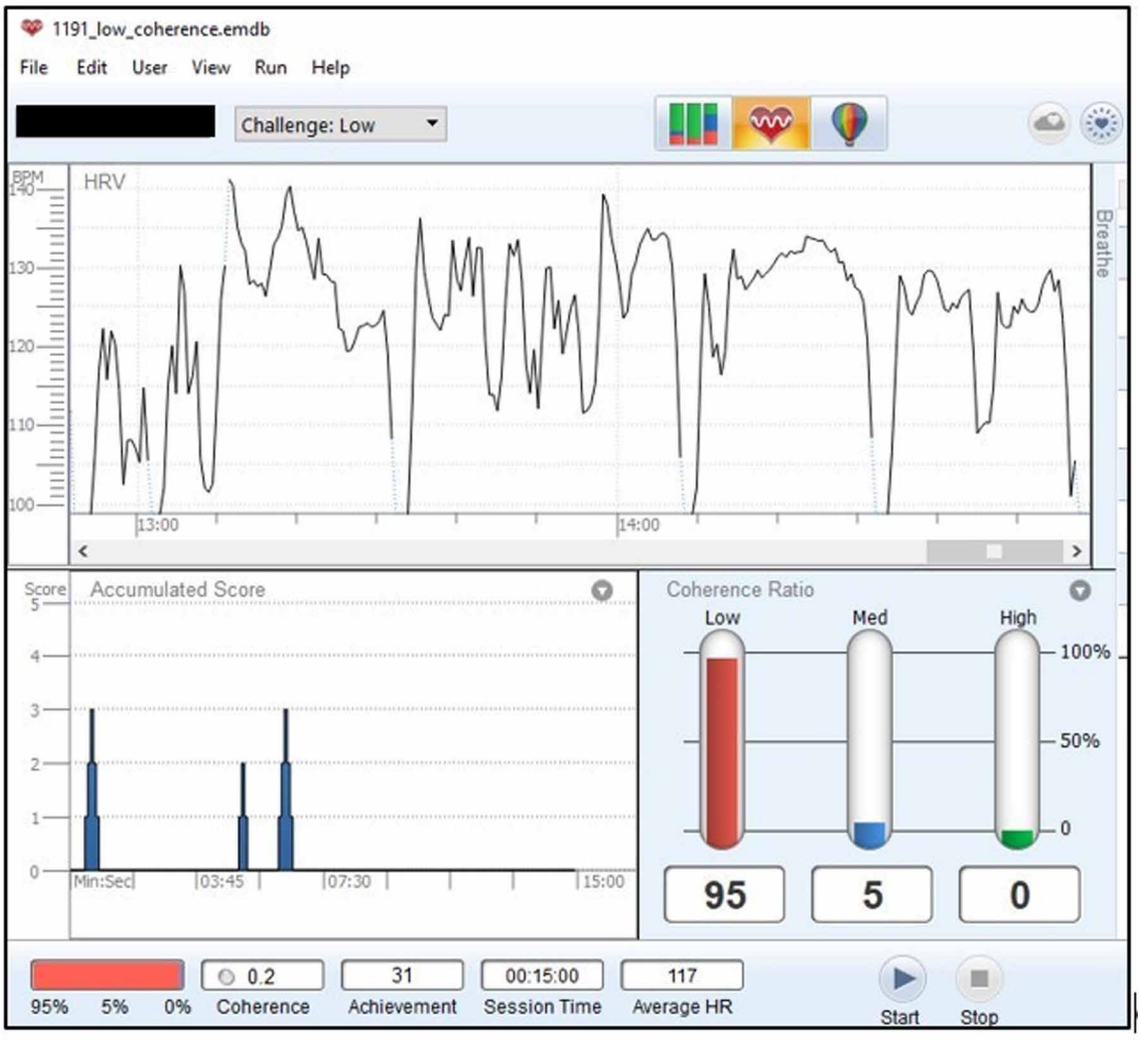
Figure 2. Heart rhythm pattern of different emotions (Rozman et al., 2008)



The emWave system includes a software, where HRV is plotted in real time and has an in-built algorithm calculating coherence scores. Figure 3 shows a sample screenshot of the emWave software interface.

Figure 3 illustrates a subject's heart rhythm pattern and a number of values regarding this pattern as the subject learns with multimedia. The upper portion of the screen shows the heart rhythm pattern of the subject. At the bottom-left of the screen, the accumulated coherence scores are shown. The bottom-right of the screen shows coherence ratios calculated based on the HRV values. During the session, the coherence ratios are recalculated every five seconds depending on the changes in HRV. The red, blue and green bars indicate the amount of time spent in low, medium and high coherence zones in ratios proportional to the total session time (emWave, 2016). The red bar indicates low coherence between SNS and PNS, showing the amount of negative emotions experienced along with the session. The blue bar indicates medium coherence between SNS and PNS, reflecting the amount of peaceful emotions. The green bar shows high coherence between SNS and PNS, reflecting the amount of positive emotions (Chen & Wang, 2011). The sum of the low, medium and high coherence scores always equals to 100%. Positive emotions could be calculated as summing the values of medium and high coherence. Considering the subject's values given in Figure 3, it could be argued that the subject mostly feels negative emotions as the value of the red bar is 95% (negative emotions), whereas the sum of the blue and green bars is 5% (positive emotions) (emWave, 2016). The heart rhythm pattern of the subject is also consistent with these

Figure 3. EmWave software interface



values, indicating negative emotions. As can be seen in Figure 3, it is irregular and disordered, following a fluctuating trend with sudden peaks and troughs reflecting low coherence between SNS and PNS.

In summary, although there are better measurements that identify more complex emotions rather than only valance dimension (either positive or negative), these would be labor-intensive for researchers, as they require more technical equipment. Consisting of a USB module and an earlobe sensor with easy-to-use software, emWave provides a practical means to detect and record emotions that can be used for multimedia research.

SOLUTIONS AND RECOMMENDATIONS

Use of affect in multimedia is a double edged sword (Sitzmann & Johnson, 2014). Hence one should be careful while using emotional design elements in multimedia. To the extent that emotional design does not lead to extraneous cognitive processing, they are welcomed (Mayer, 2014a). In an effort to make multimedia more interesting, emotional design elements should not add extraneous irrelevant detail. As suggested by Brom et al. (2018), added emotional design elements "should not change (or should not change much) the number of informational units in a text, the number of elements in an accompanying picture, or the complexity of interactions among informational units and image elements" (pp. 102-103). Instructional designers should use affect with care and reconsider the false belief that liking always leads to learning (Clark & Lyons, 2010). In some situations, affect did not lead to better achievement scores (Park, Knörzer et al., 2015) and even harmed learning if not directly related to the learning objective (Harp & Mayer, 1997, 1998). Therefore, instructional designers should carefully use emotional design elements by taking into consideration the advantages and disadvantages of the emotional design elements. First, multimedia materials should be designed based on the proven guidelines of learning (e.g., CTML, CLT) and then affect should be incorporated into multimedia by considering limitations of WM.

FUTURE RESEARCH DIRECTIONS

Moreno (2006)'s CATLM has prompted researchers to reconsider the role of emotion and motivation on learning. However, there is still a need for further research (Stark et al., 2018). First, considering emotional design, research on using non-pictorial emotional design elements in multimedia is not at the expected level. To date, and to the best of the researchers' knowledge, only Stark et al. (2018) (emotional text design) and Uzun and Yıldırım (2018) (emotional sound effects design) tested the effect of non-pictorial emotional design elements on multimedia learning. Future studies may also deal with how personality characteristics such as gender and culture may affect learning with emotionally designed multimedia (Knörzer, Brünken, & Park, 2016; Plass et al., 2014). Another important problem to resolve for future studies is how different metacognition strategies of students relate to learning with emotionally designed multimedia (Stark et al., 2018). Students who have high metacognitive skills could compensate the impact of emotion on learning. Another issue is related to the type of emotions. As research on emotional design mostly focused on positive emotions, further investigations should also deal with the effect of negative emotions (Knörzer et al., 2016). Negative activating emotions such as confusion can be beneficial for learning (D'Mello, Lehman, Pekrun, & Graesser, 2014).

CONCLUSION

Consistent with recent developments in cognitive theories (e.g., CATLM and ICALM), this chapter has discussed emotional design in multimedia learning, techniques to augment positive emotions and objective methods to identify learning emotions with a more focus on emWave emotion recognition technology. Emotionally designed multimedia may evoke positive emotions in learners and increase learning achievement (e.g., Mayer & Estrella, 2014; Plass et al., 2014; Um et al., 2012). However, in some studies emotional design had small or null effects on emotions or learning achievement (Park, Knörzer, et al., 2015;

Uzun & Yıldırım, 2018). According to Knörzer et al. (2016), the inconsistencies of research results may stem from either differences in research context or learners' personality characteristics. Taken together, it could be concluded that although emotional design evokes positive emotions in learners, increased levels of positive emotion does not always lead to better achievement scores (Clark & Lyons, 2010) due to contextual factors (Knörzer et al., 2016). Nevertheless, the importance of learners' emotional state and emotional design of learning materials should not be ignored, because they do not harm learning as with seductive details. Finally, through affordances provided by objective measurements of emotions such as emWave, emotions could be monitored in a more accurate and detailed manner.

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KEY TERMS AND DEFINITIONS

Anthropomorphism: A pedagogical strategy, in which human qualities are ascribed to nonhuman beings to make the objects more interesting.

Cognitive Load Theory: A theory, which posits that effective learning occurs if instruction is designed in a manner that is compatible with the human's limited cognitive capacity by lowering extraneous load, managing intrinsic load and fostering germane load.

Coherence: A psychophysiological state when increased synchronization and harmony is observed between SNS and PNS, psychological and physiological functions, reflecting a sine wave like ordered and harmonious heart rhythm pattern indicating that one tends to feel positive emotions.

Emotion: People's appraisal of and reaction to specific objects or facts to move forward or away from them, which evokes affective experiences such as pleasure/displeasure and arousal that are believed to affect psychological and physiological processes.

Emotional Design: Manipulating visual appeal of a product to evoke appropriate certain emotions.

Heart Rate Variability (HRV): An index value calculated based on the changes in Heart Rate (HR) between different heartbeats occurring at a certain time interval.

Multimedia Learning: A cognitive theory of learning, which refers to learning from different sources of information such as words and pictures, in which words are presented as printed, on-screen text or audio narrations and pictures are presented as graphics, diagrams or animations.

Chapter 44
Education and Altruism and the Competence That Students Do Not Know They Possess

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ABSTRACT

The term altruism in Italian contains semantic root "other" that means the one who is distinct from itself. Its meaning indicates love towards one's neighbor, more particularly, the attitude of one who directs his work towards the goal of achieving the good of others (or if you prefer, to find the own good in the good of others). Educating the students requires a particular educational-training plan. The school is responsible of this type of education, which is not only necessary within the class, but it is the necessary attitude to face the increasingly complex social problems of our time. The self-centered culture is infusing in everyone the convinction that people do not need a community anymore, promoting the abandonment of feelings, and of the sharing of relationships with the neighbor. The path to take is based on the education to the developmet of pro-socal competences, bringing into play the community as a relationship founded on the research of the common welfare.

INTRODUCTION

The term altruism in Italian contains semantic root "other", that means the one who is distinct from itself. Its meaning indicates love towards one's neighbor, more particularly, the attitude of one who directs his work towards the goal of achieving the good of others (or if you prefer, to find thier own good in the good of others).

However, altruism is not a widespread attitude in the everyday life people living in the historical moment even if this word often recurs not only in the common language, but also in the language "technical",

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such as the political one where it is difficult to find altruistic attitudes despite the widespread use of the term. Training young people on the value and meaning of prosocial attitudes requires special attention, which engage the family and school. The school is widely involved in this type of training, because the scholl class constitutes a "gymnasium", where it is possible to train and measure the capacity of each student one to promote the good of the class in which he or she is living, but school is also the place where the teacher prepare the young to face social problems, which are characterized by an increasing complexity that affects the different aspects of the life of each individual (Compte, 2015).

In our globalized time every aspect of the life of individuals, both professional and private, is connected with the expectations and interests of life of so many other people, due to the inevitable link of the contemporary world. Therefore privilege as the disadvantage of living in this form of community requires people to be responsible for acting correctly, considering the implications of their choices, whose effects take on wider aspects than those strictly personal and individual, think for example of the problems related to the environment (Dormah, 2018).

However, people are acting in the community feeling less and less connected to each other, although through the use of technological equipment they are virtually always in contact, receiving and exchanging an abundance of information. These possibilities generate a sense of self-sufficiency, allowing you to feel a greater sense of security and capacity in solving any kind of need without the need to lean on someone who can support us (Turkle, 2017).

An egocentric culture is spreading, instilling in people the conviction that they no longer need community help (Bauman, 2001), and this sense of self-sufficiency promotes the abandonment of feelings oriented to the possibility of sharing the joys and sufferings with others.

From this point of view the sense of community is also damaged, it is exposed to the risk of developing forms of isolation and demotivation that people feel, and which could also affect the very adults who have the delicate task of educating, with very dangerous consequences for the formation of the new generations. The path to take is based on the education to the development of pro-social competencies (De Beni, 2000), involving the community in a relationship founded on the pursuit of common well-being.

Bringing young people's attention to the importance of altruistic attitudes is a necessity, it arises from the deep crisis that characterizes modern society, whose indicators of emotional malaise, isolation and aggressive attitudes are increasingly common in both young and adult life.

It is therefore necessary to pay greater attention to empathic skills for the new generations, due to signs of social alienation and individual forms of desperation, If unchecked, they could lead to deeper lacerations of the social fabric (Decety & Ickes, 2011).

The interest in the subject stems from the desire to explore the implications and behavioural consequences of educating new generations towards forms of solidarity and participation. . The work concentrates on the importance of altruistic attitudes in social life.

The subject of the work is not yet adequately explored, except by philosophy. It is a recent pedagogical research trail. The theoretical frame of reference is, therefore, gradually being constructed.

Poor results the literature of the sector.

BACKGROUND

In the countries of the European Community, the general trend of societies is towards increasingly more autonomous forms of the individual, which lead to a reduced availability towards manifestations

of solidarity and an ever greater competitiveness (attitudes that can take on brutal connotations, as can be seen from the various incidents reported by the media, which occurred in some university and work environments). Such attitudes lead to increasing forms of isolation and deteriorating social integration. This atmosphere is accompanied by forms of social crisis, together with manifestations of growing emotional malaise, especially among children and young people (Barton & Garvis, 2019).

What is recorded is the increase in violent acts between adolescents and Italy is second only to the United States for the number of murders committed by young people in a year. This indicates that many minors are heading into adulthood with severe reactive deficiencies to self-control, the ability to manage their anger and lack of empathy.

The supporters of the relationship between empathy and altruism refer to the theories of Paul MacLean (1990), whose that relationship find a neurophysiological foundation. According to MacLean the limbic system can be divided into two parts: one part is involved in the feelings, emotions and behaviors that guarantee self-preservation; while the other part refers to expressive and emotional states, including empathy, which promotes sociality and conservation of the species.

Considering the presence of this hidden base, it is necessary to restore its great his importance,, so that it can bring benefical effect for the well-being of the community.

The family, firstly, the school, secondly, represent educational agencies to make young people have experience of pro-social behavior, and later, direct their way of living.

Through the indirect experiences that young people have when they live in the family and school, they have contact with situations in which they can see adults acting and dealing with situations of help to others. Subsequently, it will be this type of experience that will guide their way of dealing directly with problematic situations (Mariani & Schiralli, 2002).

They will be able to intervene actively precisely because of the model of reference which they absorbed during the years of their formation and education.

Family and school experience difficult times. They fail to be reference models as in the past. The present generations find in technology reference models for their behaviors that they believe more credible. Technology does not experience the contradictions of interpersonal relationships which, at times, contradict what words say.

It becomes, then, important that the family and the school follow the same educational path, based on common objectives that adopt consistent and credible actions.

Such an alliance helps young people to emerge from the state of educational disorientation that often accompanies them in their freshness, preventing him from taking on role models to look at in the delicate moments of his life path (Strongoli, 2017).

FOCUS OF THE ARTICLE

In international pedagogy the concept of learning-service is not new. However, in a didactic context, this kind of education is not widespread. Family and school represent two examples of communities, where the educational purpose is not only a personal development, but is oriented to the growth of the whole community, in this sense education finds its deep meaning (Gennari, 2006).

The theories about family and about society show how much this two elements are linked together, this bond crosses the specific meaning of both. The rational approach, or "relazione-simbolico" (Donati 1991), represents from 80's, the most suitable key to read nowadays society, an approach that has been

studied subsequently from groups of sociologists and psychologists. The family is a rational "organization", that is characterized by two levels: the bond of relationship and the reference of the sense. The familiar relatonship is represented as a structure where reciprocal expectations, that derives fromthe relationship between the subjects, take place; there is an exchange between the subjects, who carry a cultural wealth. In the moment of the building of the couple there is already the meeting of two different stories, consequentially each son that take part to the family represents a node of a generational plot, of a symbolic wealth, cultural and integrational. The familiar relationship, as a bond between genders and generations, is characterized, in its inner part, by the bond of relationship and the reference to the sense. Both elements do not subsitute, anyway, a sufficient summation, in fact, they give birth to somethig bigger, that is represented by the children. Educating children means forming people to whom the task of planning the development of humanity. They will give life to behaviors that they will have loving attitudes that also coincide with giving life and taking care of their fellow men, through the design of actions aimed at producing well-being in the relational context of life and work (Mariani & Schiralli, 2000).

Which are the features of a pro-social family?

We can say a pro-social family is the one where the relationships with the external world are characterized by openings, by social exchanges, by reciprocity, by sharing and solidarity (Tapia, 2000).

Where these elements are present, if not all, the majority of them, testify to the socialization that happened inside of the family towards their younger members, seen as stable and steady traits in building and rebuilding paths of personal and social identity that, in post-modernity, are considered permanent traits.

The typical pro-social family underlines traits of a growing phenomenon, that represent an answer to nowadays challenges (De Beni, 1998).

Does the role that family and school play in young people education have to be separeted in social education, which concerns school, and cultural education, which concerns family? We are all aware that if the community, particulary the scholastic one, is productive, even the productive web is vitalized.

Education becomes the real engine of change in the young peaple, the most precious asset for the whole community.

In a region, in southern Italy, a research that involves six classes from two different secondary schools evidenced how the responsibility of young people in adopting altruistic behaviors comes, firstly, from the education that families give, and, secondly, from the relationship of young people with who promotes social actions. As a result, the altruistic behavior derives from the education that both family and school have to transmit, together with social standards, respect for the rules and the empathy education and supporting participation towards who lives, for any reasons, a difficult situation, that can be a physical, psychic, economical or a social one.

WHAT CAN MAKE YOU BECOME ALTRUIST

In the education of young people it is important to understand if people that help the others, or that are involved, over different levels, in volunteering activities, are moved by the empathy education received from the family, or if the willingness to give help is conditionedby their participation in pro-social activities.

The researchers clarify some points regarding the theme of altruism. A group of Missouri University teachers, with their studies, show the existence of a deep relationship between people and pro-social behavior, that can be the commitment in helping the neighbor, or the support of people who need help.

There are proofs of the real nature of this relationship. In fact, the existence of reciprocity between pro-social behaviors of empathy and compassion in teenagers, in particular between 12 and 16 years old, has been proved.

Empathy and compassion represent the predictive characteristics for the development of pro-social behaviors, like even have been involved in activities that help people in situations of need allows the growth of positive attitudes towards the neighbor (Padilla-Walker & Carlo, 2015).

The commitment in pro-social activities make young people develop the ability to provide help. They train and increase their abilities to "read" situations of "disease", developing "decentralizating" competences, putting themselves in the neighbors shoes and living situations from another point of view, being exposed to critical situations that are usually internalized by teenagers, influencing the way they see and judge themselves.

The ability that young people normally acquires last for the entire course of their existance, even when they will face themself a situation of disease, they will know how to deal with it and how to relate with the neighbor to ask for and receive the necessary support (De Bono, 1986).

The scientific production about young people pro-social commitment focused the attention on volunteer's characteristics, that means the traits of personality, the reasons and the meaning these commitments hold for them, so their moral and social awareness or responsibility. Researches show how young people involved in volunteering activities demonstrate a high propensity to assume pro-social attitudes and behaviors.

Comparing the data coming from investigations conducted in UE countries a presence of critical elements in the motivations, that bring young people to assume behaviors free from personal interests towards the others (ISTAT, 2015).

An extremely interesting datum is about investigations conducted in US and UE abount volunteering positive effects over both individual and social side. Researchers agree to support that the teenagers involved in volunteering actions on the one. Hand can acquire knowledge and attitudes, on the other show more self-awareness and life context, giving considerable importance to the involvement in home communities.

FAMILY INFLUENCE IN EDUCATION

Although the loss of values of the family, it seems to recover a central and important role, as the first place where sons' socialization happens and as the place of the building of personal identity. Family renews with time, and it is followed by the changing that happens in society. It never goes out because is linked to men's nature. In his path family faces different, certainly different kind of difficulties, but, despite it always manages to find the way to rise up and continue its path (Galli, 2000). The family educates human behavior and its action through the relational bond, being itself a subject that is based on relationships and bonds and is interested, by its very nature, in generating family attitudes.

The role of family education supports the elaboration of judgements, individual and social behavioral norms, plays a significant and indispensable role in the education of children.

For their part, young people find in the family the most important impetus for their empathetic participation in the difficulties experienced by others. The children explain the strong role that their parents play in educating them and encouraging them to participate emotionally and concretely in providing the necessary support to others and in finding ways that can lead to resolutions of a material or emotional

nature problem. The family has a central role which anticipates the educational action of schools and other educational agencies as well as the role of friends.

Many children claim that it was parents (47%) who encouraged their involvement in charitable activities, higher datum than all other options, including friends (29%) and teachers (24%).

In particular, it is the role of the mother and her relationship with the children that have the greatest impact on the pro-social attitude of the children, making them develop a significant commitment. Positive family relationships double the probability of young people engaging in activities that promote the well-being of others, receiving a sense of well-being themselves.

On the whole, a number of studies show that parents play a key role in guiding children towards civic participation and in encouraging them to make unselfish commitments to the benefit of the community.

The connection between family ties and empathic participation highlights how the values that parents transmit to their children can foster their participation in activities that are seen as beneficial for the whole community. In this sense, the resulting indication is that there can be an inter-generational transmission of the citizen's sensibility and participation in civic life that is born at an early age, within the parental-child regulation.

Data from research carried out in some secondary schools in a southern region of Italy, show that the family is much more important than school in promoting the development of young people's involvement in civil society than is commonly believed, however, without the educational action of the school the role of the family alone may not be sufficient or incomplete, in so far as within the school the young person comes into contact with young people who have received forms of education which are inspired by different values and which could disorient and cast doubt on the validity of the own education and training. The educational intervention that guides the school is oriented to the training of the citizen, with a view to its active participation for the building of a right, fair and supportive society.

SCHOOL INFLUENCE ON EDUCATION

Educating young people in altruism, encouraging them to assume attitudes of help and support for others, is seen as a necessity of our society, because it represents the fulcrum of the growth and development of individual and social well-being and which can, and must, take place through education (Sloan Wilson, 2015; Wilson, 1979).

It consists in educating to the behavior and acquisition of pro-social skills and is part of an area of research related to behaviors and the helping relationship (Mauss, 2000).

School and teachers can face the education of young people towards those values that are innate and that are abandoned because of ways of living centered on individualism.

Docents become the main actors to promote the discovery of modes of relationships oriented to the acquisition of those behaviors that help the new generations to rediscover the value and importance of solidarity and therefore the offer of help towards their own classmates (Tapia, 2000).

Neurosciences gave access to problems such as learning and conscious altruism. Altruism is inside our genetic code, but learning how to use it is the emergency in our society, that produces inequalities and exclusions every day (Simger, & Fehr, 2005).

The altruism is within our genes but the urgency of implementing actions oriented to the support of those in a state of need is pressing: our society produces imbalances and exclusions every day (McLean, 1990).

Faced with the multiplication of planetary problems requiring a common solution, commitment of a collective participation, the man of the 21st century increasingly tends to fall back into his own little world and seek salvation by relying on his own individual resources (Beck, 2000). This paradox contradicts the need for community that everyone brings with him from birth.

THE SCHOOL THAT DOES RESEARCH

In a first grade secondary school institution and in a second grade was conducted, in the school years 2016-2017 and 2017-2018, a research that involved for the first grade secondary school six class: three classes in the second year of the course and three in the third year of the course, with pupils aged between 12 and 14. In secondary school there were also six classes involved: three for the first year of course and three for the second year, with students aged 14-16. For a total of three hundred students, coming from different socio- economic and cultural contexts.

The economic power of parents, understood as the availability of means and tools useful to the acquisition of high-depth educational values: availability of books, table conversations, access to art exhibitions and travel, is closely related to education that parents have received.

The aim of the research was to investigate how many children were engaged in pro-social activities and what were the reasons behind their commitment and whether their experience could serve as an educational model for those who, within the same class, they had no commitment and empathic participation.

In the first phase of the research, when the students were presented with the research in its phases and what its purpose was, the students were not available. The questions that the teachers asked him were perceived by the students as intrusive.

From the point of view of the young people, the activities they carried out outside the school did not in any way concern the teachers, precisely because the activities they carried out outside were of no interest for school life. Teachers had to do their work with their interest in pupils had to be limited to school hours. The school was considered an institution separate from the rest of society, a sort of island where the inhabitants populate it a few hours a day and then separate, forgetting it until the next day.

Everything that happened inside the school was seen as a sort of suspension of reality and therefore of life itself.

The study was introduced by the question that the philosopher Thomas Nagel poses as the foundation of positive behavior: “What would you feel if this happened to you?” (Nagel, 1994) and to which pupils have been involved in providing their own personal response.

For the study, the teachers involved asked the three hundred students to answer questions related to empathy and pro-social behaviors. Interviews with adolescents were repeated four times during the school year, to analyze changes in their behavior and the impact that their involvement in pro-activity have produced during the reference period. The analysis of the data showed a decrease in the tendency to altruism among young people in their early teens (12-14 years). While 15- to 16-year-olds recorded a sharp increase in empathic participation as they matured.

A constant in the levels of empathy and pro-social behaviors have pointed out the girls who are not affected by the age factor.

In addition, almost half of the adolescents who participated in the study said that they often worked in support of people or the environment.

While almost two thirds claimed to have done so at least sometimes.

Among the activities mentioned, the most common were providing support to outsiders - for example, collaborating with a food bank in the area of residence– and serving as volunteers at institutions or charitable initiatives.

Teenagers have also expressed a number of different motivations for their involvement. The most common response was to be motivated by the desire to improve things or help people (43%), followed by the personal pleasure of doing so (28%).

This suggests that the boys are stimulated by a set of goals, both self-oriented and disinterested, This is also reflected in the fact that a third of them said that their involvement was personally beneficial and at the same time brought benefits to others and the environment.

An element of positivity that has manifested itself with the procedures of the research project has been the interest of the students in understanding which mechanisms are already present in the human nature, because there are behaviors that unite all men and because these attitudes or predispositions satisfy the patrimony of each.

To discover that the drive to altruism was the force that allowed the ability to preserve itself was the element that motivated them to talk about the emotional sphere, of what they perceive when they help someone in difficulty and what are the reasons that lead them, instead, to turn away from them (Krznaric, 2014).

Finally, it emerges, that when young people feel supported by their social environment and, by people who have relationships with them, by family and by school, their concern for what happens to others is reactivated.

If a student can count on external support from parents and teachers, and also have friends who offer support and help, all this ends up giving a great impulse to his predisposition to the help of others, in terms of pro-social commitment.

A search has emerged in the search, the boys through the activity of aeducation to the altruism have found the key to open their emotional world and look for words to talk about it

THE DIRECTION WE MUST CHOOSE TOGETHER TO BUILD THE FUTURE

Different ways can be adopted to teach pupils to develop pro-social attitudes. In the classroom, for example, empathy can be developed by engaging a pupil to listen to a companion while telling him how he felt during a personal experience and to imagine his feelings (Nagel, 1994).

Empathetic participation training involves educational techniques that help young people to direct their attention as they become aware of bodily sensations, emotions and thoughts that pass through them while listening to others' experiences. Empathy can be developed through a student listening to a classmate telling him how he felt during a personal experience and imagining his feelings (Singer & Fehr 2005).

Training for empathic participation involves techniques that help young people focus attention while becoming aware of their body sensations, emotions and thoughts that pass through them while they listen to others' experiences.

Altruism requires the ability to come into contact with more specificemotions and feelings such as loneliness, for example by imagining a loved one with whom one has an emotional bond while at the same time focusing attention on the sensations of heat human that are felt .

The resulting feelings can be transmitted from one to the others.

Educating the students in a participatory feeling requires a particular educational-training plan.

The teacher will have to prepare courses that will structure times, methods, resources and contents. Students will have to be guided to imagine themselves letting gradually emerge their feelings that will be extended to other people (Johnson, Johnson & Johnson Holubec, 1994).

Helping the struggling classmate can be a benefit for those who receive the help and be motivated by the personal interest of who offers it. It is evident that the altruistic manifestation must manifest itself through our actions and by the lack of recognition by third parties (Macaulay & Berkowitz, 1970).

As long as altruism does not become a natural behavior, it must be trained by reflecting on appropriate behavior, working on how and when is it appropriate to help, and by using structured procedures to be included in the path.

It is the responsibility of the entire teaching team to share a common line of education based on the recognition of values that guide their actions and that aim to acquire for students well-rooted behaviors resulting from guidelines values deemed unavoidable.

To achieve such high and important goals for the individual and for the communities it is necessary to activate participatory listening actions, to operate an authentic tuning into the words that the other addresses to us, avoiding to remain on the surface avoiding deep and participatory relationships (Strongoli, 2017).

Pupils will learn through teachers how to enter into a relationship, how to act in order to grasp the message that is transmitted to us and thus operate correctly in offering their help. Young people, more than adults, are able to grasp the authenticity of a communication, are ready to reject any person they feel as not authentic.

Teachers, therefore, must, before undertaking any form of training in professional skills, build authentic mutual support relationships among themselves in order to be credible testimony in the eyes of every student.

CONCLUSION

Pro-social behaviors is a natural trend towards which man tends. Some cultural contexts make it difficult for young people to express their feelings, as attitudes of solidarity and participation are mistakenly considered not as signs of strength but as manifestations of weakness. Therefore, education is needed to make it easier for children to develop and manifest their innate pro-social behaviors. In order to increase such behaviors among adolescents, particularly among males, who are experiencing the greatest difficulties, attention must be paid to how we can work to change the social environment in which young people live, so as to encourage them to express their pro-sociality, taking it as a constant attitude of their actions.

In the type of society that characterizes contemporaneity, the pressures exerted on young people so that they do not express feelings considered a sign of weakness are urged, through the invitation to adopt bullies attitudes and not very sensitive, stifling in them the possibility of carrying out pro-social behaviors. The attention of families and teachers must be directed to the contexts in which young people grow and to the groups of socialization in which they are inserted. In the school context, pro-social education fails due to conflicts between members of the class group or personal interests. The risk consists in confusing self-oriented empathy with altruism oriented towards others (Macaulay & Berkowitz, 1970).

Altruism is characterized by constant availability, combined with the determination to do everything in everyone's ability to provide help to their partner according to their needs. It is the will to remedy the problems of the other through the implementation of actions necessary for the purpose.

In the classroom the altruism presents itself asa significant interaction, or relationship, between two or more people, in which the aspirations and goals of a person are shared and supported in their realization by other people .

The essence of the educational discourse must be centered on the will to work on a positive revolution, that is, on the capacity of a community as small as the class and as large as the school, to make sense of a shared and therefore constructive people.

The characteristic of a positive revolution consists in offering its own contribution, even modest, and to believe that offering help, encouragement and support can take a little at a time the upper hand over the forces that are opposite (De Bono, 1991). In the adoption of this point of view, constructive will is synonymous with overcoming disunity, disintegration oriented to the future, to improvement. Without openness to hope, education would be closed on itself, proved of its meaning of improvement, without its prospective vision because it would be denied its function.

A school that engages in cooperative learning should not be considered a waste of time or utopian (Johnson, Johnson, 1994), learning the other means exercising skills of decentralization and shared thought, which is to be considered as the basic process of the emotional literacy of young people.

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KEYTERMS AND DEFINITIONS

Aid Report: A report in which at least one of the two players aims to promote growth, development, maturity and the achievement of an adequate and integrated way of acting. The other can be an individual or a group.

Altruism: Lively inclination or love towards one's neighbour, which results in active participation in the resolution of problems, difficulties and needs of others.

Education: Methodical conferral or learning of intellectual and moral principles, valid for certain purposes, in accordance with the needs of the individual and of society.

Educational Design: An activity designed by the teacher that allows to transform what is definable as cognitive activity into material and conditions.

Empathy: The ability to place oneself immediately in the state of mind or in the situation of another person, with no or little emotional participation.

Group Class: Set of students who live in the same environment and are linked each other as members belonging to that environment.

Participated Listening: Suspend your activities to devote yourself to another person with a voluntary act participating in your life situation.

Chapter 45
Constructivism in 21st Century Online Learning

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ABSTRACT

Augmenting communication in and among those in the academic, business, and military communities, the exponential advancement of science and technology has availed vast amounts of information to virtually millions of people around the globe. In conjunction with this knowledge explosion has been a growing concern for the democratization of the learning process, with constructivism driving much of the educational agenda, most particularly in areas such as online distance education. This chapter examines the resurgence of the constructivist approach to teaching and learning, its convergence with rapidly changing technological advances, and its relationship to future trends in online pedagogy and andragogy.

INTRODUCTION

Augmenting communication in and among those in the academic, business, and military communities, the exponential advancement of science and technology has availed vast amounts of information to virtually millions of people around the globe. In conjunction with this knowledge explosion has been a growing concern for the democratization of the learning process, with constructivism driving much of the educational agenda, most particularly in areas such as online distance education. This chapter examines the resurgence of the constructivist approach to teaching and learning, its convergence with rapidly changing technological advances, and its relationship to future trends in online pedagogy and andragogy.

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BACKGROUND

While the constructivist method has been highly emphasized in the recent literature for online and distance education (Barak, 2017; Brown, L. 2014; Bryant & Bates, 2015; Holzweiss, Joyner, Fuller, Henderson, & Young, 2014; Huang & Liaw, 2018; Mbati & Minnaar, 2015; Miller-First & Ballard, 2017; Perrow, 2017; Ștefan, 2017; Symeonides & Childs, 2015; Thorne, 2013), it is not a new approach to learning. Presenting an early example, Socrates facilitated discourse with students asking directed questions to assist them in realizing the weaknesses in their logic and critical thinking. This enabled learners to share in the responsibility of their learning through active participation, while negotiating meaning in the creation of shared understanding. In contrast, medieval professors in later Western culture most often served as primary repositories of information along with the scrolls and velum texts found in the limited number of physical libraries available to educators. With the lecture serving as the quickest and easiest way to disseminate information to both small and large groups of individuals, it was both an efficient and effective delivery method in the shaping and forming of student knowledge, quickly becoming the standard for traditional education.

FOCUS OF THE ARTICLE

Resurgence of Constructivism

While the lecture method was the norm of information delivery for centuries in Western culture, the knowledge explosion arising from the latter part of the 20th century demanded more active learner participation. In light of this constant and rapid flux of information and knowledge, students became life-long learners compelled to use metacognitive skills to constantly evaluate and assimilate new material into their respective disciplines. As this implies, knowledge was no longer viewed as a fixed object; rather, learners constructed it as they experienced and co-created an understanding of various phenomena by collaborating and working with peers and professors as well as with the information. Now, rather than strictly acquiring information, Duffy and Cunningham (1996) explicated that "learning is an active process of constructing … knowledge and … instruction is a process of supporting that construction" (p. 171).

Based on the work of Kidd (1973), Long (1983), Moore (1989), and Palmer (1993), Grooms' (2000) *Learner Interaction Model* (see Figure 1) illustrates that in the constructivist culture, the learner perpetually interacts with these three components of learning--content, facilitator or professor, and peers--each mutually and non-discriminately influencing the other.

Critical in this process is recognizing the shifting role of the professor who becomes the *guide on the side* or content facilitator and is no longer the proverbial *sage on the stage* or content provider. The student's role also has changed from being a passive receiver of information to an active participant in the knowledge-making process, aligning with Bandura's early work (1977, 1994) on the concept of the autonomous learner, an important dimension of the constructivist model. Based upon the earlier work of Reid-Martinez, Grooms, and Bocarnea (2009) and Reid-Martinez and Grooms (2015; 2018), Table 1 delineates these two approaches to learning.

Of special interest in the above listing is the role of community. The constructivist approach recognizes that students do not learn strictly within the limited confines of a local educational institution, but rather within the broader international and global context of their personal lives extended through social

Figure 1.

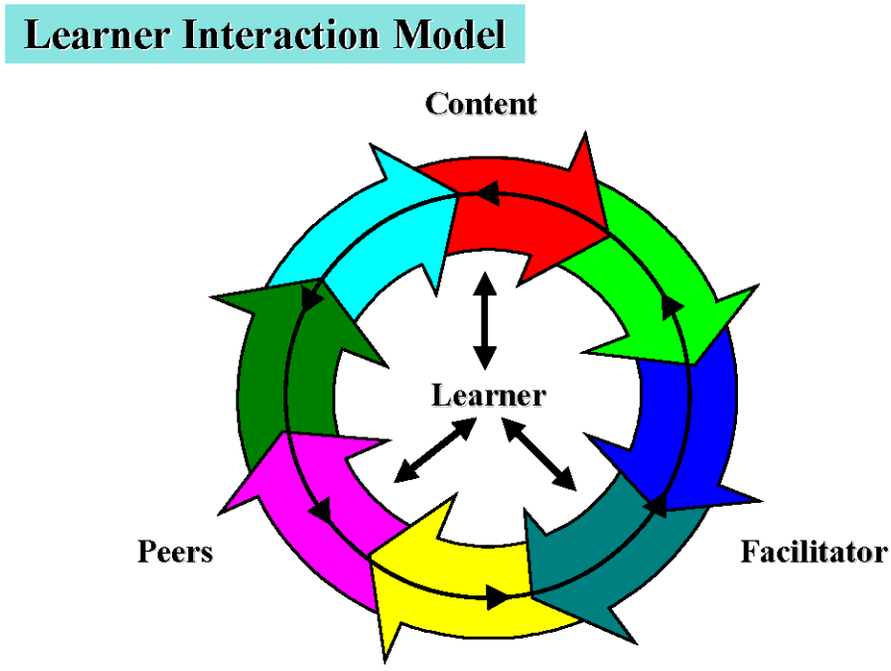

Table 1. Approaches to learning

	Traditional	Constructivist
Professor	Sage on the Stage	Guide on the Side
	Content Provider	Content Facilitator
Learner	Passive Recipient	Active Participant
Knowledge	Fixed Object	Fluid
Organization of Learning	Ordered & Structured	Open & Often Chaotic
Communication	Uni-directional	Multi-directional
Primary Resource	Text & Professor	Multiple Sources
Delivery Method	Lecture	Active Process
Media	Print	Blended
Technology	Basic Computer	Multiple Device Convergences, Cloud Computing, AR,VR, etc.
Format	Structured & Individualized	Adaptive & Collaborative
Activities	Goal-Oriented	Problem-Centered
Focus of Learning	Knowledge & Understanding	Application, Analysis, Synthesis, & Evaluation
Assessment	Recall	Alternative Assessment
Community	Local Educational Institution	Integrated with Life in Global Contexts

media and multiple technologies. Consequently, the boundaries between the educational institution and the larger community become blurred creating its own unique set of opportunities and challenges.

As people work collaboratively through a variety of learning activities employing new technologies, they bring multiple worldviews and experiences to each situation often creating a plethora of perspectives. During this collaborative learning process, they must negotiate and generate meaning and solutions to problems through shared understanding. Thus, education moves from a single, solitary pursuit of knowledge to a collaborative learning community that shapes and informs responses to the environment. As noted almost two decades ago by Fuller and Söderlund (2002), this challenges the common metaphor of the university as a self-contained village.

Rapidly Changing Distance Learning Technologies

Over the years, educators have experimented with and successfully employed multiple media for distance learning, and today, as much as in the past, they continue to stress that pedagogy must drive technology (Rourke & Coleman, 2011). As early as the 18th century, print material was used and even today still serves an important role in distance education even as it gives way to more reliance on technology and web-based resources for collaborative development of knowledge that incorporates the diversity of learners and their contexts. After the 1930s, other media became significant with audio--including radio and audiotapes--and video--including film, public broadcasting, and cable--dominating much of the 20th century.

Much of this education was one-way based on a mass communication or one-to-many educational model. Basically, it was a rigid structure with information flowing in one direction, from the powerful and knowledgeable instructor reaching to the individual or even the larger group of students. It included elements of limited feedback through the use of such things as the penny post in the 19th century and the addition of the telephone and fax in the 20th century. Limited opportunities for face-to-face interaction were also incorporated with some programs. Thus, much of distance learning during those times remained mainly non-interactive.

By the 1990s, the advent of the Internet presented new opportunities in distance education. The result was the evolution of a new type of collaborative learning, in which the potential for interaction between the professor and the learner increased exponentially with wide-area networks accommodating synchronous and asynchronous communication. While exploring computer-mediated activities of the online learning environment in the early stages of its development, Santoro (1996) highlighted three broad categories: (a) computer-assisted instruction, which allowed the computer to serve as "teacher" by structuring information delivered to the human user; (b) computer-based conferencing, which included e-mail, interactive messaging, and group conference support systems; and (c) informatics, which referred to online public access libraries and interactive remote databases. This proliferation of the Internet unlocked the door for educational institutions to reach and connect beyond their four walls. Through this interconnectivity, they make services accessible to students around the world via online activities as evidenced in such research as Frantiska (2017) and Ivey (2017) and through the implementation of higher education ecosystems, such as ORU GeoVision™ that leverages micro innovation to transform the learner experience (Matthews, 2018). As Matthews noted, these ecosystems need to explore technology such as

wearables, Wi-Fi, Augmented and Virtual Reality, CRM [Customer Relations Management Systems], SIS [Student Information Systems], LMS [Learning Management Systems], AI [Artificial Intelligence],

Chatbots, Blockchain [or other authentication processes], APIs [Application Programming Interfaces], Avatars, Capture lecture, BI [Business Intelligence], Degree Pathways, Telepresence, Smart-classrooms, and mobile apps. (¶4)

For the past 25 years, researchers such as Cotton (1995), Bocarnea, Grooms, and Reid-Martinez (2006), Grooms and Reid-Martinez (2013), and Reid-Martinez and Grooms (2012, 2015, 2018) have continued to explore not only the trends in distance education but also the understanding of the issues involved in aligning the environment with student needs. Typical factors include (a) the characteristics of the discipline, (b) the degree of interactivity sought in the online distance learning process, (c) learner characteristics, (d) instructor traits, (e) the expansiveness of the distance education initiative, (f) the desired level of accessibility and flexibility as it relates to methods of dissemination and delivery capacity, and lastly (g) the availability of technical support.

Today in the convergence of technologies, fused communication devices create more mobility and simultaneously provide mixed realities through virtual immersive environments. As early as 2012, Rolf noted continuing advances, such as interactive optical sensory technology, that fused the virtual with the physical. Through these and other fusions in our contemporary educational ecosystems, communicating with students and colleagues has become more instantaneous, integrated, and complex. Learning is adapting new modalities and explorations in the role of technology and when combined with disciplines such as neuroscience, it is transforming learning in ways that were never thought possible a few decades ago. Indeed, fluidity best describes the personalized learning that is with the lifelong learner at all times.

As this suggests, these new technologies allow enhanced capacity for adaptive individualized learning. As noted by Allen and Seaman (2013), adaptive learning helps overcome the barriers to online learning, a common concern of many academic leaders. As we see in the research of such scholars as Yang, Gamble, Hung, and Lin (2014), critical thinking can be enhanced through adaptive learning in the online environment. These new adaptive learning technologies accelerate and enhance learners' problem-solving ability. The fusion of technological capacity for adaptive learning with collaborative technology platforms results in individuals operating at a more advanced level and collectively harnessing greater learning and problem-solving abilities from all participants.

With such rapid technological advances, today's educators are dropped into what Jacque Ellul (1964) described as the intersection of tension between humanity and technology. This struggle with the latent and manifest, intended and unintended consequences of technology exists as students and professors wrestle with cloud computing, three-dimensional immersive learning environments, and other rapidly expanding cloud opportunities.

Such technology facilitates greater flexibility and customization in the learning process. Almost two decades ago Lead Learning Designer at IBM, Don Morrison (2004) demonstrated how the learning process can be established within parameters and policies that most appropriately align with the primary strengths and weaknesses of each medium. He noted that among others, cost, time constraints, delivery speed, and infrastructure help determine appropriate application. Morrison's work also pointed to ways in which educational models could be designed to marry the traditional and the online, moving from the simple to the more complex.

As the above suggests, these new electronic forms of communication have forced a paradigm shift in education. This move is most avidly seen in distance learning, where even the terminology has shifted from distance education to words such as online or e-learning. Such terms more clearly indicate the

way in which learners can use multiple media to easily collaborate through a continuous integration of knowledge and social capital. Indeed, it is the beginning of a new world of educational ecosystems.

FUTURE RESEARCH DIRECTIONS

As previously discussed, the rapid growth of technology continues to herald unprecedented opportunity for distance learning, and when wed to a constructivist approach, it presents opportunities for online pedagogy and andragogy that can transcend traditional modes of education. From this marriage emerges three primary factors that define the new online learning: (a) *community* development--the ability to build networks and communities that cross time and geographical boundaries, (b) s*tructure*--the technological ability to manage vast amounts of information, and (c) *collaborative* opportunities--for shared knowledge and wisdom building in response to the complexities of a global society (Reid-Martinez, 2006).

Community

As Bocarnea et al. (2006) note, today's technologies launch a new paradigm of online learning and teaching, which has the potential to be communal in nature. Primarily, these technologies allow for interaction between students and professors, students and peers, and the broader community in unprecedented ways. For example, students today have greater instructor and peer access through social media and cloud-based learning platforms. Indeed, the study of mobile technology for learning in environments of high action and great distance as found in the work of Black and Hawkes (2011) points to the now ubiquitous capacity of learning in unprecedented ways. In turn, this poses the question of expectation--whether conscious or not--regarding ubiquity of instructor presence and community development. It also enhances the ubiquity of the student in the learning process.

Indeed, learning is no longer "just in time," but with adaptive learning and other capacities that allow for learning that is 'just for you' and 'just with you' through wearable smart devices and other advancing technologies. This contemporary and developing technology now allows learning to be fluid with the learner in a simultaneous and continuous nature. (Reid-Martinez, personal communication, January 3, 2014)

These new technological advances raise the question of boundaries in the learning process. While advancing technologies provide unprecedented opportunities for networking and building strong virtual learning communities, they do transcend geographical boundaries and normal hours of operation as well as far beyond the duration of students' formal education. As early as 2002, Young highlighted the differences between the boundaries embedded in his traditional face-to-face class and that which he encountered online. This suggests that guidelines following best practices such as those described by Mbati and Minnaar (2015) and Stevens (2018) are needed to manage the continuously changing nature of virtual learning experiences. Such research is essential to prevent online instructors and students from feeling overwhelmed by the 24/7, ubiquitous opportunity for interaction.

In addition, this communal nature of the virtual learning environment provides opportunities for students to bring their local community contexts into the learning experience in direct ways as well as immediately allowing them to apply what they have learned through their study. For example, students

in leadership programs can be employed full-time in leadership positions and take their learning experiences directly into their work environment through well-designed course assignments. The professor is no longer someone whom the student must wait to see in class later in the week, but rather is readily available in cloud-based learning platforms to serve as consultant and mentor as the student applies the principles studied that week. The professor has become the *guide on the side.* This triangulation of student-professor-content points to the need for well-designed learning experiences developed from a constructivist perspective to meet the challenges and needs of today's students. Indeed, uniting the new technology with this approach meets the needs of contemporary students working in rapidly changing and highly demanding global environments.

Additionally, rapid advancement of technology creates a moving target challenge for course developers who often find themselves reacting to the technological advances rather than proactively establishing the technology's relationship to the learning process. While scholars such as Schweizer (1999) noted unsound pedagogy and inadequate design in early online courses, others such as Wang and Newlin (2002) reinforced the importance of incorporating the opposite as critical predictors of successful student performance. Just a short time later, others such as Beetham and Sharpe (2007) and Rourke and Coleman (2011) continued to reinforce the critical role of pedagogy in using technology. Such approaches assure that good pedagogy is the driver of learning, not new technologies, helping to resolve Bocarnea et al.'s (2006) observation and concern that theory typically "follows technology in desperate attempts to describe the impact of an already existing and rapidly fading … technological reality" (p. 385).

This posits that staying focused on strategy and content design remains the dominant challenge. Online pedagogy, the science *of* and *about* online education, provides perspective to assist in focusing and maintaining the balance necessary for creating excellent online learning experiences.

Structure

Forecasted 20+ years ago by Negroponte (1995), the information age is becoming an unprecedented opportunity in the democratization of learning that must be managed well. After the scramble to have everything digitized, the primary challenge today is how to create meaningful knowledge from such massive amounts of data. Quality of knowledge, in contrast to quantity, drives the heart of this concern. In light of this potential overload, *structure* is essential to online knowledge development.

Related to structure, is the development of open-source initiatives. While most often understood as the software that is open for use and modification by the public, the phrase has become a recognized attribute ascribed to multiple endeavors, such as knowledge-building. The open-source nature of online initiatives pushes a new model for managing learning and knowledge-building through the communal process. It allows diverse individuals from various locations to combine information from multiple sources into distributed knowledge networks. Through this open-source structure, participants interact to share experiences and knowledge, thereby expanding their awareness of new concepts and differing approaches to problem-solving as they modify the information in the open-source environment and redistribute it back to fellow participants (Bocarnea et al., 2006).

As this suggests, through interaction, participants construct complex webs of knowledge in the open-source cyberspace. The technology provides the structure to create and maintain webs of knowledge, and it also grants ease of access globally to those interested in that knowledge. In the process, knowledge is given away to others who in turn begin to use it in multiple ways, while beginning the next evolution of knowledge development as they add to and transform the knowledge base they accessed through the

open-source structure. With this transformation through this structural capacity is the transference of power and control that becomes less centrist and more distributed globally. As the above reflects, this is the heat of the constructivist approach to learning.

Collaborative Knowledge-Building

As noted above, interaction is the key for the development of open-source knowledge-building. While scholars such as Cederblom and Paulsen (2001) posited learning as a behavioral change, others hold that it is simply when learners meet needs and establish goals for attaining knowledge (Ponton & Carr, 2000). Referring to this process as an implied contract, Keirns (1999), along with the above scholars, suggested that if online learning is used, structure is critical to allow students to advance in their knowledge.

Because "engaging the learner in reflective and collaborative thought processes … results in the most effective learning, whether the setting is a traditional classroom or an online environment" (Cox & Cox, 2008, p. 553), the design of the online course becomes the principal structure to assure learners' goals are achieved. In that course design, one way of attaining the collaborative thought processes is to incorporate structured interaction. Not only does this interaction provide for collaborative thoughts and knowledge development, it provides multiple opportunities for faculty to prompt students' critical thinking. In keeping with this, researchers such as Pelech and Pieper (2010) went so far as to clearly lay out, among other approaches, the roles of visual literacy, bridging questioning, and kinesthetic activities in applying Bloom's taxonomy for constructivist learning.

While these dimensions of critical thinking undergird contemporary collaborative capacity in online learning, other psychological dimensions are becoming more prevalent in understanding how critical thinking and collaboration can increase. For example, Rolf (2012) surfaced the complexities of virtual collaboration in his study of contemporary technologies' role in creating mixed realities. Another example is Mabrito's (2011) study of vicarious interaction--that is, observing not participating in peer as well as faculty-peer online interaction--which can generate more idea awareness in a constructivist learning environment and has potential impact on how collaboration occurs.

A common way to collaborate in the online environment is through interaction. Blair (2002) suggested that stronger relationships are forged through increased interaction frequency. Increased interaction relates to higher learner commitment due to the socialization the learner experiences as a participant in the knowledge-building process. Thus, learner perception of interaction plays an important role in student achievement, satisfaction, and quality of learning.

Again, in the collaborative nature of the constructivist online culture, interaction perpetually occurs between learners and content, learners and instructors, learners and peers, and learners and external experts with each type of interaction reinforcing and fostering collaborative knowledge-building. Teaching disappears and "communication of information rules, where information is available to all and in abundance" (Brown, T. H., 2015, p. 228). With this in mind, online course design must include best structures to capitalize on this collaborative interaction.

CONCLUSION

As the above suggests, the advent of online learning education has not just provided opportunity to disseminate information in a new medium, it has radically changed the online and distance learning paradigms in terms of distribution methods, community building, knowledge development, and learning. The use of 21st century technology is rapidly closing the gap of the communication immediacy essential in developing communities of practice for knowledge-building. With their open-source networks, these new technologies encourage and actively support the constructivist approach to learning. Most of all, online and distance education through its constructivist pedagogy and contemporary technologies has the technical capacity to fulfill its greatest potential, which is to reach every learner who desires to participate in the knowledge-building process. The result can be a democratization of education not previously seen, allowing for shifts in power and control throughout societies.

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KEY TERMS AND DEFINITIONS

Autonomous Learner: An individual who takes responsibility for his or her learning.

Blockchain: The authentication of digital credentialing.

Chat Bot: A chat robot.

Cloud-Based Technology: Resources are stored in the virtual environment that allow access from multiple venues rather than being restrictive to one geographical location.

Collaborative Learning: The process in which individuals negotiate and generate meaning and solutions to problems through shared understanding.

Constructivism: An approach in which students share responsibility for their learning, while negotiating meaning through active participation in the co-creation of shared understanding within the learning context.

Distributed Knowledge: Information dispersed throughout a community of practice and not held by any one individual.

Interaction: Mutual communicative exchange between individuals.

Chapter 46
Creativity and Impactful Learning Through Implicit Cognitive Vulnerability

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ABSTRACT

Creating an instructional environment in which the learners can be cognitively vulnerable with the information learned, with learner colleagues, as well as with the instructional facilitator is vitally important towards information attainment and actively evaluating and revising one's own conceptual framework-ing of information. The instructional engagement of the learner within the instructional environment is vitally important, towards knowledge acquisition as well as the learner's creativity towards understanding and working with the information, while emphasizing the strengths associated with impactful learning. Creativity is understood within implicit cognitive vulnerability, articulated as value, effectiveness. Further, impactful learning is understood as relationships and community, as well as respect and consciousness.

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INTRODUCTION

Implicit cognitive vulnerability is an understanding around the instructional engagement and learning process that occurs within a teaching-training environment. Through the implementation and impact of implicit cognitive vulnerability, one's professional creativity has the potential to be realized. At the basic level of understanding, implicit cognitive vulnerability is a reflection of the learner's ability to feel safe within an instructional environment and with new knowledge, wherein short-term memory and long-term memory's cognitive acquisition of and connection between old and new information is able to successfully enhance connections so as to achieve the higher order thinking skills of analysis, synthesis, evaluation and creation can be realized by the learners (Anderson, 2013; Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths & Wittrock, 2001; Bloom, Englehart, Furst, Hill & Krathwohl, 1956; Krathwohl, Bloom & Masia, 1964). Specifically emphasized is the higher order thinking skill of creation, or creativity, Implicit cognitive vulnerability is a supported frame of reference and comfortability of the learner, that supports knowledge acquisition by framing the learning experience within a developed understanding of trust, comfortableness, openness towards new ideas and new ways of thinking, and a connection with others that can be described as an interdependent reliance upon others within the learning environment.

The ability to be vulnerable within an instructional space does support one's ability to *think out of the box* and embrace the newness of ideas that may initially seem uncomfortable, yet upon closer inspection and the ability to work within the safe space of the learning environment the learner may recognize the interconnected nature of prior information with new information. This understanding of the interconnected nature of learners and instructional facilitators throughout the instructional process is extremely important, towards developing an environment in which learners support each other's strengths as well as perceived weaknesses while striving towards achieving stronger informational understandings. These stronger informational understandings are achieved both individually and as a group endeavor.

Through the supportive understanding of implicit cognitive vulnerability, implicit cognitive vulnerability can be achieved. The objectives of the article are towards offering a framework of understanding around understanding the foundations upon which implicit cognitive vulnerability sits, as well as ways through which to positively implement and impact the professional creativity of implicit cognitive vulnerability towards a successful instructional engagement of the learners.

BACKGROUND

Cognitive vulnerability has traditionally been viewed within the professional scope of cognitive psychology as a state of emotionally-laden cognitive depression (Haeffel & Hames, 2014; Hanklin & Abramson, 2001; Matthews & MacLeod, 2005; McGinn, Nooner, Cohen & Leaberry, 2015). The suggestion that vulnerability is supported by a level of stress and enhanced cognitive dissonance has been recognized as a problem that needs to be solved. Yet within the learning process, cognitive dissonance and a low level of uncomfortableness associated with subject matter, engagement with the subject matter, offers the opportunity to accentuate new ways to think about prior knowledge. The learning process can be a bit uncomfortable, as new information is woven into prior knowledge; however, a recognition that this discomfort and cognitive dissonance moments of un-learning and re-learning information in new and different ways, to recognize the new and different ways towards understanding information is integral

towards supporting the creative process and positive impact of one's implicit cognitive vulnerability towards breaking out of prior thought patterns while allowing the freedom towards creativity, towards innovation and towards the ability to think about information in new and different ways. For this reason, this knowledge base discussion will focus upon areas of influence and impact upon implicit cognitive vulnerability as an instructional style of support and engagement throughout the learning environment, specifically: the impact of trauma upon the brain's amygdala; Maslow's hierarchy of needs; Vygotsky's conceptual framework of understanding; Wittgenstein's social context and word choice; and, Bandura's motivation and self-efficacy theories.

Amygdala, Trauma and Learning Impact

Psychological distress is something that highlights a human's responses of fight, flight, face or freeze. These well-known reactions to distress is a clear impact upon one's cognitive abilities, as supported by the amygdala's response systems that changes one's natural ability to appropriately respond to the exposure of distressing events. As quoted from Ito, Erisir and Morozov (2015), "Purely psychological distress, without physical pain or physical discomfort, renders brain more vulnerable to a broad range of traumatic events, increasing chances of mental illness" (p. 2536; Cougle, Resnick, & Kilpatrick, 2009; Resnick, Yehuda, Pitman, & Foy, 1995). Instead of mental illness, consider that an instructional environment supports the learner's comfortableness towards cognitive dissonance, during which learning can occur. Recognizing this, the needs of the learner towards a comfortable environment in which the instructional facilitator supports a safe and vulnerable environment in which learners can work with the information and be incorrect without judgement, rethink information in new and different creative ways towards attaining successful cognitive understanding, and emphasis upon respect amongst all learning colleagues must be achieved. Traumatic events and traumatic underlying engagement within the learning environment reflects an exposure to basic concerns around one's cognitive safety that could be impactful towards the amygdala that may result in deficient cognitive capabilities and implications towards lowered learner success (Cacciaglia, Nees, Grimm, Ridder, Pohlack, Diener, Liebscher, & Floor, 2017). Recognizing the impact of the instructional environment upon the learner and understanding the impact of distress and trauma upon the learner's ability to take in and work with new information is vitally important within an instructional environment. As such, the ability to develop an instructional environment within which all learners can feel safe, open and vulnerable does allow for a cognitive vulnerability to arise, as cognitive vulnerability emphasizes the need for one's engagement with the subject matter to evolve and enhance through implicit cognitive connections with the prior and new information. Creativity is necessary to evolve within a safe and vulnerable environment, wherein one's cognitive connections are allowed to freely evolve and embrace the newness of ideas and understandings.

Maslow's Hierarchy of Needs

Maslow's hierarchy of needs also supports the fight, flight, face or freeze base cognitive understandings, from physiological needs that engage in mere survival understandings through not only self-actualization but also self-transcendence (Koltko-Rivera, 2006; Maslow, 1943, 1954, 1961, 1962a, 1962b, 1963, 1964, 1969a, 1969b, 1970, 1971, 1979, 1982, 1987, 1993a, 1993b, 1993c, 1996, 1999a, 1999b, 1999c). The work of Maslow is integrally important within an understanding of implicit cognitive vulnerability due to the needs of learners to have not only physiological and safety needs met, but the clarity of support

and belongingness within the learning environment must be achieved, with an instructional facilitator's modeling towards self-efficacy and esteem around the knowledge base throughout the learning experience. Koltko-Rivera's (2006) work emphasized Maslow's hierarchy of needs that also supported the integration of self-transcendence as a recognition of learner support and engagement with the subject matter, towards working with the information in positive and impactful ways:

Table 1. A Rectified Version of Maslow's Hierarchy of Needs

Motivational Level	Description of person at this level
Self-transcendence	Seeks to further a cause beyond the self and to experience a communion beyond the boundaries of the self through peak experience.
Self-actualization	Seeks fulfillment of personal potential.
Esteem needs	Seeks esteem through recognition or achievement.
Belongingness and love needs.	Seeks affiliation with a group.
Safety needs	Seeks security through order and law.
Physiological (survival) needs	Seeks to obtain the basic necessities of life.

(Koltko-Rivera, 2006, p. 303)

Implicit cognitive vulnerability embraces the essentials of Maslow's hierarchy of needs, towards supporting and enhancing the learner's comfortableness within the instructional environment, as well as comfortableness with the subject matter. By comfortableness, considerations around the ability to be incorrect, revisionary, and openly embracing cognitive dissonance are imperatives.

Vygotsky's Conceptual Framework of Understanding

Vygotsky's work that highlights conceptual frameworks of understanding (Vygotsky, 1933/1966, 1935, 1981) embrace the impact of implicit cognitive vulnerability within the learning environment as well as while embracing professional creativity. Implicit cognition emphasizes prior knowledge and long-term memory inter-connectedness, based upon prior learning and prior understandings of information. Yet what occurs when new information is introduced? What occurs when prior knowledge connections are questioned and enhanced by the introduction of new information, of deeper understandings around prior information? Vygotsky's conceptual frameworks of understanding suggest the learner's connections between previously learned and understood information are solidified, yet what if prior understandings are incorrect? What if prior connections between previously learned and understood information are not complete or require a greater depth of understanding such as the progression of a learner from novice towards expert levels of subject matter expertise? Cognitive dissonance, cognitive vulnerability are natural progressions through re-learning and understanding information in new and different ways. Reframing, restructuring, re-scaffolding one's conceptual framework of understanding is a cognitively vulnerable place for a learner and must be carefully supported and guided by a strongly engaging and trusted instructional facilitator towards the learner's ultimate success.

Wittgenstein's Social Context and Word Choice

Wittgenstein's (1922) work around words that people choose to describe different events and different information is intriguing. The social context in which Wittgenstein's work is housed can be realized within the world of semantics and philosophy. More specifically, the suggestion that words have meaning for the style of communication and understandings underlying the communications, based within word choices. Wittgenstein's work is important within the realm of implicit cognitive vulnerability, due to the recognition that words do have meaning and can impact the learner's ability to work with informational subject matter. How the learner receives communication, the style of communication that occurs amongst and within the instructional environment, is impactful towards the learner's ability to successfully work with the new knowledge, the new subject matter information. The facilitative instructor's style of engagement with the learner and with the larger instructional collegial group, the interactive communications between learners, all reflect the social context of the instructional environment and directly impacts the learner's implicit cognitive vulnerability as well as inherent ability towards creatively understanding and working with the new information under study.

Bandura's Motivation and Self-Efficacy

The work of Bandura (1977, 1986, 1997) supports learning motivational engagement as well as a learner's sense of self-efficacy associated with the subject matter under study. This includes the vitally integral support of the learning community as a safe, supportive area that embraces self-efficacy (Bandura, 1977, 1986, 1997) as a motivational effort, including the expectancy construct (Parsons & Goff, 1978), supporting Vroom's expectancy theory (1964) that, according to Holdford and Lovelace-Elmore (2001), Vroom supports an understanding that "intensity of work effort depends on the perception that an individual's effort will result in a desired outcome" (p. 8). This nicely frames within Bandura's work, as the learner's self-perception around potential ability to be successful with the information under study and within the instructional environment are integrally important. The learner's understanding and engagement within an instructional environment that embraces implicit cognitive vulnerability is impactful, towards learner's self-efficacy as well as their own sense of creativity and new ways through which to think about the subject matter.

FOCUS OF THE ARTICLE

Creativity and impactful learning within the instructional learning environment is vitally important towards learner success. As such, considerations around implicit cognitive vulnerability are inherently important and supportively impactful around learner success. Prior discussions around the importance of psychological distress and trauma directly impacts the brain's amygdala, directly impacting the learner's ability towards cognitive understanding and long-term information retention (Cacciaglia, Nees, Grimm, Ridder, Pohlack, Diener, Liebscher, & Floor, 2017; Cougle, Resnick, & Kilpatrick, 2009; Erisir & Morozov, 2015; Resnick, Yehuda, Pitman, & Foy, 1995). Also discussed has been Maslow's hierarchy of needs (Koltko-Rivera, 2006; Maslow, 1943, 1954, 1961, 1962a, 1962b, 1963, 1964, 1969a, 1969b, 1970, 1971, 1979, 1982, 1987, 1993a, 1993b, 1993c, 1996, 1999a, 1999b, 1999c), Vygotsky's conceptual framework of understanding (Vygotsky, 1933/1966, 1935, 1981), Wittgenstein's word choices in social

context of engagement (1922), and even Bandura's motivation and self-efficacy work (Bandura, 1977, 1986, 1997) with additional understandings around expectancy constructs (Holdford and Lovelace-Elmore, 2001; Parsons & Goff, 1978; Vroom, 1964). After framing the background of understanding, looking forward supports a discussion that is focused upon implicit cognitive vulnerability from a learning and development standpoint, with considerations towards creativity and impactful learning understandings.

Implicit Cognitive Vulnerability

Implicit cognitive vulnerability supports the learner's cognitive engagement within a safe and supportive instructional environment, emphasizing the open understandings around the need for freedom to openly think in new and different ways, and that it's acceptable for the learner to think *outside the box* and sometimes be *way off base* with ideas and understandings around the information under study. As described by Crawford (2018):

Implicit Cognitive Vulnerability is a theoretical construct, a concept that engages in an understanding revolving around how a person understands information, shifts information from short-term memory into long-term memory access, and the vulnerability within the learner's cognitive processes that support or abandon the learner's ability to conceptualize the new information within prior learned information. (p. 5149)

This acceptance and support are vitally important within an instructional environment, modeled and supported by not only the instructional facilitator but also by the collegial learners throughout the learning community environment. It is suggested that the "intensity of work effort depends on the perception that an individual's effort will result in a desired outcome" (Holdford & Lovelace-Elmore, 2001, p. 8), further supporting the emphasis upon motivational support of the learners and the freedom of learners to create basic understandings of the knowledge base, then progressively thinking differently about the subject matter while enhancing the conceptual framework of understanding (Vygotsky, 1933/1966, 1935, 1981) through engaging and open communications with the instructional facilitator and the collegial learners. As reflected through the work of Crawford, White and Young Wallace (2019):

As well, I realized that my professional journey would evolve into attempting to better understand the process of learning as an individualized endeavor. Not only towards better supporting the knowledge acquisition by learners so as to develop a base knowledge that would support enhanced engagement with the subject matter, but also towards better understanding the formation and support towards developing a viable learning environment that embraced the concepts of cognitive vulnerability (Crawford, 2015, 2016, 2018; Crawford & Semeniuk, 2016; Crawford & Smith, 2015), conceptual frameworks of understanding (Vygotsky, 1934/1987, 1962, 1978) and learning in landscapes of practice (Wenger-Trayner, Fenton-O'Creevy, Hutchison, Kubiak, & Wenger-Trayner, 2014; Wenger-Trayner & Wenger-Trayner, 2015). (p. 7-8)

Yet, from Crawford's (2018) description of implicit cognitive vulnerability, an understanding of the theory is reflected as:

The primary concerns revolving around the conception of Implicit Cognitive Vulnerability have to do with the impact of the instructional facilitator, the collegial learners, and the subject matter prior experience on the part of the learner. Each aspect within the instructional environment is integrally important to the impact upon the learner's cognitive understanding and implicit memory retention and retrieval. Simplistically stated the triad of components, or constituents, within this instructional process are imperative towards supporting and engaging the learner's successes. (p. 5150)

However, the instructional environment is not only framed through the working relationship between the instructional facilitator and the learner. Instead, the instructional environment and collegial learners within the environment are also impactful.

An interesting discussion revolves around Implicit Cognitive Vulnerability and ways to deal with issues, controversies or problems associated with the concept of Implicit Cognitive Vulnerability. One instructional style does not meet the needs of every single learner, even if the subject matter is similar in presentation and prior knowledge attainment and understanding. Much of this may be the ways that different instructional facilitators present the subject matter to the learners; as well, much of this may be due to the community of learning that is developed and the trust that bonds the collegial learners within the instructional environment. (p. 5152)

Yet the supportive impact of the instructional facilitator, the actual subject matter under study, the instructional environment and the collegial learners is not the fully developed engagement within the realm of implicit cognitive vulnerability. Understandings around creativity and impactful learning must also be realized.

Creativity

Within an instructional environment, questions around creativity versus learning are consistently under discussion within the era of assessment and mandatory standardized testing. Significant study has occurred, around the concept of creativity within instructional environments (Baruah & Paulus, 2019; Henriksen, Mishra & Fisser, 2016; Mullen, 2017; Paulus & Brown, 2007). Yet, what is creativity? Henriksen, Mishra and Fisser (2016) suggest that,

Creativity can be viewed as a process and/or a product, and is generally thought of as the production of useful solutions to problems, or novel and effective ideas (Amabile, 1996). An idea that has novelty, but lacks in value or effectiveness to other people, cannot be considered "creative" (Cropley, 2003). (p. 28)

As suggested by Paulus and Brown (2007), "It appears that the brainstorming performance of groups is often hindered by various social and cognitive influences, but under the appropriate conditions, group idea exchange can be quite effective" (p. 248), then reflective of an understanding that to "propose that sharing and building on each others' ideas in a group setting should produce cognitive stimulation" (Baruah & Paulus, 2019, p. 156) enhances the learning community environment more fully through a vulnerability that allows for the support of creativity.

Of intrigue is the perceptions around intellectual diversity and experiential diversity, suggesting the ability of collegial learners to welcome other people's ideas into the discussions while checking, recheck-

ing and testing the developing informational understandings in a safe environment, can only enhance opportunities towards creativity when implicit cognitive vulnerability has been supported and modeled by the facilitative instructor. Thus leading into the development of an environment that embraces a safe, supportive learning environment in which a learner's implicit cognitive vulnerability can thrive through a sense of burgeoning self-efficacy, thus allowing for the cognitive comfortableness towards creativity; and engagement. As suggested by Baruah and Paulus (2019):

Although groups should benefit from intellectual or experiential diversity, thus far the literature has been mixed in terms of the support expressed for this expectation. Research shows that functional informational diversity in terms of heterogeneity in knowledge, expertise, or experiences in teams can enhance creative performance (Hülsheger, Anderson, & Salgado, 2009; Jackson, May, & Whitney, 1995). However, when multiple perspectives are at odds, high diversity may make it harder to resolve differences among perspectives (Olson, Walker, & Ruekert, 1995). Thus, it is not surprising that some researchers have found no effect of functional diversity on innovation (e.g., Sethi, Smith, & Park, 2001). (p. 164-165)

Through the support of understandings around implicit cognitive vulnerability, engagement in creative endeavors can be more fully supported and realized throughout the learning environment. Worthy of recognition is that instructional environments must more fully embrace an understanding of cognitive engagement within safe and vulnerable areas of endeavor, as:

Educational environments should encourage students in collaborative creative activities and other group tasks in order to allow for a development of group skills and collective intelligence. This kind of development is required for success in collective endeavors that are important in the workplace, research groups, and educational settings. Research on group creativity provides much valuable information for guiding the application of group creative activities in school settings. (Baruah & Paulus, 2019, p. 172-173).

However, implicit cognitive vulnerability creates a cognitive action and interaction that emphasizes the ability to *think outside the box* by the learners, without the fears associated with negative impact upon the learner who presents extraordinary, notable and complex new ideas around subject matter. Why is this concept important towards supporting the learner's creativity?

Creativity can be learned, but since it is a thinking skill it can only be "learned by doing" or as "learning in action." Creativity involves approaches to thinking rather than a set body of knowledge that can be taught. However, we can reinforce and support sustained creativity as a "habit of the mind." However, this also means that the education system and educators must recognize and support a sustained facilitation of creativity as a habit of the mind, and agree upon what that is and how to engage it. This can vary greatly across contexts and cultures. (Henriksen, Mishra & Fisser, 2016, p. 34)

Developing a strongly supportive and collegially hospitable, convivial and embracing learning environment that recognizes different ways through which learners can view new information while delving into prior learning and prior experiences is importantly viable. As well, consideration beyond creativity and towards impactful learning supports implicit cognitive vulnerability.

Impactful Learning

Improving and differentiating the consumption of information and the ability to view new information in differentiated manners is reflective of implicit cognitive vulnerability through the recognition of impactful learning. This discussion circles back towards considerations related to safe and vulnerable instructional environments, wherein the instructional facilitator supports the modeling and engagement of collegial learners throughout the learning community, towards embracing aspects of instructional strength. These instructional strengths can be described through implicit cognitive vulnerability understandings as supporting strength of the amygdala's ability to work positively within stressful situations with a feeling of self-efficacy and ease (Cacciaglia, Nees, Grimm, Ridder, Pohlack, Diener, Liebscher, & Floor, 2017; Cougle, Resnick, & Kilpatrick, 2009; Erisir & Morozov,2015; Resnick, Yehuda, Pitman, & Foy, 1995), with considerations towards Maslow's hierarchy of needs (Koltko-Rivera, 2006; Maslow, 1943, 1954, 1961, 1962a, 1962b, 1963, 1964, 1969a, 1969b, 1970, 1971, 1979, 1982, 1987, 1993a, 1993b, 1993c, 1996, 1999a, 1999b, 1999c) that highlights an assurance of physiological and safety needs, as well as an inherent acceptance of one's belonging.

This is allowing further self-esteem support, towards reaching not only self-actualization but also self-transcendence that creates an environment of creativity and impactful learning. Bandura's motivation and self-efficacy (Bandura, 1977, 1986, 1997) fits well within Maslow's work, especially towards considering expectancy constructs (Holdford and Lovelace-Elmore, 2001; Parsons & Goff, 1978; Vroom, 1964). Of course, Vygotsky's work around the conceptual framework of understanding (Vygotsky, 1933/1966, 1935, 1981) and Wittgenstein's (1922) aligned social discourse and semiotic verbiage further supports an impactful learning environment through the clearly articulated enhancement of initial learning environments towards impactful learning environments. From an understanding that focuses upon the learning climate and impactful, positive influences, the following is suggested:

When considering the separate learning climate domains, the positive work-related well-being construct, work engagement, seemed to be specifically influenced by two domains in particular, namely 'educational atmosphere' and 'formal education'. A positive work atmosphere, constructive communication with faculty and structured, fitting, informative education are aspects likely to positively influence the enthusiastic, positive, fulfilling work-related state of mind (work engagement) of the residents. This could explain the finding that these learning climate domains ('educational atmosphere' and 'formal education') were found to be associated with work engagement. (Lases, Arah, Busch, Heineman, & Lombarts, 2017, 139-140)

Not only does the learning climate's well-being construct, positive sense of engagement and atmosphere throughout the learning environment reflect strengths, but highlighted are both formal education and the positive influence of an educational atmosphere are significantly impactful. Of further intrigue is Leach's (2018) work, resulting in the recognition that, "Four humanistic learning environment characteristics (i.e. relationships, community, respect, and consciousness) were found to foster five developmental postindustrial social skills (i.e. socioemotional development, communication, collaboration, sociability, character, and social responsibility) using inductive data analysis" (para. 1). All of these learning environmental characteristics are emphasized as supporting implicit cognitive vulnerability, reflective of the modeling of learning community behaviors and expectations through the work of the instructional facilitator. Further, the five developmental post-industrial social skills are emphasized

through the strengths associated with supporting and enhancing implicit cognitive vulnerability within a learning environment that embraces this style of socioemotional expectations and creative endeavors, resulting in impactful learning.

SOLUTIONS AND RECOMMENDATIONS

Implicit cognitive vulnerability as a theoretical understanding within the learning environment is a varied and ubiquitous recognition of the depth of impact the instructional facilitator and collegial colleagues have upon the learning environment and, ultimately, upon the learners within the space. Each learner's implicit cognitive vulnerability offers a differentiated view of the instructional environment, with a recognition of the needs of each learner emphasized. As Crawford (2018) suggests,

One instructional style does not meet the needs of every single learner, even if the subject matter is similar in presentation and prior knowledge attainment and understanding. Much of this may be the ways that different instructional facilitators present the subject matter to the learners; as well, much of this may be due to the community of learning that is developed and the trust that bonds the collegial learners within the instructional environment. (p. 5152)

However, even though instructional facilitators may not be able to meet the needs of and understanding of the learners' needs, an emphasis upon *do no harm* must be the guide towards supporting the learners' efforts. One's implicit cognition, their long-term memory, can be positively impacted by a learning environment that embraces vulnerability more fully and embeds creativity as well as impactful learning as mainstays of the learning milieu.

Creativity as Value

Creativity and value, then considerations towards value and creativity. An intriguing statement by Weisberg (2015) communicated,

… the value attributed to some product is the result of a subjective judgment, which is subject to change over generations. Such changes have the consequence of making it impossible to develop a cumulative knowledge base in the study of creativity. In response to those problems, an alternative definition of creative, based on the criteria of intentional novelty, and not including value in any form…. (p. 111)

A recognition of subjectivity and judgement associated with any sense of value placed upon creativity is highlighted by acknowledgement around to what extent might creativity subjected by intentional novelty. Of further consideration, is that creativity and creative design may be suggested as to "…describe three characteristics of a creative design: novelty, value, and surprise" (Grace, Maher, Fisher & Brady, 2015, p. 125). Understandings that creativity is valuable, as well as reflections of novelty and surprise may also be worthy of advanced emphasis.

Creativity as Effectiveness

Shared mental models may be a supportive aspect of the effectiveness of creativity, although implicit cognitive vulnerability supports a more open and supportively engaging sense of mental models that allow for a more open, respectful and intriguingly curious sense of creativity. The ability towards embedding creativity throughout the instructional process may support learners towards an effectiveness associated with embedded value and strength within a communal concept. The outcome of an instructional event, an instructional focus, is the attainment or over-reach of the learning objective; as such, implicit cognitive vulnerability and the supportive learning environment embedded within this approach is strong.

Yet creativity as effectiveness may take on different understandings. For example, Santos, Uitdewilligen and Passos (2015) suggest:

… investigate the mediating mechanisms of intra-group conflict and creativity in the relationship between shared mental models and team effectiveness (team performance and satisfaction).… that high shared mental models are related to low levels of intra-group conflict, foster creativity, and in turn improve team performance and satisfaction. These findings contribute to a scarce thematic – the relationship between shared mental models and creativity – emphasizing the importance of a shared understanding for creativity and team effectiveness. (p. 645)

A question that arises around creativity and effectiveness may bring forward concerns around an *chicken or the egg* approach, wherein is the mental model shared from the beginning of the enculturation of the team members within the space, or is the mental model actually modeled and supported towards developing by the team's lead, resulting in the shared mental models and creativity? Towards expanding this understanding into an instructional environment, do the collegial learners arrive in the learning environment with shared mental models, or does the instructional facilitator model and support the growth of similar mental models within a learning environment, towards creating an environment that supports creativity and impactful learning through implicit cognitive vulnerability within the learners?

Impactful Learning as Relationships and Community

Within a learning environment, the relationships and community structure directly impact and support the development of impactful learning environments. As is posited by Merrill (2008), "far too much instruction is still not effective, not efficient, and not engaging" (p. 162). Further, concerning learning environments, "we have just scratched the surface of how to design what to teach and how to teach" (Merrill, 2008, p. 162). The importance around creating meaningful, valuable and impactful learning environments that support the learning community's focus upon the learners' relationships and community engagement are vitally important, embedding learner-centered, knowledge-centered, assessment-centered, and community-centered engagements (Bransford, Brown, & Cocking, 1999). Strong instructional design and instructional support through the instructional facilitator's guidance and modeling offers an impactful learning environment that supports a controlled instructional event that allows for a safe and supportive environment, embracing a comfortableness towards developing relationships and community that supports the learner's implicit cognitive vulnerability.

Impactful Learning as Respect and Consciousness

An impactful learning environment that emphasizes respect and respectful engagement amongst collegial learners is vitally important, as is the respectful and conscientious efforts of the instructional facilitator towards modeling these expectations that lead towards an impactful learning environment. A conscious engagement around the instructional process that has the option to be supportive or detrimental, respectful or oppressive, bring forward consciousness or nothingness. Watson (2017) quotes hooks (1994) in a discussion around the strengths of impactful learning environments, with considerations towards respect and consciousness as well as the opposite understandings:

It is worthwhile to acknowledge that English instruction is not neutral; often, it is a gatekeeper by which assimilation and conformity are measured. bell hooks states that Standard English, far from being an impartial tool of communication, "has the potential to disempower those of us who are just learning to speak, who are just learning to claim language as a place where we make ourselves subject" (168). This is an important point. hooks continues, "It is not the English language that hurt me, but what the oppressors do with it, how they shape it to become a territory that limits and defines, how they make it a weapon that can shame, humiliate, colonize" (168). (Watson, 2017, p. 8)

Oppressors are just as important and worthy of discussion as are the liberators, as the instructional facilitator can support the learner's implicit cognitive vulnerability or squelch the ability of learners to be successful within an instructional environment. Impactful learning environments must bring forward strengths and qualities of engagement. Towards assurances of positive impact.

FUTURE RESEARCH DIRECTIONS

Directions of future trends and emerging research efforts are growing as the concepts around implicit cognitive vulnerability slowly develop into a viable theoretical framework that embeds the positivity of impactful learning environments within the understanding of learner's cognitive understanding and strengths around one's cognitive vulnerability. Qualitatively testing the viability of this theory more fully within instructional environments is a necessity, not only within face to face environments, but specifically within blended and online learning environments that desires the community and collegiality frameworks of support.

CONCLUSION

Implicit cognitive vulnerability is necessary and appropriate towards enhancing the learning environments in which learners attempt to successfully strive towards successful informational attainment and conceptually support the learners through creativity and impactful learning opportunities, through the lens of implicit cognitive vulnerability.

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KEY TERMS AND DEFINITIONS

Cognitive Vulnerability: The ability of the human brain to be malleable and open to new and different ideas worthy of examination and scrutiny, through the written word, spoken word, visual means or tactile means.

Collegial Learner: A co-learner within a learning environment, reflecting someone of respectful ease and engagement, with similar learning objectives who is mutually supportive of instructional efforts and events.

Creativity: The ability of learners to consider old, new and differentiated information in different ways, mixing and matching information from different resources towards coming up with an innovative and novel outcome.

Impactful Learning: The instructional process that may result in adding to the learner's cognitive short-term and long-term memory information, that encourages and prompts the strength of influence and impression upon the learner's understanding of the subject matter.

Implicit Cognition: The unconscious understanding and awareness of one's ability to reach into memory, understanding, practices, activities and awareness of differentiated viewpoints.

Instructional Facilitator: The teacher, the leader within an instructional environment who guides the instructional process through differentiated means, towards supporting the learners and achieving instructional objectives.

Vulnerability: Allowing others to view one's fragileness and disruptive dissonance, especially throughout the learning process within this discussion.

Chapter 47
Concept Maps as a Technique for Organizing, Analyzing, and Transforming Knowledge

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ABSTRACT

The chapter begins with the origins of concept maps as a tool to promote constructivist learning, an educational philosophy and practice, and is followed by a concept map taxonomy. A definition of concept maps is provided and the main differences between Mind Maps©, Thinking Maps®, and Concept Maps are discussed with Thinking Maps classified as a type of concept map that is separate and different from both other maps. The chapter then offers a second definition of the term "concept maps," with a detailed discussion of Thinking Maps resulting in a new taxonomy of knowledge or concept maps. The authors then investigate integrating concept maps with cognitive styles theory to determine if concept mapping might have a neuro-psychological basis and if mapping theory can be related to different academic fields and professions. The chapter concludes that the use of concept mapping can promote more holistic and effective teaching, learning, and practice in STEM education.

INTRODUCTION

Concept maps is a generic term for graphic organizers in need of clearer definitions and a more definitive taxonomy to enable further research on their use not only in education but also in business, science and engineering. In pursuit of such a taxonomy this Chapter focuses on three specific concept maps, also known as knowledge maps: Mind Maps, Concept Maps and Thinking Maps. It is argued that these specific types of maps are isomorphic with three cognitive styles: the Object, the Verbal and the Spatial. The

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linking of Mind, Concept and Thinking Maps with cognitive styles theory allows for a more functional taxonomy, more rigorous quantification of their effectiveness, and greater applicability in the real world.

Concept mapping traces its origins to David Ausubel's "Advanced Organizers," which were constructed as an attempt to break out of the 20th century positivist, reductionist and behaviorist approach to psychology and education. J.D. Novak, reacting against the same traditional philosophies and scientific methods, modified Ausubel's advanced knowledge organizers into visual diagrams, coining the term "Concept Map" and made their construction into a major tool to advance constructivist education. After giving a background to Novak's Concept Maps and the subsequent more generic term, "concept maps" (i.e. without caps), we then take Martin Eppler's knowledge map taxonomy and modified it as a provisional framework to help meet the objectives of this chapter.

After detailing with the similarities and differences between the three kinds of concept maps, we then discuss how Mind Maps, Concept Maps and Thinking Maps, can be correlated with different cognitive styles, the Object, the Verbal and the Spatial. This correlation of concept maps with cognitive styles theory, especially as presented by neurophysiologists, Blazhenkova and Kozhevnikov, opens up the practice of concept mapping to neural patterns to the brain on one level and to the larger world of STEM education and professions on another. The Chapter concludes with evidence that the three major kinds of maps continue to have a significant impact on scholarly research. The issue involved in this regard, however, is not whether or not one concept mapping technique is more effective than another but that all three maps, can be used together each complementing the other. The result is a more holistic and balanced way of constructing knowledge than previous methods of organizing, interpreting and analyzing information.

BACKGROUND

J. D. Novak, a constructivist education scholar modified educational psychology "Advance Organizers" (Ausubel, 1963, 1968) and translated them into visual form by drawing diagrams which he called "Concept Maps." This simple but highly significant step occurred when Novak and his colleagues at Cornell were tracking changes in children's knowledge of science in a science, technology, engineering and math (STEM) research project. Novak (2010) saw that this method of recording student achievement could be transferred to improving student performance in itself. The invention of concept mapping for student improvement paralleled a constructivist paradigm initiated by such prominent educational psychologists such as Piaget (1971), Vitgosksy (1978) and Von Glaserfeld (1995).

This alternate paradigm could be characterized by a shift from a passive learning process in which students are given materials to be learned and problems to be solved to a more "constructive" student centered and interactive way of teaching and learning. In the old paradigm, dictated by positivist stimulus and response theory, students were rewarded with good grades if they learned the material and solved problems to the satisfaction of the teacher and punished with lower grades and other negative means if their academic performance was evaluated as unsatisfactory (Novak and Canas, 2008; Herrick, 2012). In addition, the constructivist mapping technique posits that new knowledge can be learned most effectively by relating the new to previously existing knowledge, a practice now known as scaffolding, (Berk, 1995; Hmelo-Silver, 2007). Moreover, Concept Maps are organized hierarchically, following Ausubel's notion of subsumption, that in the natural order of things, more general or superordinate concepts subsume more specific, detailed concepts. (Novak, 1990, Novak and Canas, 2008; Novak, 2010). Finally, The links in a concept map, are defined by the use of connecting phrases between concepts to

form meaningful propositions. Concept mapping theory, however, does not constrain the labels that can be used, allowing map makers considerable freedom in describing the relationships among concepts (Novak, 1984; Novak, 2008).

From Novak's notions of Concept Mapping we can define concept maps as follows:

The generic term, "concept maps" can be defined as structures consisting of nodes, which contain concepts that are interconnected with links as labelled arrows resulting in a construct which 1) helps to answer focused questions that are context dependent; 2) represents organized knowledge that includes associated feelings or affects as well as logical thoughts to form meaningful propositions.

Eppler's Taxonomies

Given this definition, we move to the construction of knowledge map taxonomies. Perhaps the most definitive classification of concept mapping as a meta-cognitive tool can be best found in the works M. J. Eppler, who postulated a taxonomy that results to a further definition of a concept map, or he called them, "knowledge maps. (Eppler, 2006, 2006a; 2008; Okada, 2008). This "knowledge map," also known as concept map, can be defined as . . .

. . . a visual display of captured information" and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail. The individual items of knowledge included in such a map can be text, stories, graphics, models, or numbers . . . in such a way that the mapping itself also creates additional knowledge (Vail, 1999, p. 10 as quoted in Eppler, 2008).

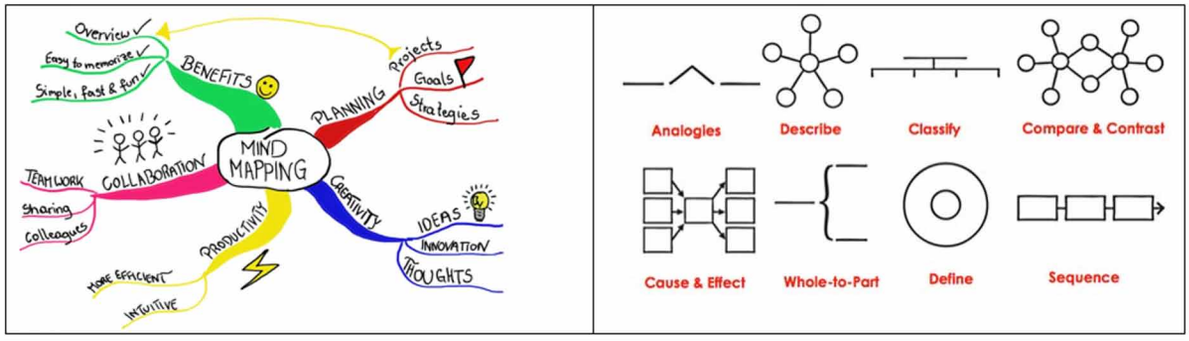
Examples of knowledge maps defined as such can be found in the works of S. Kim (2003) and J-H Woo (2004) who independently showed how knowledge maps can be applied specifically to the specific field of construction management while others use concept maps in other disciplines such as computer and information science (Zin, 2007; Wiegmann, 1992; Yang, 2007; Kim, 2003; Woo, 2004).

Given these definitions, Eppler argues that "knowledge maps" are the parents of "conceptual diagrams;" sets and subsets of knowledge maps and defined as a *systematic depiction of an abstract concept in predefined category boxes with specified relationships, typically based on a theory or a model*." Subsets of such diagrams, according to Eppler are, Mind Maps, "metaphor maps," and Concept Maps. In this chapter we ignore metaphor maps and replace those maps with Thinking Maps, resulting in our triad of Mind, Concept and Thinking Maps (Figure 1).

DISCUSSION

This section argues that these specific concept maps are isomorphic with three cognitive styles: the Object, the Verbal and the Spatial. The linking of Mind, Concept and Thinking Maps with the categories in cognitive styles theory allows for a more functional taxonomy, more rigorous quantification of their effectiveness, and greater applicability.

Figure 1. Mind maps, concept maps and thinking maps
Note the concrete (object) characteristic of the Mind Map vis a vis the spatial and verbal Concept Map and spatial Thinking Maps.



Mind Maps

Mind Maps © are the invention of a psychologist, Anthony Peter "Tony" Buzan, who working outside academia as an educational consultant, popularized the idea of improving mental literacy. He eschewed traditional academia to become a non-academic author on cognitive subjects such as memory, creativity and speed reading, writing books and giving lectures that made him into a multi-millionnaire (Crocoran, 2015).

Mind Mapping has been especially popular in K-12 education, in business, and even in medical circles (Budd, 2004; Summers, 2014; Eppler, 2006) and has been found to be especially effective in motivating students in collaborative learning and other classroom settings. Mind Maps are often drawn by hand and could be considered a kind of webbed map where branches with nodes radiate out from a central idea, theme, or target and. As such they can be described as a more colorful and pictorial form of concept mapping (Buzan, 2005; Jones, 2012; Budd, 2004; Zampetakis, 2007).

Concept Maps

As in the case of Mind Maps, Concept Maps, have been found to most effective in business and education (Blunt, 2014; Roediger, 2006; Hmelo-Silver, 2007; Wang, 2016).

Concept Maps, a more specific category of concept or knowledge maps, are a way of representing relationships between ideas, usually presented as words, but sometimes as pictures or images. An analogy to Concept Maps and many knowledge maps are sentence diagrams, with Concept Maps parsing out strings of sentences such as paragraphs instead of single sentences. Moreover, in a Concept Map, each word or phrase, or even a paragraph as node connects to another and links back to the original idea, word, phrase or paragraph. As stated previously, a distinguished feature of Concept Mapping are the links, used to connect phrases between concepts to form meaningful propositions. Concept mapping theory, however, does not limit the labels that can be used, allowing map makers considerable freedom in describing the relationships among concepts (Novak, 1984; Novak, 2008.

Thinking Maps

Thinking Maps ®, a map "language" was invented by David Hyerle, a visiting scholar at Harvard who received his doctorate degree from the University of California, Berkeley and studied under the renowned linguist George Lakoff and prominent educator, Arthur Costa. Hyerle's maps consist of fixed structural templates that are intended to correspond with different fundamental thinking processes. As such, Thinking Maps are much more rule based than Concept Maps and Mind Maps, providing a common visual iconic vocabulary to organize, structure and analyze information. (See map on the right in figure 1 and Hyerle, 2014; and Tang, 2012).

Thinking Maps, with eight root maps as its basic vocabulary are associated with formal logic operations that can be regarded as abstract symbols that may point to mental operations occurring physically in the brain. Students and teachers trained in Thinking Maps by analyzing text as content into one or any of the eight different maps construct formal logic statements as a kind of abstract geometry where mental operations involve attaching visual symbolic mapping patterns with analytical mental operations.

Thinking Maps can be compared with G.I.S. maps where the concept maps are used to analyze text material as a set of interconnected maps in the same way G.I.S. maps are used to organize and analyze knowledge of terrains in the real world. To continue the analogy, Thinking Maps extract meaning from textual material rather than topological reality. While they differ in their objects of analysis, both maps lay out important concepts in non-linear and highly structured visual patterns (Chang, 2007; Fu, 2007; Tomlinson, 2010).

Cognitive Styles Theory

Cognitive style or "thinking style" is a term used in cognitive psychology to describe the way individuals perceive, process and remember information. Our reason for connecting cognitive styles with concept mapping is because cognitive styles theory: 1) can serve as a framework for an alternate way to classify concept mapping as a mental process; 2) gives a neurological basis for concept mapping that other theories and taxonomies do not; and 3) provide access to metrics and measuring instruments currently lacking in concept map theory.

Oleysa Blazhenkova and Maria Kozhevnikov (2009; aka B&K in this chapter), the leading proponents of cognitive styles theory divided mental processes into two groups: the Visual and the Verbal. In their neurological scheme visualizers prefer to process information though brain pathways associated with sight while verbalizers prefer processing information conditioned by speech and the written world. As a consequence visualizers and verbalizers process and organize data and information in different terms and ways. In the next section the authors attempt to link B&K's cognitive style model with concept mapping to construct our new taxonomy.

According to Maria Kozhevnikov (2007), in an article based on work funded by the National Science Foundation:

Cognitive style historically has referred to a psychological dimension representing consistencies in an individual's manner of cognitive functioning, particularly with respect to acquiring and processing information . . . as stable attitudes, preferences, or habitual strategies that determine individuals' modes of perceiving, remembering, thinking, and problem solving (464).

Kozhevnikov and Blazenkova have been influenced by Riding (1991)'s two-dimensional cognitive theory with its computer aided Cognitive Style Analysis (CSA) assessment tool. Riding's theory posits and the assessment tool measures two orthogonal styles, the Wholist-Analytic (W-A) and Verbal-Imagery (V-I). Wholist-Analylic persons are those who prefer to analyze and solve problems from a more systems perspective while verbal-imagery persons are more dependent on a linear, sequential cause and effect approach (Riding, 1997). Meanwhile, Herman Witkin has developed a field dependence-independence cognitive style model with accompanying assessment instruments that measure whether or not an individual prefers to solve problems by regarding a mental task from a gestalt perceptive or a with a more reductionist approach. Gestalt persons prefer to solve problems from a more systems and holistic perspective while the reductionist prefers to focuses on key parts independent of the context or environment in which the problem is presented (Witkin, 1978; Witkin, et al, 1997).

Neuropsychologists Olysa Blazhenkova and Maria Kozhevnikov, building on the work of Witkin as well as Riding, developed a three dimensional model of cognitive style along with a measuring instrument the measures whether persons are Visual or Verbal thinkers. With its highly sophisticated and validated measurement instrument, The B&K model has the advantage of correlating the two different cognitive styles with different neurological pathways and correlating the typology with different academic majors and professional fields. These correlations are made possible by breaking down thinkers into Object and Spatial thinkers as persons who prefer to think visually and non-verbally.

This linking of cognitive styles systems with learning systems is not altogether unprecedented, especially if that relationship is connected with internet communication technology (ICT) and computer aided education systems. For instance computer scientists, Trianatfillou et al (2002, 2003, 2004) are developing an adaptive educational system (AES) based on hypermedia integrated with cognitive styles to improve student learning. In specific regard to Concept Maps, Kathryn Jablokowb (2015) is using concept maps and cognitive styles research to test engineering achievement. Also in the area of linking cognitive styles with concept. mapping, Tatiana Gavrilova and Irina Leshcheva (2015, 2015a, 2015b) perspective are attempting . . .

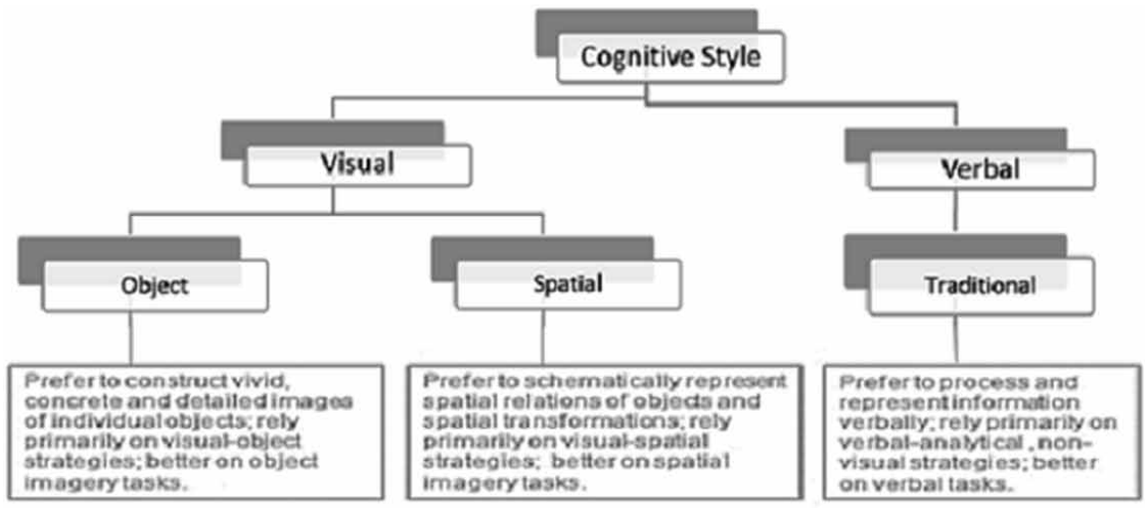
. . . to create new, consistent and structurally holistic knowledge bases for various areas of science and technology . . . [by] . . . research into correlations between the expert's individual cognitive style and the peculiarities of the expert's subject domain ontology development (Leshcheva, 2015, p. 3883).

Accordingly, one of this chapter's main hypotheses is: if a strong relationship exists between concept maps and cognitive styles then a similar relationship could exist between concept mapping and different academic majors and professional fields. For example, Object visual cognitive styles associated with Mind Maps appear to correlate more with the humanities disciplines and fields while the Spatial visual cognitive style can be shown to be are more congruent with STEM disciplines (Blazhenkova, 2009, 2011; Kozhevnikov, 2010, 2014).

Figure 2 is a concept map of the B&K model with the respective attributes of the three different types of the three cognitive styles that we intend to correlate with specified concept maps in our new taxonomy.

The taxonomy in figure 2, is grounded in neurophysiological areas of the brain, as described figure 3. Roughly and metaphorically speaking it can be argued that the Verbal cognitive style can be located in the left side of the brain while the Visual on the right side of the brain.

Figure 2. A cognitive styles taxonomy



By integrating cognitive styles with concept mapping Mind Maps, Concept Maps and Thinking Maps can be more clearly defined and differentiated as follows: Concept Maps are preferred by visualizers who also have a strong Verbal bent while Mind Maps and Thinking Maps can be associated with those who prefer Visual thinking. The two types of visualizers, however can be distinguished from one another in that individuals who prefer Mind Maps are more concrete thinkers while Thinking Mappers are more logical and abstract in their mental processes. They prefer the spatial style of processing information in terms of locations, motion and spatial relations, not only in representing and manipulating knowledge but also in transforming it. Mind Map users, on the other hand prefer the object mental style of codifying information through the representation and manipulation of individual objects and scenes in color, detail and shape.

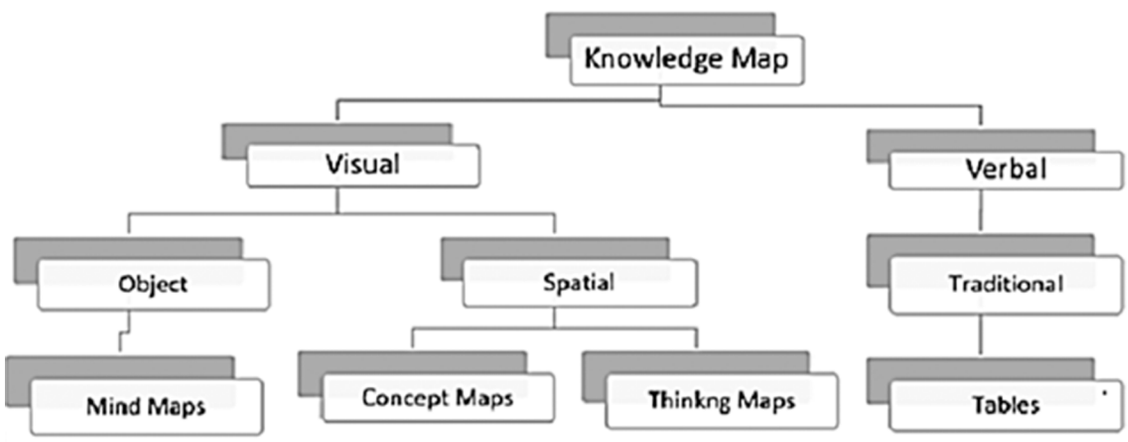
Figure 3. Location of different cognitive styles in different areas of the brain roughly corresponding to the left (Verbal) and right (Object) with the Visual Spatial cognitive style found in both regions (Blazhenkova, 2009)

		Visual	
Systems	Verbal	Object	Spatial
Brain areas involved in processing (Cabeza & Nyberg, 2000; Gazzaniga, 2004)	Primary Auditory Cortex, Broca's area, Wernicke's area, Supramarginal gyrus, Angular gyrus	The ventral stream runs through V1, V2, V4 and to the inferior temporal lobe	The dorsal stream runs through V1, V2, V3, V5 (also known as MT area) and to the inferior parietal lobe

Both visual types, Object and Spatial, associated with Mind Maps, and Thinking Maps respectively are orthogonal to Verbal style thinkers, who can be associated with Concept Maps with the caveat that while Concept Mappers tend to be verbal, they can be also be spatial. Verbal persons ware those who prefer to represent and process information through words and texts using discrete linguistic units ordered according to sequential semantic and grammatical structures. This verbal manner of organizing, analyzing and presenting information and knowledge is still quite prevalent in education as evidenced by the continued use of the lecture and more traditional methods for knowledge representation, organizing and presenting information. Examples of this predominantly verbal processing mode include the textbook itself, text tables, Power Point slides homework assignments consisting of writing essays, briefs and summaries and tests measuring the regurgitation of memorized content.

Although concept mapping can sometimes also be highly verbal in its construction, this division of information processing and knowledge generation between Verbalizers and Visualizers with the latter broken further into Object and Spatial thinkers leads to our final taxonomy as presented in figure 3. In that taxonomy Mind Maps are associated with visual object thinkers and Concept Maps and Thinking Maps with visual spatial thinkers.

Figure 4. Final Knowledge map taxonomy, integrating cognitive styles classification (figure 2) as frame and theory behind new taxonomy



In this provisional taxonomy, integrated with cognitive styles theory categories, the generic rubric "knowledge map" is subdivided into cognitive style's two types of mental processing, the "visual" and the "verbal," with Concept Maps and Thinking Maps classified as "spatial" modes of thinking (Figure 4).

Previously we stated that one of the benefits of merging concept mapping with cognitive styles is the integration of the two can result in the better concept map measuring instruments. This is because Blazhenkova and Kozhevnikov have developed a cognitive style measuring instrument called the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ). This cognitive style questionnaire demonstrated high internal reliability, predictive, discriminative and ecological validity in both children and adults. Furthermore, the measuring instrument allowed researchers to correlate cognitive styles with the different academic and professional fields (Blazhenkova, 2009, 2009a, 2011). For example, cognitive style

researchers using the OSIVQ have found that visual arts majors prefer the Object style of information processing but score low on processing information verbally. At the same time engineering and science majors and professionals tend to score high on the spatial questions of the same cognitive style assessment instrument. As might be predicted, students and professionals in such fields as the humanities, the social sciences and legal have been tested to be more verbal in their cognitive style preferences. Architect students and professionals, it should be noted tend to score higher on both the object and spatial mode of processing information and at the same time higher on the verbal than object learners. These scores indicate that architecture students are more holistic and balanced in their majors and disciplines than other students (Kozhevnikov, 2010; Casakin, 2016; Kawahara, 2013; Pérez-Fabel, 2017).

Applying Thinking Maps to STEM

We conclude this chapter on concept maps with a discussion of how Thinking Maps, the less researched and understood of the three maps discussed, can be used to study and understand scientific concepts in an alternate, non-linear, non-reductionist and more holistic and structural way. In this case example, the reader of this chapter is a chemistry, physics, biology, or environmental science instructor who wants to introduce the concept of the Bohr atom as a basic concept required in any of these fields. Students have been assigned a reading on the Bohr atom, part of which is presented as follows:

According to the Bohr or solar system model of matter, every atom consists of a nucleus with a certain number of electrons rotating about the nucleus in their orbits. The nucleus is much larger than the electrons. These particles are assumed to be very small spheres or ball-shaped. This is similar to the configuration of a solar system, with a large sun in the center and planets rotating in orbits around the sun. Is it possible that the atomic level represents a smaller universe of some sort?

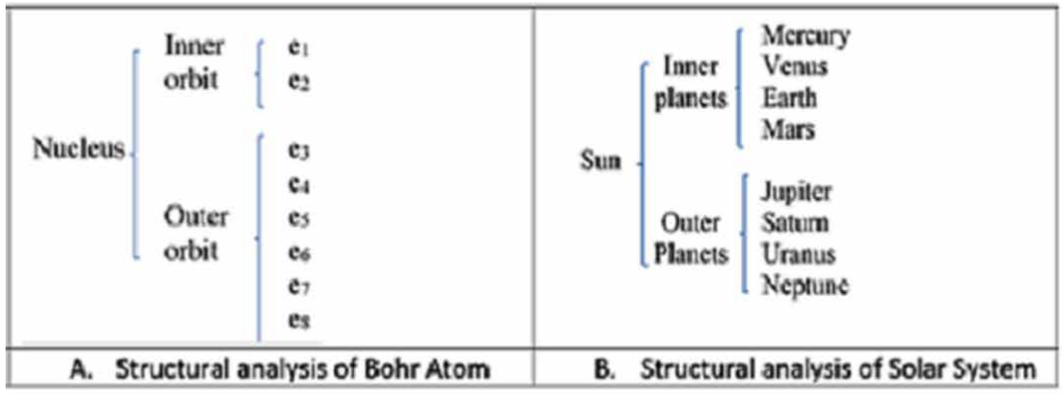
For example, let us compare oxygen with our solar system. Oxygen consists of a nucleus and 8 electrons in orbit. Our solar system has our Sun and 8 planets in orbit around it. Is it possible that the third electron from the Oxygen nucleus is similar to the third planet from the Sun– our Earth – except on a very small and different scale? . . .

Following that train of thought, perhaps solar systems are actually "atoms" in a much larger universe. Some stars are very large and some are much smaller than our Sun—just as some atomic nuclei are large and some are small, depending on their atomic number and weight. The rotating galaxies could be like rotating eddies in a liquid or gas. (Bohr, 2019)

In this thought experiment with Thinking Maps as a concept mapping technique, the instructor has already prepared students on how to use the maps for analysis by advanced organizing and showing that knowledge or concept mapping is a technique that can be used to visualize information and data structurally and synthetically, as in putting together parts to form a whole that is greater than the sum of its parts. In our example, students are asked to draw Thinking Maps, A and B, on the structures of the solar system and Bohr atom respectively (Figure 5) instead of simply reading the material, underlining or highlighting sections and memorizing the content.

To continue our example, Thinking Maps as concept or knowledge maps can be constructed as structural maps, A and B, as illustrated in figure 5.

Figure 5. Two thinking maps (parts maps) showing how the Bohr atom (a) is structurally similar to the solar system (b)



After having constructed parts maps of the Bohr atom and the Solar System the next step is to conclude that the structure of A is isomorphic or analogous to B, from which, an analogy Thinking Map, the Bridge Map, can be constructed accordingly. At this point the instructor can lead the students to new knowledge by asking, "Now that we can see that the Bohr Atom is structurally similar to our Solar System, in what ways do they differ?

One answer, stated in the text, is the obvious difference in scale. However, upon further reading students will learn that these two structures are completely different in terms of dynamics. That is, while both systems are similar structurally and both systems have orbits around larger foci, the nucleus and the sun respectively, the dynamics of the Bohn atom is such that the electrons can make quantum leaps, from one orbit to another. This difference leads the students to the next part of the text --- again not shown above---- that describes the completely different mathematics involved in calculating these "quantum leaps." To compare and contrast the similar and different properties or qualities of the solar system and the atom, students can then use a "Double Bubble" map which is a systems analysis of properties or qualities, This example of using specific Thinking Maps to compare and analyze two different systems illustrate how they can be used as a scaffolding device to not only construct knowledge but use the knowledge constructed as maps to be lead to new knowledge which in this case would be an introduction to the properties and dynamics of sub atomic particles.

FURTHER RESEARCH DIRECTIONS

Thinking Maps consists of symbolic elements acting as the root vocabulary of a non-verbal language to organize and analyze information that can be constructed as visual related statements and propositions. As a system of eight fixed graphic symbols, Thinking Maps can be compared to other symbol systems such as those found in music and symbolic logic. In music, for example, a musical score, which has its own iconography, visually tells a person to mentally hear a sequence of notes, played or sung at certain speeds such as allegro or moderato and in tandem with other sequences of notes combined in different harmonies. Thinking Maps is an analogous visual system of symbolic patterns but more akin to the symbol systems of formal logic in that in both systems the symbols are linked specific to mental operations.

A critical review of the content of and bibliometric analysis of the number of articles show that Mind, Concept and Thinking maps continue to increase as scholarly topics over the last 20 years. Although the exact reasons for this increase of research on these three map systems are uncertain, it is clear that concept maps because of their proven effectiveness is not a fad that will soon dissipate (Wheeler, 2003; Clayton, 2006; Able, 2006; Nesbit; 2006, 2013). It is less certain, however, as to which one of these maps, if any, will dominate in the future. If education and the professions demand more rule based, rigorous and abstract intervention techniques to increase critical thinking through non-verbal spatial thinking, then Thinking Maps or a similar kind of rule based map will become more prevalent. However, if the education and professional communities dictate the need for freer and more creative thinking in the form of what neuropsychologists call concrete or object visual thinking, then the use of Mind Maps or their analog will continue to increase. On the other hand, if more advanced verbal skills are needed in the future, then Concept Maps may continue to be in the forefront among academic intervention tools for greater academic and professional performance. We predict, however, that the future will demand the continual need for all three kinds of cognitive styles and maps resulting in less constrained and more holistic thinking. Consequently, all three types of concept maps, Mind, Concept and Thinking, will continue to increase and used more in tandem ---- not as competitive techniques but complementary tools to advance more effective methods for organizing, interpreting and analyzing information in all its many forms.

CONCLUSION

The differences between Thinking Maps and Mind Maps and Concept Maps, meta-maps that reflect different cognitive styles, have been further and more clearly defined in that Thinking Maps, as eight different fixed root maps, are more abstract and rule based than Mind Maps or Concept Maps. These differences between Thinking Maps and the other two Maps can perhaps be better understood by comparing the game of checkers with the game of chess. In checkers the game is played with essentially one piece with certain functions plus certain rules of the game. By analogy Concept Maps and Mind Maps, as in checkers, the players operate only with one kind of token, the node and with only one basic rule, which is to connect the nodes via variable links into a meaningful pattern. Thinking Maps, on the other hand, has eight basic pieces, each representing different mental operations. These, eight visually patterned maps, like the pieces in chess, can be combined in infinite combinations to construct more complex structures to not only organize and analyze knowledge but to create new knowledge.

The main focus of this chapter, however, is not on Thinking Maps but how these Maps fit along with Mind and Concept Maps in a new taxonomy that integrates concept mapping with cognitive styles theory. The new taxonomy shows how Mind Maps can be correlated with Object visualizers, Thinking Maps with Spatial visualizers and Concept Maps with spatial Verbalizers. This congruency means that knowledge maps, like cognitive styles theory, can be empirically tested via vetted measuring instruments and linked not only to physiological mental processes, but also to academic and professional fields. These linkages open up new possibilities for applied research to transform knowledge in STEM education as well as STEM professions.

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Section 6
Online and Virtual Learning

Chapter 48
Incorporating Technology in a Cooperative Learning Environment

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ABSTRACT

Cooperative learning is largely considered a powerful instructional method. Decades of research based on the interdependency theory has created a strong framework on how to design an effective cooperative learning environment. In recent years, new technological innovations have emerged, creating a new field of research known as Computer-Supported Collaborative Learning. This chapter examines how technology can be incorporated using the foundation set by cooperative learning, the challenges such incorporation solves, and the challenges it creates. Additionally, this chapter poses some recommendations for both practitioners and researchers of cooperative learning.

INTRODUCTION

Cooperative work and socialization have been an ever-increasing presence in the world. New technologies have allowed humanity to erase vast distances between people in other countries. This enables people to develop friendships and collaborations between countries and continents. Additionally, the workforce has seen a gradual shifting from isolated manufacturing and artisan jobs towards a more service and information industries that require employees to interact and work with others both within and between departments.

With such social and economic shifts, new educational initiatives have risen to develop the skills to thrive in this new environment. However, changing educational goals is not an easy task. Schools in countries, such as the United States, the public education systems and subsequently their goals were created during a time of industrialization. The skills necessary for students to obtain were very different. The instructional methods developed during the early stages of education to teach these skills is still a common sight in modern classrooms. Getting to class before the bell, rows of desks facing forward, and

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the teacher acting as a "sage on a stage" imparting knowledge to waiting vessels are all reminiscent of the industrial sector in which it was created. This industrial model well reflected the skills students would need as they joined the workforce with arriving on time, following explicit instructions, and following a hierarchy with little interaction with their peers.

However, with technological, social, and economic life shifted, these industrial sector skills are no longer useful. The teacher-centered model of education no longer addresses the needs of the students or the economy. Starting in the late 1970s and early 1980s, a call for the shift toward active learning, or student-centered instruction began to gain ground. This instructional style gave students greater independence to discover and explore on their own with teacher guidance rather than direction. The rise in active learning led to decades of research into effective instructional methods including Cooperative learning. This specific version of active learning has only increased in popularity with the rise of technology, which allows for increased communication across vast distances and the breaking down of barriers between positions and industries.

Research done in the field of cooperative learning has developed a framework of what variables affect the success of instruction. While cooperative learning has benefited from decades of research in a wide variety of contexts, the development and attempted incorporation of new technologies into a cooperative learning environment is riddled with mixed results. This paper examines the uses of technology in cooperative learning environments based on previous research in the field in an attempt to guide practitioners in the successful implementation and highlight areas in need of additional research.

Background in Cooperative Learning

While cooperative learning is not new and can be traced back to ancient times with the likes of Socrates. In terms of modern education, cooperative learning began to receive more attention following World War II, when psychologists found that learning in groups had potential advantages compared to learning individually. These studies in combination with Constructivist learning theories from the like of Vygotsky, Piaget, Bruner, and others who promote knowledge is created based on individual perceptions, have led to a boon of research and understanding of what benefits are offered, how group learning occurs, and what variables matter in determining its success or failure.

Students learn better across a vast range of skills and knowledge in a cooperative learning environment compared to a traditional teacher-centered environment. Research conducted in a variety of contexts and across age groups have shown cooperative learning to increase achievement score in reading, writing, mathematics, and science more than traditional learning methods (Johnson, Johnson, Roseth, & Shin, 2014; Slavin, 2018; Slavin & Lake, 2018). In addition to the increases in achievement outcomes, cooperative learning also improves desirable soft skills including relationship building, conflict management, creativity, and critical thinking (Cohen, Lockheed, & Lohman, 1976; Johnson & Johnson, 2009; Martin & Dowson, 2009; Slavin & Oickle, 1981). The skills and knowledge gained from working in cooperative learning environments strongly align with the 21st-century skills thought to be important for the modern workforce and sought after by companies (Haseski, Ilic, & Tugtekin, 2018; Kivunja, 2014). Countries with higher rates of cooperative learning score higher on the international test PISA suggesting students exposed to more cooperative experiences will be more competitive in the workforce (*PISA 2015 Results (Volume I)*, 2016).

Though the benefits of cooperative learning are great, they are not realized simply by having students work in groups (Cohen, 1994). Many variables moderate the success of cooperative learning that must

be addressed during the design and implementation of the cooperative environment. These variables include establishing interdependence between students, creating the correct instructional structure and the instructor's ability to facilitate, motivate, and manage their students during the cooperative lesson. Without these design considerations and successful implementation students in the cooperative environment not only fail to achieve the optimal result resulting in collaborative inhibition but also perform worse than their peers learning individually (Barber & Harris, 2015).

Moderating Variables of Cooperative Learning

Interdependency is the leading theory in traditional face to face cooperative learning developed largely by David and Roger Johnson (2009). The theory states that there are two types of interdependence that may occur during cooperative learning, positive interdependence or negative interdependence. For cooperative learning to be successful to occur, positive interdependence between group members must be present. Positive interdependence occurs when individuals in groups work in a manner that promotes the success of the group. This success is driven by increased interactions between group members and content (Bernard et al., 2009). Interactions between individuals are thought to increase their understanding of the material through the sharing of ideas and perspectives (Tsovaltzi, Judele, Puhl, & Weinberger, 2017). Negative interdependence, on the other hand, sees individuals working in a manner that obstructs the success of the group limiting productive interactions between members. Often this negative interdependence is driven by individualistic environments promoting competitive behaviors stifling student cooperation. The establishment of positive interdependence is the goal for many of the design and implementation variables that are foundational for cooperative learning.

The structural design of the cooperative lesson is one moderating factor in establishing positive interdependence among learners. For the purpose of this paper, structural design is defined as any decisions regarding the cooperative lesson that occurs before the implementation of the lesson. This includes the physical layout of the learning environment, available or distribution of resources, and decisions made regarding the task to be completed by the learners.

The simplest facet of the structure is the physical environment of the classroom where cooperation is taking place. The layout of desks, for example, affects the ability of a group to be able to cooperate. Settings such as traditional instruction environments where the desks are all facing a single direction are not conducive for group interaction whereas grouping desks allow individuals to communicate more easily limiting student interactions (Gillies & Nichols, 2014). Another aspect of the physical environment that may affect interdependence is the number of resources that are available to the groups. Resource scarcity or restriction is one-way interdependence is created. Limiting the resources necessary for completing the task forces students to work together. Limiting the number of computers available to a group needing to complete a task involving them is an example of resource restriction. The physical scarcity of resources fosters positive interdependence as the group members must work together if they are to succeed.

However, resource restrictions are not isolated to physical resources. It is possible to distribute knowledge of a topic in segments across learners to create individual knowledge scarcity. One instructional method under cooperative learning, which applies knowledge scarcity is jigsaw learning. In jigsaw learning, students are given only pieces of information that are to be used together to complete a larger task. While this instructional method may support the creation of interdependence, the use of limited resources, physical or otherwise is not enough.

Following the successful design of a cooperative environment, the success of the lesson is not ensured. Another vital aspect of cooperative learning is facilitation. Facilitation in a cooperative environment differs from that of a traditionally led classroom. Where in a traditional classroom environment the teacher is at the center of the instruction, in a cooperative learning environment the teacher removes themselves from the authoritarian position and moves to guide students through the learning process rather than provide information. Research in the field has shown that proper facilitation is imperative to the success of a cooperative lesson. While expert facilitation leads to student success, a teacher who is too involved or not involved enough can lead to students failing to show benefits from a cooperative lesson (Gałajda, 2012; Hmelo-Silver & Barrows, 2006).

Though it is important for the teacher to step back from direct instruction, it is also important to note that groups are not static, but rather dynamic and cycle between different stages of group development (Cassidy, 2007; Gałajda, 2012; Gersick, 1991; Tuckman & Jensen, 1977). As such, teachers must also be dynamic in nature and adjust their involvement levels to meet the needs of each individual group. Groups at different stages need different supports. Those who are in a stage of high performance would need less instructional support compared to groups in a state of high volatility. Therefore, it is important for teachers to monitor what groups are doing and what they need from them as the facilitator. However, teachers often note the difficulties that arise in monitoring multiple groups working independently (Gillies & Boyle, 2010). The challenge in monitoring the various groups makes the differentiation of instruction a formidable task. This challenge of monitoring the multiple groups also creates issues within classroom management particularly in terms of individual accountability.

The management of learners in a student-centered environment, such as a cooperative lesson greatly differs from a teacher-centered class. Within a teacher-centered classroom allows the teacher to see what is going on at all times with students typically working on the same track to complete a given product. In contrast, within a cooperative classroom student groups are operating towards completing the same general task, however, the path they take to get there may vary widely and accomplished at different speeds. This, in turn, is perhaps the largest concern and criticism of cooperative learning. It is often a concern of all groups (students, teachers, administrators) that the use of cooperative learning allows certain students to slip through the cracks or ride on the coattails of their peers a phenomenon known as social loafing (Nokes-Malach, Richey, & Gadgil, 2015). Additionally, students are at risk of being overshadowed and left behind in cases where a single student dominates the group, this is known as the superstar effect (Webb, Nemer, & Zuniga, 2002).

These moderating factors identified in research done in the cooperative learning field are important foundations for the incorporation of technology in the emerging field of Computer-Supported Collaborative Learning (CSCL). These key considerations can be used as a framework to examine the incorporation of technological advancements that CSCL purport to do. As will be discussed, the incorporation of different technologies attempts to affect foundational moderators as well as solve some of the issues in management identified in face-to-face cooperative research.

Cloud-Based Collaborative Content Tools

Collaborative content tools are one example of technological innovations incorporated into cooperative learning environments. Collaborative content tools are platforms allowing multiple authors to create and edit content over the internet. One of the best-known collaborative content tools is Wikipedia. This tool relies on leveraging knowledge of its community to create a product known as a wiki. These wikis are a

co-constructed understanding of the topic that may continuously be edited to reflect changing perceptions or new knowledge. Wikis have quickly become a popular technological tool used in classrooms attempting to implement a cooperative lesson (Glassman & Kang, 2011). However, many other collaborative content tools exist including Google drive, which offers a variety of pre-established structures for use including spreadsheets, words documents, slides, and more. Each collaborative content tool offers different benefits and drawbacks that must be considered on a case-to-case basis.

These collaborative content tools are ideal for supporting cooperative learning through structural changes to the environment by creating a virtual space where learners may interact without having to congregate in a single space. Through this virtual interaction, learners can share ideas and create a product reflective of their knowledge and understanding of the subject matter. The creation of these products requires both social and cognitive processes to create a collaborative product based on the mutual construction of knowledge making them ideal for cooperative learning (Biasutti & El-Deghaidy, 2012; Cress & Kimmerle, 2008). To understand how the use of collaborative content tools, a deeper look into the pros and cons of how these tools may affect the structural facets of a cooperative lesson must occur.

The functionality of collaborative content tools mimics some of the structural facets that were found to be effective in creating positive interdependence in face to face cooperative research. Because any device connected to the internet can access these tools, they remove the need to have a physical space for group members to meet. Additionally, these content tools create a setting similar to jigsaw allowing students to share their own personal knowledge with the group. Finally, the use of these content tools allows for additional task complexity. All of these considerations help build positive interdependence and positive cooperative outcomes.

Additionally, these collaborative content tools help mitigate some of the problems perceived by teachers during implementation. Facilitation and management of students working in cooperative groups is often a concern for teachers who are comfortable with more teacher-centered instructional approaches. Collaborative content tools assist teachers in this by giving a platform where teachers are able to track the progress of each group from their own computer as well as track each student's contributions through history tracking features of these tools allowing for increased individual accountability to prevent social loafing.

While there are, many benefits to using collaborative content, tools there are also some drawbacks in their use. In terms of lesson structuring drawbacks, the use of collaborative content tools removes the ability to restrict resources. By removing resource restrictions, those designing a cooperative learning environment run the risk of introducing negative interdependence within the group causing the lesson to become ineffective. Additionally, research on the use of various collaborative content tools has revealed that while cooperative learning increases student motivation, the inclusion of content tools yield mixed results (Roseth, Saltarelli, & Glass, 2011).

Communication Technology

In addition to affecting the foundational moderators of cooperative learning, designers can augment the ability for learners to interact during the lesson using technology. Whereas collaborative content tools are designed around the purpose of creating a virtual product, communication tools are designed to allow the spread of ideas and extend discourse to the virtual space. Communication platforms fall within one of two categories, synchronous communication tools that allow real-time chat via text or video. Alternatively, there are asynchronous tools that allow for intermediate messages that may be accessed at any

time allowing for more flexibility. While there are many different, platforms that allow for messaging the flexibility they lend to cooperative learning are the same. The ability to communicate with peers over distances and at any time offers obvious benefits to cooperation. With such technology, group members can communicate at their leisure even across time zones increasing interaction.

Synchronous communication platforms allow students to communicate in real time. This allows for instant responses and for the online messaging to mimic face-to-face cooperation. Found to increase motivation (Giesbers, Rienties, Tempelaar, & Gijselaers, 2014). However, this real-time communication also offers certain challenges. Because synchronous communication happens in real time, everyone must be online at the same time often leading to frustration in students attempting to organize a time that works for all outside of a traditional class (Capdeferro & Romero, 2012).

Asynchronous communication formats allow for a more flexible discourse setting. Asynchronous messaging can abolish scheduling conflicts and time zone differences allowing groups to work effectively at their own pace. Additionally, this intermediate communication format allows for increased reflection shown to benefit learners (Giesbers et al., 2014). The drawback of asynchronous messaging, however, is that they lack the flow of traditional conversations causing significant delays in obtaining information and causing frustration in learners from the lower levels of interaction in this format (Offir, Lev, & Bezalel, 2008).

Research on these two types of communication formats is mixed for cooperative learning. Some studies report a preference for synchronous online communication (Offir et al., 2008), while others report preferences for asynchronous communication (Murphy, Rodríguez-Manzanares, & Barbour, 2011). Further, it is suggested that each format may be beneficial for different aspects of learning with synchronous communication being better for obtaining information whereas asynchronous formats allowed time to think and allowing richer responses (Johnson, 2008). Thus, some researchers posit that synchronous and asynchronous communication complement one another and should be treated as an additive in nature (Ligorio, 2001; Oztok, Zingaro, Brett, & Hewitt, 2013). Recommendations for how to rectify these differing results and theories are addressed next.

SOLUTIONS AND RECOMMENDATIONS

Practitioners

The incorporation of technology into a cooperative learning environment has the potential to further the many benefits found in cooperative learning if carefully managed. This paper makes it clear the potential benefits in the inclusion of technological advancements. These benefits, however, are only realized if properly incorporated. As with all good lesson planning, a thoughtful design must occur to align content, pedagogy, and technology into a cohesive whole (Koehler & Mishra, 2005). While often technology is chosen for novelty or as a piece to be designed around; this paper suggests technology to be incorporated should be chosen last in the design process and only if it is clear how it strengthens one of the aspects the educational community recognizes as foundational in cooperative learning. In addition to considerations of past cooperative research, teachers must also reflect on their pedagogy to determine if the incorporation complements their teaching style. While some innovations may be neutral to pedagogy, including the different communication formats do fall into different pedagogies (Giesbers et al., 2014; Murphy et al., 2011; Oztok et al., 2013).

Researchers

For researchers, this paper suggests when designing a CSCL classroom a few considerations. For one, recognize that teachers have different preferences and will require time to adjust to any pedagogical changes the study may make. To clarify, if the instructor commonly teaches in a traditional manner and are asked to become a facilitator, they likely will require time to make sense of the role (Fendt, 2010). Additionally, as pieces of technology are incorporated into the cooperative lesson additional sense making surrounding the technology and if how quickly the instructors are to adopt it must be considered. If these considerations are not made and too short of a study is conducted, the results are likely to be misleading. It should also be cautioned that different districts, schools, and even classrooms will likely have different structural needs that may require shifts in the CSCL design and as such, attempts should be made to make any intervention flexible in terms of implementation, leveraging teachers' expertise.

FUTURE RESEARCH DIRECTIONS

With new technologies emerging every day, new research topics emerge. With the emerging technology, no doubt will there be efforts to incorporate these innovations into the classroom to produce more effective and efficient learning opportunities. As is clear in the computer supported cooperative learning research, not all of these innovations will be effective in promoting the growth of a learner. In many cases, it is likely that different learner characteristics will affect the outcomes of individual studies. As such, future research should not focus on specific technological innovations, but rather focus on how they affect the variables we understand as fundamental to an instructional method. Such foundations have been suggested in this paper including, lesson structure, teacher facilitation, classroom management, and student motivation.

Perhaps the most urgent research that must be conducted is testing the transferability of the interdependence theory given recent questions of its place in CSCL (Roseth et al., 2011; Zeneli, Thurston, & Roseth, 2016). If these findings are correct it suggests that computer-supported collaborative learning is not dependent on the establishment of positive interdependence. Furthermore, if this finding is confirmed it may have ripple effects into the broader cooperative learning field, dislodging over a decade of research done based on interdependence as a driving theory.

CONCLUSION

Technology has allowed for many great evolutions in our society. It has allowed us to communicate and cooperate across great and small distances like never before. However, often technology is pushed for its own sake rather than with true purpose. While the research on the traditional face-to-face cooperative learning has clear significant benefits to learners (Slavin, 2011). Our understanding of how to incorporate technology within cooperative lessons still has many unanswered questions. Some technologies such as collaborative content tools provide resources to address various concerns about learning equity and accountability challenges. Meanwhile, others such as communication formats seem to yield mixed results graying the waters. Even further, some of the fundamental theories upon which cooperative learning is based on has been called into question in computer-supported cooperative learning research. Because of

these issues, additional research must be done to gain better insight as to how to effectively incorporate technological tools into cooperative instruction.

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KEY TERMS AND DEFINITIONS

21st Century Skills: Skills and knowledge thought to be essential for the modern workforce. At its simplest form it is often noted as the "4 Cs": Communication, Collaboration, Critical Thinking, and Creativity. *Note that 21st century sometimes refers to a framework from the Partnership for 21st century learning.*

Asynchronous Communication: A communication format that occurs intermittently. Communication is usually text based and allows learners to access messages at any time and revisit previous messages.

Collaborative Content Tools: A website or platform that may be accessed by multiple users either simultaneously or intermediately. They are used to share knowledge and create a product.

Collaborative Inhibition: A term used to describe the failure of a group to achieve their potential result. Typically measured against pooled individual scores.

Computer-Supported Collaborative Learning: A cooperative learning lesson which incorporates a computer to support learning. This is a broad sub-field of cooperative learning.

Cooperative Learning: An instructional approach that uses groups working towards a common goal. Sometimes collaborative learning is used interchangeably with cooperative learning though this is a point of contention for some.

Facilitation: A student-centered instructional approach where instructors guide students to learn for themselves rather than direct instruction where knowledge is imparted.

Structure: Design decisions that make up a curriculum or a lesson. This includes the task, resources, and organization of the lesson before implementation begins.

Synchronous Communication: A communication format that occurs in real time. Communication can occur various forms from text, video, or voice.

Chapter 49
A Survey on the Use of Adaptive Learning Techniques Towards Learning Personalization

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ABSTRACT

E-learning has a great impact on learners today. E-learning supports enhancing learner knowledge anytime, anywhere with lesser efforts than traditional models. In these situations, nonlinear approaches often modify teaching and learning strategies according to students' needs, and hence, automated machine-guided approaches seem useful in the name of adaptive learning. It identifies individual learner styles and provides the most suitable strategy that fits each learner as a case of personalization. Adaptive learning uses personalization for continuously improving student outcomes. Personalized learning takes place when e-learning systems use educational experience supporting desires, objectives, endowments, and curiosities of each individual learner. This work has reviewed the recent developments in the problem area of learning personalization through adaptive learning. Then the solution domain methods are compared to identify the knowledge and technology gap from their limitations. These analyses help to identify research potentials in learning technology for future works.

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INTRODUCTION

Education systems are developing day by day to provide best learning experiences to the learners with proper knowledge acquisition. Various learning methods are used in modern education systems. Mobile learning is one of the popular learning methods nowadays. Mobile learning helps learners to learn by using hand held mobile devices like mobile phones, palmtops, tablets, laptops etc. Mobile learning facilitates learners to acquire learning resources from online educational hubs. Mobile learning allows learners to learn from any place as per their convenience without imposing any time bound to access the learning resources. Mobile learning can incorporate personalized learning methodology that aims to modify the learning process depending on each learner's strengths, requirements, abilities and interests. Personalized learning enables a learner to learn through a learning approach which is established on the facts that what the learner knows and how the learner learns the best. The major aspects of mobile learning are learner adaptation and device adaptation. Learner adaptation depends upon two factors such as knowledge level and learning style. On the other hand, device adaptation refers to the heterogeneities of learning device specifications (Huang et al.,2012). Adaptive learning method involves providing best suited learning contents to each learner through modifiable teaching-learning method as per the needs of each learner. E-learning is one of the contemporary techniques of learning where technology-enhanced learning (TEL) (Chatti et al.,2010) is used. E-learning provides an anytime-anywhere learning platform. Table 1 describes some of the prevailing educational systems and their characteristics.

Table 1. Characteristic features of some popular educational systems

Traditional offline learning System	Offline learning refers to the situation where the learning platform is not handled by any automated system. Hence the input set of data is static. Face to face classroom learning is an example of this type of learning system.
E-learning system	It refers to Electronic learning system where the learners learn through electronic devices and digital media.
Intelligent Learning System(ILE)	In this environment learners have the facility to solve his/her problem. One or more instructor can assist the learner and monitor learner's learning style and activity.
Adaptive learning system	It mostly focuses on learners' needs. Learning contents are modified according to learners' requirements.
Blended learning system(Graham,2006)	It is the combination of both traditional learning and E-learning. But the main focus is to monitor the learners and to improve their performances.

In a conventional classroom situation the instructor instructs numerous learners at the same point of time. In such a situation, individual learners are forced to learn from the same learning resource in a same learning manner. But it may not satisfy each learner's individual need. Hence, it is tremendously complicated for an instructor to resolve the best possible learning strategy for each individual learner in a class. Even if an instructor is capable of resolving all the strategies, it is extremely complicated to incorporate all of those strategies in a particular classroom. Abiding to the situation, it has to be understood that developing a learning model in this circumstances of traditional learning is quietly impossible (Essaid El Bachari et al.,2011). To overcome this deficiency, the escalating development of Recommender Systems (RSs) has facilitated learners to make appropriate decisions. The chief goal of e-commerce RSs is to afford a patron that helps individuals to decide their objectives. It also facilitates

in designing and developing E-learning environments. In order to provide each learner a proper effective educational environment, the following things are to be considered- identification of each learner's need, cognitive capability of each learner and learning style & motivational factors at the personal level of each individual learner. An automatic system is thus highly on demand which can decide by its own that what sort of learning resources are to be recommended for the learners suiting their individual learning needs and styles properly (Klašnja-Milićević et al.,2011). Studies show that numerous E-learning systems don't reflect each individual learner's discrepancy. To judge the needs of each learner varied yet distinct requirements like prior knowledge, enthusiasm and learning techniques are to be addressed. Adaptive learning objective offers an optimal path that fits learners' individual uniqueness that escalates the learners' developments. The personalized learning path provides flexibility and adaptability to the system (Ali et al.,2018). It is most important for learners to exploit those learning techniques that help them to learn more suitably. Adaptive learning system works in such a manner that individual students are purely benefited. Considering all the aspects, adaptive learning should be the focus area of any type of learner as this system prioritizes student outcomes. Also, adaptive learning system ensures continuous improvement of the system. Hence one of the most important criteria is collecting and analyzing feedbacks from each individual student which helps the adaptive learning system to be more effective and relevant (Shelle et al.,2018). Student modeling is a technology-based approach which enhances individual student engagement, motivation, and knowledge (Brusilovsky et al.,2016). TEL provide a closed environment to the learners which sustenance the learners to get a Personal Learning Environment(PLE) (Chatti et al.,2010). Personalized learning is a successful paradigm which combines teaching and technology. It also continuously adapts itself to fulfill each individual learner's need. It also enhances instructor and learner perspectives to a great extent (Nandigam et al.,2014).

BACKGROUND

Currently, enormous numbers of learning models are available in E-learning paradigm. Each of these models has their individual uniqueness. In this section, detailed review of some existing models has been presented prioritizing personalization within the scope of contemporary learning systems.

E-Learning System Based on Dynamic Individual Learners' Preferences

Personalization is a combination of the following steps:

1. Learners' background understanding.
2. Learners' choice based learning substances providing.
3. Approach of demonstration of the learning substances.

Student's psychology (Essaid El Bachari et al.,2011) is one of the most important aspects that helps to know each individual learner' s choice which in turn can improve each learner's performance. There are several learners' personalization models. One of these useful models is the Myers-Briggs Type Indicator's (MBTI) questionnaire (Myers,1993). MBTI focuses on learners' human behaviors which prefer personalities rather than measuring skills or capabilities. The most important dimensions for a learner's preferences are-

1. Where a learner prefers to focus his/her attention.
2. The most desired way for a learner to take learning information.
3. Learner's transaction with the external world.

The above dimensions help to infer the preferences of a learner. Preferences can be Extraversion (E) or Introversion (I), Sensing(S) or Intuition (N), Thinking (T) or Feeling (F), Judging (J) or Perceiving (P).

The combinations of the above preferences result in sixteen personality types like: ENFJ (Extroversion, Intuition, Feeling, and Judging) and others. These personality types focus on dominant and auxiliary preferences. The clarity levels associated with each personality type are very clear, clear, moderate and slight. But to design & develop a learning system structure supporting all these 16 personality types for each single course is very difficult & tedious task. According to Myers-Briggs Type Indicator (MBTI), there are four types of learners such as- i) Sensory Type(S1), ii) Intuitive Type(N1), iii) Feeling Type(F1) and iv) Thinking Type(T1). Architecture of the work discussed by Essaid El Bachari et al.,2011 is firstly divided into three elementary parts-

i. Domain Model: Domain Model contains course topics. Each course topic is included into some Chapter (CH). Chapters include different Concepts (C) and the lower level is Learning Objects (LOs).
ii. Learner Model: In this model, each learner's identity information like: name, age, educational level, languages etc. and individual preferences containing favorite world, information, decision and structure are studied.
iii. Pedagogical Model: This part represents teachers' knowledge. In this model, teachers can re-structure LOs according to the learning goals and also can change their strategies as needed. Adaptation of learners according to their needs is the prime focus area of the model.

Intelligent Tutoring System

Intelligent Tutoring System (ITS) (Sani,2014) supports personalization learning technique based on each learner's individual need. An ITS always delivers an immediate and effective solution to each learner's problem.

The basic components of an ITS are-

1. **Student Model (Whom to Teach):** It contains each individual learner's personal details, their learning styles and present knowledge status.
2. **Tutor/Pedagogical Model (how to Teach):** It chooses the correct teaching method for each individual learner to make them able to learn with proper understanding.
3. **Domain Model (What to Teach):** It contains knowledge of each individual domain.
4. **Interface Model:** It is an intermediate stage between the system and the learner.

In the following, various techniques of an ITS development are discussed-

1. **Bayesian Network:** A Bayesian Network is a type of statistical model that uses Bayesian inferences for probabilistic computations. It represents a set of variables and their conditional dependencies through a Directed Acyclic Graph (DAG).

2. **Fuzzy Logic:** Fuzzy logic is a multi-valued dependency technique. It deals with the values that can be any real number between 0 and 1. Fuzzy logic represents indistinctness and indefinite information.
3. **Collaborative Filtering:** Collaborating filtering is used to compare different methods of building a recommendation system. Memory based technique, Model based technique, Matrix Factorization technique, Clustering technique and Deep Learning technique are some of the widely used collaborative filtering techniques.
4. Data Mining: It is a process which finds patterns from a huge pre-existing database. It can also be described as analytical step to discover knowledge from database.
5. Artificial Neural Networks (ANNs): ANNs are composed of multiple nodes which work like the neurons of human brain. These nodes are connected via links which are associated with a weight. ANN nodes take input data, perform simple operations and generate outputs. Two types of mechanisms such as-Feed Forward and Feed Backward are used in ANNs.
6. Intelligent Agents: An Intelligent Agent is an autonomous system which performs actions to archive a formulated goal. Different AI techniques are used to make these agents more powerful.
7. Ontology: There has been a recent surge in the utilization of ontology to develop ITS. To specify the precise relationship and hierarchy between learner and their corresponding needs, researchers prioritize the use of this technology to resolve the problem of providing appropriate content to the learners.

A Personalized E-Learning System With Five Layer Based System Design

A personalized E-learning system with five layer based approach is presented by Lu et al.,2007. This system aims to provide E-learning services based on the preferences of the naive learners. Parameters of this system are based on the recommendations from the learners who are learning the course, the teachers who are teaching the learners and the experts who are competent in the domain of learning. It adheres to the following five layers to help predict the learning ability of each individual learner. The descriptions and the functionalities of different layers are given below-

1. **Database Layer:** It contains user account, course and user profile databases which help to know the basic information, learners' trajectory, course materials and their corresponding difficulties.
2. **Feedback Acquisition Layer:** This layer represents questionnaire, quiz, and behavior records. This layer assists to know learners' behaviors, abilities and preferences.
3. **Data Mining and Inference Layer:** It infers learning materials' difficulty levels and the learners' abilities.
4. **Recommend and Push Layer:** This layer facilitates to know learners' new abilities and also recommends appropriate course materials for individual learners.
5. **Presentation Layer:** It is the outermost layer which contains registration, login, searching and browsing interfaces for the learners.

The proposed technique has calculated difficulty parameters of the course materials dynamically and classified them into five difficulty levels such as-very hard, hard, moderate, easy, and very easy. Each difficulty level is defined as Dif_n where n=1 to 5, Dexp denotes the experts' decision about the difficulty level of a learning material. C_n denotes the number of experts who have decided the difficulty level of a

learning material to be Dif_n. Cexperts denotes the total number of experts. Dexp was calculated as per equation (1).

$$D\exp = \sum_{n=1}^{c_n} \frac{c_n}{c_{\exp erts}} Dif_n \tag{1}$$

Similarly, learners' and teachers' decisions regarding the difficulty level of a learning material are denoted by D_{stu} and D_{tea} respectively. C_m and C_k denotes the number of learners and teachers who have decided the difficulty level of a learning material to be Dif_n respectively. $C_{learners}$ and $C_{teachers}$ denotes the fixed number of learners and teachers respectively. D_{stu} and D_{tea} can be calculated as per equation (2) and (3) respectively.

$$D_{stu} = \sum_{m=1}^{5} \frac{C_m}{C_{learners}} Dif_m \tag{2}$$

$$D_{tea} = \sum_{j=1}^{5} \frac{C_j}{C_{teachers}} Dif_j \tag{3}$$

The adjusted difficulty (D) parameter of a certain material is calculated as per equation (4).

$$D = w1 \times D_{\exp} + w2 \times D_{tea} + (1 - w1 - w2) \times D_{stu} \tag{4}$$

Here, w1 and w2(0<1-w1-w2<w2<w1 <1) are the weights of the course difficulty parameters recommended by the experts and decided by the teachers.

Calculation of the Level of Learner Abilities

A set U is defined as U={time spent on each material, questionnaire feedback after each material, quiz feedback after each material, times clicking on antecedent material links, random mouse move and click}. Here, u_i,i = 1 to 5, denotes an element of U. The corresponding weights of the elements of U define a set W={w_i,i = 1 to 5}. Here, w_i,i = 1 to 5, represents the weight of u_i,i = 1 to 5. The assessment values of each u_i,i = 1 to 5, define the assessment set V={V_i,i = 1 to 5}. Here, V_i,i = 1 to 5, represents the assessment value of u_i,i = 1 to 5. The corresponding weights of the elements of V define a setA={a_i,i = 1 to 5}. Here, a_i,i = 1 to 5, represents the weight of V_i,i = 1 to 5. T_i represents a learner's browsing time on a specific material. $\overline{T}$ represents the average T_i value for n number of learners browsing a specific criteria and calculated as per equation (5).

$$\overline{T} = \frac{\sum_{i=1}^{n} T_i}{n} \tag{5}$$

Time range is calculated using bios time period b. Now, from the previous information, the system can calculate the ability of each individual learner(X) as per equation (6).

$$X = W \bullet v_X \tag{6}$$

In equation (6), W denotes the factor weight and v_X gives vector set result for each individual learner(X)

Personalized Learning Approach in E-Learning Environment

In last few years there has been a rapid change in the curriculum design process and also in the pedagogical methodology. The curriculum shows focus on the outcomes of each individual learner. Personalized learning is now a most advanced approach in education technology which deals with individual learner's need (Yi et al.,2017). Learners are the primary component of the learning system bearing specific individual traits of their own. Hence, for the construction of a learning model, the basic information of each learner and a measurement of the initial knowledge level of each learner are required. After gathering these information, in the next phase more detailed information (learning resources, learning behavior, learning data, intermediate testing) about each learner is considered and analyzed so that a better revised learning model can be developed to ensure continuous improvement in each individual learner's learning and performance. E-learning systems provide online learning environments to their learners. Thus, a personalized learning model incorporated in an E-learning environment deals with each learner's need in the online learning environment. So, learning motivation, learning ability assessment, resource recommendation, staged test, learning achievement test are the essential components of the personalized learning model based E-learning environments for learners' accomplishments.

A personalized learning system in an E-learning system comprises of the following major components-

1. **Learning Style:** Since personalized learning satisfies individual learner's need, each learner has the opportunity to choose his/her own learning style in the E-learning environment.
2. **Learning Prediction:** In this phase, comparison between the predicted result of each learner's performance evaluation and the corresponding expected result is made.
3. **Learning Intervention:** This approximation strategy is used to reduce the gap between the predicted and the expected result of each individual learner's performance evaluation to improve each learner's learning activity in the E-learning environment. Here, the appropriated analysis of learners is highly required to find the desired results.

Hybrid Recommendation System in Personalized Learning Environment

In this platform, the tutoring system incorporates different recommendation skills suggested by the learners as per their requirements. The major components of the automatic recommendation system discussed by Klašnja-Milićević et al.,2011.are-

1. **Learner System Interaction:** It comprises of-
    a. **Registration Form:** Used to collect the information regarding the learning styles of each individual learner from the survey conducted on learners.

b. **Course:** It contains- theory sessions, tutorials and tests.

2. **Offline Modeling:** In this module, each learner's goal is obtained from each individual learner's profile. Also, appropriate learning style of each learner is determined from the survey. Thereafter, the current status of the course, learner's affiliation and rating are provided by this module.
3. **Recommendation Engine:** It provides recommendation list which helps to modify the learner–system interaction process.

Learners can be categorized into different categories in view of learning styles depending on the four parameters. Table 2 shows the four parameters and the corresponding learner categories.

Table 2. Learner categories in view of learning styles depending on four parameters

Parameter	Learner Categories
Information Processing	Active and Reflective learners
Information Perception	Sensing and Intuitive learners
Information Reception	Visual and Verbal learners
Information Understanding	Sequential and Global learners

One of the most important aspects regarding the recommendation system architecture is to maintain and monitor the database of each individual learner's history properly. Learning activities of each learner are observed to obtain a sequence. A pattern is found in the activity sequence of different learners through a complicated process. This process is divided into five phases such as- Short Phase, Large Phase, Transformation Phase, Sequence Phase and the Maximal Phase. These phases help to know the learners' needs more specifically. After the completion of the learning activity from each learning material by each learner, each learner is evaluated to judge his/her acquired knowledge. After the evaluation, learners are given grades like: excellent, good, average or passing. In this recommendation system, a collaborative filtering provides a useful rating of an individual learner .This in turn increases the excellence of the Intelligent Tutoring System.

A Personalized Course Recommendation System

Another personalized E-learning system providing adaptive learning facilities is proposed by Chen et al.,2005. This proposed architecture comprises of two parts-

1. Communicating with learners (Front-end part).
2. Analyzing each learner's capability and accordingly delivering the appropriate study material to each learner (Back-end part).

In the following, the functional sketch of this system is depicted in step wise manner-

Step1: Gather learners' personal details. Accept a learner's query and search a suitable course for that learner.

Step 2: Identify the status of a learner from the user account database.
Step 3: Load the course selected by a learner from the user profile database.
Step 4: Select a suitable material from course database based on individual learner's ability.
Step 5: Display the recommended course to the learner and wait for the feedback from the learner.
Step 6: Feedback agent collects feedback responses of all learners.
Step 7: Evaluate the abilities of all the learners through the analysis of the learners' feedbacks given on the learners' selected courses.
Step 8: Modify the course parameters and the corresponding materials in the database.
Step 9: Rewrite the learner's present ability.
Step 10: Store the modified course materials into the course database.
Step 11: Check the ability of each learner for the recommended course again.
Step 12: Select course for each individual learner based on the learner's prior information.
Step 13: Store the course IDs of the already recommended courses to avoid redundancy in course recommendation.
Step 14: Interface agent can learn the recommended course materials from the display area.
Step 15: Learners proceed with learning in further with learning materials recommended by the system.

In this personalized learning environment, an individual learner's learning process is comprised of the following activities-At first, the system recognizes learner's category and accordingly classifies a learner as beginner or as an experienced user. Then, for each of the first time users, the system provides original course materials according to each individual learner's query. Thereafter, each learner learns the course and answers the assigned queries. According to the responses of each individual learner, the system re-evaluates each individual learner and generates appropriate course material.

In the above functional sketch of the system a pleasant learning environment is provided by a module called interface agent. A personalized agent encloses feedback agent and the course recommender agent to help individual learner. Since the learning environment focuses on individual needs, hence tuning the difficulty parameters of the course materials is one of the most important aspects of this learning environment.

Fuzzy Approach Based Personalized Learning System

Fuzzy logic supports multi-valued dependency. Fuzzy logic deals with values in the range of 0 to 1. It works with linguistic uncertainties by defining fuzzy rules to embed human thinking in a computer process. A fuzzy logic based personalized learning system to learn English language is proposed by Hsieh et al.,2012. This work has enhanced the abilities of the learners in an extensive learning environment and has used fuzzy logic approach for learners' feedback generation. These feedbacks help to calculate the Degree of Vocabulary Cognition (DV) in the article as per equation (7).

$$DV_{i,k}^{N} = DV_{i,k}^{O} + \frac{FB_{i,d}}{C}, \forall k \in A_d \tag{7}$$

where $DV_{i,k}^{N}$ is the new DV of word k for individual learner i after reading the article (A_d). $DV_{i,k}^{O}$ represents the old DV and $FB_{i,d}$ is the new feedback. C is a constant.

Feedback and DV help to calculate Memory Cycle (M_c) as per equation (8).

$$M_{Ct+1}^{i,w} = M_{Ct}^{i,w} + Fib_{t+1} \times DV_{i,w} \times \frac{\sum_{d=1}^{WT_t^{i,w}} FB_{i,d}}{WT_t^{i,w}} \tag{8}$$

$M_{Ct+1}^{i,w}$ in equation (8) denotes new memory cycle of a word w. Fib_{t+1} represents the Fibonacci sequence and $WT_t^{i,w}$ represents the number of recommended articles. Adapted fuzzy approach recommends articles as per learners' requirements. This effectively increases each learner's English learning capability.

Open Student Modeling Based Personalized Learning System

An Open Student Model (OSM) is more learner friendly than the traditional personalized learning model. OSM is a tool in which each learner has the ability to view and modify the state of his/her individual knowledge based on self-awareness and review of the status of self-learning. OSM provides surplus advantage to each learner by providing self-modification facilities to each learner. Open Social Student Model (OSSM) enriches the social impact by permitting the learners to reconnoiter each other's models. OSSM is almost similar to gamification which is broadly used in different games; but in educational aspect, it is similar to a leader board which gives opportunity to each learner to know the top performance and thereby allows each learner to compare his/her own performance with the top performance in the performance evaluation scenario. Mastery Grids (Brusilovsky et al.,2016) approach is used to assess the efficiencies of OSM and OSSM. The fact that can be found in the context of comparison between OSM and OSSM is that in OSM approach, only me is concerned whereas in OSSM, there are three concerning types like: me, me vs group and group. OSSM interface has an extraordinary engagement power. It motivates each learner to perform better so immensely that each weak learner tries hard to improve. This approach facilitates the creation of learners' groups. Through these groups, all the member learners can share and enhance their knowledge. This provides a very efficient visual implementation platform for knowledge distribution and improvement. MOOCs are the recent applications of the said approach.

FOCUS OF THE ARTICLE

In this chapter authors have focused on adaptive learning and mostly on personalization approaches. Personalization is something which targets individual learner requirements and tries to find their difficulties. It is a continuous process which can make constant improvement and involve the learners. Using different AI techniques authors have tried to enhance this personalization approach in an E-learning platform.

SOLUTIONS AND RECOMMENDATIONS

Different Approaches for Intelligent E-Learning System Development

E-learning is a learning technique which educates the learners by electronic means. Numerous approaches are used for developing personalization supported intelligent E-learning systems. Some of these approaches are claude based, some are ontology based, some are semantic network based, some are fuzzy logic based (Khodke et al.,2016), some are neuro fuzzy based and many more.

Table 3. Comparison between different approaches for developing personalization supported intelligent e-learning system

Approach	Perceptions Used	Learning System Name	Characteristics
Fuzzy logic technique used in Adaptive Teaching to aid computation(Chryasafiadi& Virvou,2012)	FuzKSD used to dynamically identify and update the domain knowledge of the learner using fuzzy cognitive maps.	FuzKSD	i) Focus on adaptive teaching and personalization. ii) Monitoring learners' performances. iii) Dynamic update of the model according to each learner's personal need.
Segregation of alike learners in Competitive Systems(Molina et al.,2011)	The system judges the notion of the students towards the concept of rivalry within learning processes. Factors like motivation and emotions towards the exam system are considered. These factors are used to make adaptive matches for those learners who share similar knowledge in this aspect.	Information System for Competition based on problem solving in Education (ISCARE)	i) Adaptive match making for the learners having identical knowledge. ii) Motivating learners having negative sentiment towards competition. iii) ISCARE uses AI algorithms for analyzing learners having same knowledge level. iv) It does not support elimination system.
Theory based inception and evaluation of learning styles(Williams & Seepersad,2012).	The existing models along with the parameters used for assessment have been discussed.	Felder Silver Learning model	i) Ambiguity handling.
Collaborative Intelligent Learning system(Khodke et al.,2016)	Relates knowledge from ViPS to enhance the construction and comparison for the learning of real pulleys	Virtual Physics System (ViPS)	i) Collaborative and intelligent system with focus on physics. ii) Virtual surroundings, simulation atmosphere. iii) Tracks each learner's behavior to solve the difficulties.
Experimental theory Model(Healey & Jenkins, 2000)		Kolb Model	i)This model is based on experimental learning theory and mostly used in higher education.
Behavioral theory Model(Duff, & Duffy, 2002).		Honey and Mumford Model	i) Focus on the behaviors of each individual learner in different situations. ii) It is extensively used in Management training and education
Gregorc Model(Terry, 2002)		Cognitive theory model	i) In this model, initially teachers present the idea of the content through presentations. Based on this, students perform gestures through assigned discussions, assignments, tests and projects. The entire learning process is dependent on motions exposed to the environment.
Felder–Silverman Model(Felder & Silverman, 1988)		Psychological theory model	i) It has similar property like behavioral theory based on insights from Kolb Model. ii) This model deals with the nuances of learning in the field of engineering education addressing its five prime categories.
Meta-learning theory model(Othman &Amiruddin, 2010).		Flemming VARK model	This model supports the fact that to understand and provide appropriate learning preferences to learners, several modalities of resource presentation is necessary. The natural instinct of the student to perceive information differs and accordingly his/her needs are to be catered to.
Carl and Myers Brigg Indicator Model(Egges et al.,2003)		Personality model	Learning based on personality measures through ðve mannerisms of the OCEAN model [Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism].
Intelligence theory model (Gardner,1992).		Howard Gardner	This model concentrated on the intelligence quotient (IQ) factor of learners. Based on seven modules of mind such as linguistic, musical, logical- mathematical, spatial, bodily-kinesthetic, interpersonal, interpersonal functioning.
Neuropsychological theory Model(Smillie et al.,2006)		Chris Jackson	This model focuses on functional revisions to the bio behavioral systems of reinforcement sensitivity theory(RST) .

As its name indicates, the 'experiential learning theory' affirms the importance of experiential activities such as fieldwork and laboratory sessions, however it does not prioritise those forms of learning. What is important is to systematically take the learner around each stage of the cycle, ensuring that effective links are made between each stage.

Analysis and Comparison of Solution Domain Methods

Table 4. Existing learning style model

Sl.No	Learning Style	Supporting Theory	Limitation of that style
1.	David Kolb model(Healey & Jenkins 2000).	Experimental learning theory	This experimental learner theory though encourages experimental activities like laboratory work along with theoretical sessions, but it does not promote these forms of learning.
2..	Gregorc model(Terry 2002).	Cognitive theory	For this learning model, educators should keep in mind that they do not typecast learners as per learning preferences and to handle inventory learning styles.
3.	Felder–Silverman Index of learning styles (Felder, & Silverman, 1988).	Psychological theory	Index of Learning Systems (ILS) is focused on two components such as- learning style and learning performance. But there are some major aspects like internal reliability, validity, inter –scale correlations which are still unaddressed.
4.	Carl Jung and Myers Briggs (Barbuto, 1997)	Personality theory	As personality is based on multi-level or hierarchical aspects comprising both primary and secondary level traits, this theory does not suffice this.
5.	Honey and Mumford model (Duff & Duffy 2002).	Behavioral theory	This model shows less consistency and rationality in huge data sets. Also the multi-dimensional characteristic framework faces invariance among groups of faculties.
6.	Flemming VARK model(Deborah et al., 2015).	Meta-learning theory	The main limitation of this method was its homogeneity and also the fact that it deals with same sample size. As the samples were collected from the same university, it was anticipated that the results could vary in case of varied inputs.
7.	Howard Gardner multiple Intelligence (Gardner 1992)	Intelligence theory	This work concentrated on seven mind modules but other possible mind aspects are to be explored with respect to learning model development.
8.	Dunn and Dunn model(Dunn, R. 1990)	Biological & Experimental theory	This model focuses on learning preferences which are classified into category such as environmental, emotional, physical and sociological. They are comprehensive to each other. So there is a possibility of considerable overlapping of their preferences.
9.	Chris Jackson(Smillie et al.,2006).	Neuro-psychological theory	More fundamental works are essential to define behaviors in RST so that this can enhance portray confidence in the psychometric measures.

FUTURE RESEARCH DIRECTIONS

Research Challenges

In this survey the authors have tried to utterly focus some of the personalized learning approaches in E-learning environment. Each of the models already been discussed in this chapter have shown a precise

idea in some specific research areas to fulfill the embedded challenges in those areas. These research activities obviously have enhanced some of the portions of the field of learning personalization. But a thorough analysis of these research works establishes the fact that these approaches are not enough to satisfy each individual learner's learning needs completely. In the following, some of the vital limitations of the existing models are listed:

1. In some of the existing models, focuses on each individual learner have been given. But no minute concentration is given to identify the prerequisites corresponding to each individual learner. These prerequisites differ from learner to learner and these variations are very vital to incorporate personalization aspects.
2. Each individual learner has his/her own focus area of learning and his/her own learning rate. So the assessment process should vary from one individual learner to another.
3. Since each individual has their own learning style, so the components of learning databases should also be increased according to learners' needs.
4. There are two main parts of a learning system. One is the learner and another is the instructor. It is very difficult to decide that to whom among the learners and the instructors, the highest priority should be given to take the suggestions from. In most of the cases instructor guidelines help learners to learn more efficiently and effectively, but sometimes learners' suggestions are also very vital for the modifications of teaching-learning process.
5. The modern learning systems are focusing on adaptive learning concept. In this regards, the task of measuring the continuous improvements for each individual learner with respect to various courses is also very difficult to accomplish.
6. Different models have focused on different parts of the learning system like: learners' behaviors, learners' feedbacks, experts' recommendations, learner assessment processes and many more, but a proper and systematic integration of these parts is very much needed to build a learning system gearing personalization aspects. Again, this integration is very difficult to implement.

RECOMMENDATION

Proposed Model

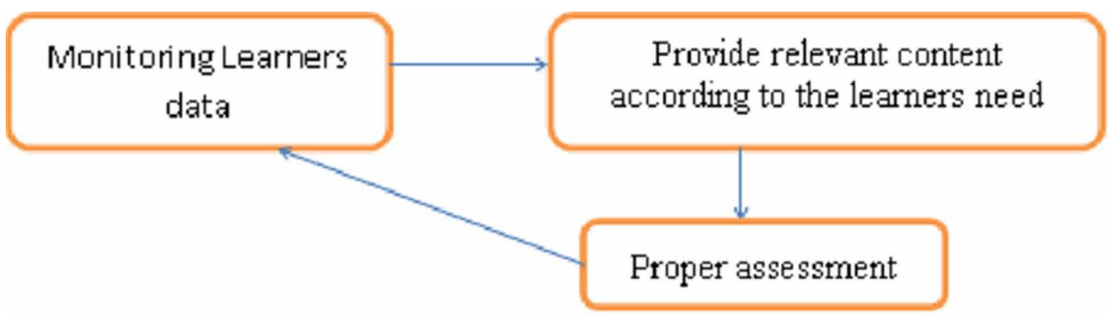
Personalized Learning is an utmost popular word in education technology. This is a learner centric process with an adequate number of approaches having different explanations. Currently most of the educators realize that personalized learning is essential now-a-days. Also this is gaining top priority among the learners. The fundamental task of an instructor is to make this unpretentious, evocative, and transformative. Since we are focusing on personalization approach there is an accountability to develop learner's overall improvement.

The proposed model consists of the three major components of learning system-

1. Properly handling and monitoring learners' data:
   a. Since we are focused on personalization, this part is very much essential to know each learner's behavior (learner's pre-requisite information) in the learning aspect.
   b. Mode of study can differ based on learners' needs.

   c. Continuous updating and corresponding expert opinion generation is required so that learners can find the proper track. AI approaches are used in these cases to help us developing an automated decision making system.
2. Appropriate and relevant learning content methodically being provided to the learners:
   a. The major component of this part is learner's requirement, content design approach and the expert opinion.
   b. This model will not only focus on learners' learning styles but also provides automated Competency–Based Education policy which will help the learners in global collaboration.
   c. Expert system will make learners future ready.
   d. Digital literacy is also considered so that each individual learner has the ability to share his/her own thought which can enhance the learning database.
   e. As there are three major components in this portion, we can use weighted fuzzy approach which will help us to generate rule according to each individual's need.
3. The proper and correct assessment needed for each individual learner after he/she learns the content:
   a. There are various types of learners and hence the technique for assessing learners should also differ from one learner to another. If a learner yearning for a technical degree prepares for a job, it shall be appropriate if the system assesses the learner through project based assessment. Assessment processes shall be customized as per personal and professional requirements.
   b. Innovative and creative assessment can also be done by the learners. Different learning style models can be utilized to do the same.

Figure 1. Fundamental Objective of our proposed personalized learning system

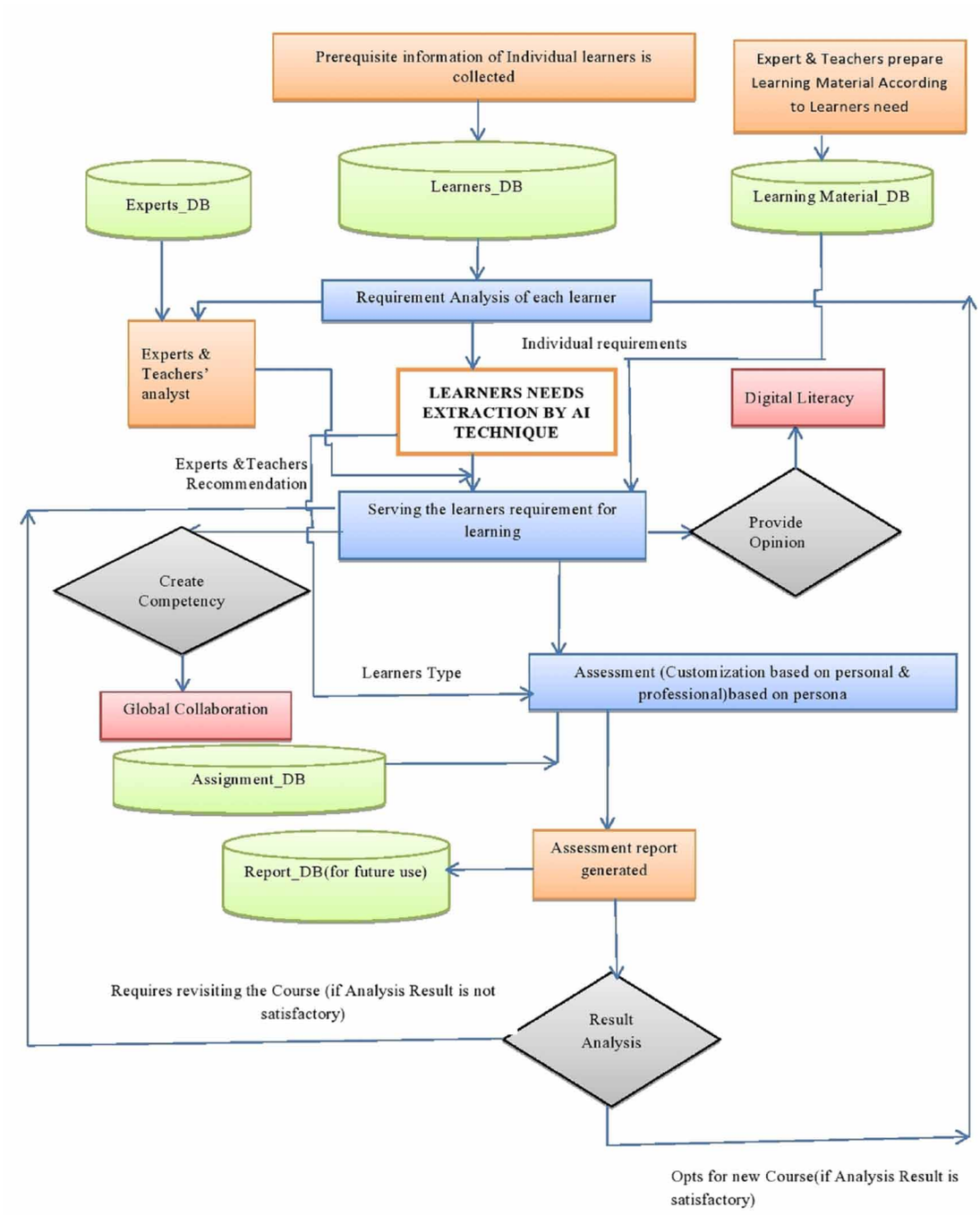


The above three steps are intended to function in a circular way so that the learning database updating, content enhancement and various types of assessments can take place for learners' benefits.

CONCLUSION

Adaptive learning methods in the E-learning environment help generating personalized learning experiences often found varying which maximizes student learning efficiency and at the same time educates learners using various methods and media objects. But as enormous amount of heterogeneous learning resources are generated on the web on daily basis, it is not easy for the learners to choose appropriate

Figure 2. Schematic diagram of the proposed method



resources for their learning. In the first phase of this chapter, the authors have surveyed some of the existing learning models and adaptive learning approaches in E-learning. This survey has portrayed different ideas in different areas like: development of E-learning system which dynamically works for individual learning preference, intelligent tutoring system, personalized E-learning system, recommendation system in the field of personalization, hybrid recommendation system, open student modeling which focuses on personalization and implementations of different Artificial Intelligence (AI) techniques like fuzzy logic and other for learning model development. In the next phase, the authors have compared some of the existing approaches of intelligent E-learning system development. This comparison has revealed more analytical facts about different types of models, their strengths, weaknesses, usefulness and limitations. After going through all these phases the authors have found that there are existing models which focus some of the specific areas in the field of personalization. So, the authors have tried to incorporate the vital aspects of the surveyed models and recommend a system which will follow three steps such as: i) Monitor each individual learner's data: It will help to judge the learning needs of each individual learner more effectively. ii) Provide relevant and effective learning content according to the need of each individual learners: It is a very much known fact that learners are the major component of a learning system. But sometimes learners don't have the ability to take their own decisions properly regarding learning. This inability may be proved to be very costly for the learners in their futures. So in this proposed system, there is a scope for each individual learner to know the experts' opinion which can help each learner in decision making. iii) Proper assessment: Adaptive learning supports continuous improvement. Assessment results can judge each individual learner's performance and thereby be helpful to track each individual learner's improvement. After getting the results of the learners', the system analyzes those results and decides what learning content to be provided next to the learners. The above mentioned three steps will be executed in a circular path so that the learners have the scope of improvement in every phase. AI techniques will be incorporated to carry out the above mentioned steps automatically and fast without any manual human error. This incorporation can improve the quality of the learning model and also can help each individual learner by considering their personalization aspects.

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KEY TERMS AND DEFINITIONS

Adaptive Learning: Adaptive learning is an online educational system that scrutinizes each learner's performance in real time and revises learning techniques based on supportive data. It provides competent, effective, personalized learning paths to engage each student and also enhance personalization.

Artificial Intelligence (AI) Technique: Artificial intelligence (AI) is a branch of computer science that deals with making computers to mimic human behavior. AI techniques are those procedures which are used to enable computers to show human like intelligent activities such as visual perception, speech recognition, decision-making, natural language understanding etc.

E-Learning: E-learning is a learning platform where the learners utilize electronic technology to access learning curriculum. E-learning enhances learners' understanding by enabling the learners to learn from any place at any time with the use of internet.

Intelligent E-Learning System: Intelligent e-learning system is those e-learning systems which are embedded with AI techniques. These systems can perform intelligent learning activities like generating suggestions for each individual learner, modifying teaching-learning process as per each learner's needs, providing customized learning materials to learners etc.

Personalized Learning: Personalization is something that meets individual requirements. Personalized learning is a learning approach which customizes learning according to each learner's strengths, requirements, abilities and interests. It proposes pedagogy, curriculum, and mostly the learning environments that meet the individual learner's needs.

Student Modeling: Student modeling is an architectural representation of an Intelligent Learning Environment (ILE). The model focuses on student's understanding constructed through a student's interaction within an ILE. ILE familiarizes the student model accordingly and convey suitable learning path for the individual student.

Chapter 50
Different Shades of Virtual Learning Environments:
From Retrospective to Prospective

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ABSTRACT

The emergence of the internet has opened a wealth of new, network-based applications, from digital music stores to new venues for scholarly publishing. It has replaced the physical learning environments with virtual ones. The virtual learning environments are utilized for not only imparting informal but formal education as well. A collaborative virtual learning environment is a computer-based, distributed, virtual space or set of places. In such places, people can meet and interact with others, with agents, or with virtual objects. Collaborative virtual learning environment might vary in their representational richness from 3D graphical spaces, 2.5D, and 2D environments to text-based environments. In this milieu, the proposed study shall make an endeavor to time travel and identify various virtual learning systems, services, and tool that are being used and adopted by virtual learners. In addition, the study shall also anticipate the future virtual learning environments based on current trends and future requirements.

INTRODUCTION

The emergence of Internet and increased reliance on distance learning has opened a wealth of new, network-based applications, from digital music stores to new venues for scholarly publishing. It has replaced the physical learning environments with virtual one. The "learning" aspect is driven by activity and "virtual" referring to the technology that is brought to support the learning (Barajas & Owen, 2000; Tebb & Dee, 2003). According to Oxford University Press (2015), a virtual learning environment (VLE) is a system for delivering learning materials to students via the web. These systems include assessment and student

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tracking features, as well as collaboration and communication tools. The virtual learning environments are utilized for not only imparting informal but formal education as well. System which can be referred to as a Virtual Learning Environment can often be referred to as Learning Management System (LMS), Content Management System(CMS), Managed Learning Environment (MLE) and Learning Platform. Various institutions have developed e-learning systems which help educational programs cross borders of time and space. The value of a virtual learning environment is to fully bring out the characteristics of both 'Learning Any Where' and 'Learning Any Time', i.e., learning in an asynchronous way. Importantly, a virtual learning environment can support human-to-human communication by bringing people together and allowing them to communicate via the internet. This communication can utilize collaborative virtual environments (Cheng & Ye, 2010; Olguin, Delgado & Ricarte, 2000; Passerino & Santarosa, 2008). A collaborative virtual learning environment is a computer-based, distributed, virtual space or set of places. In such places, people can meet and interact with others, with agents or with virtual objects. Independent of time-limit or geographical limits, this way allows students exchange opinions and information by ICT (Information and Communication Technologies). Virtual learning environment systems can also help teachers to track individual students login span, performance and also act as a repository where learning materials can be made available for use (Demian & Morrice, 2015). Collaborative virtual learning environment might vary in their representational richness from text-based environments, 2D environments and 2.5D to 3D graphical spaces. Access to collaborative virtual learning environment is by no means limited to desktop devices, but might well include mobile or wearable devices, public kiosks, etc.(Churchill, Snowdon, & Munro, 2012). Virtual learning environment can be accessed via an online or computer-based system and examples include the following and more:

- Distance Learning Degree Programs
- Professional Certification Courses
- Instructional Videos
- Video or Audio Lectures
- Books, Articles, and Other Writings
- Podcasts
- Webinars
- High School or University Classes

In this paper authors deliver deep review of the developments of virtual environments for education, from informal learning to formal instruction, and current trends.

Objectives

1. To trace the time travel and identify various developments in the virtual learning environments till date.
2. To evaluate the current trends in it.
3. To anticipate its future, based on the past and current trends.

BACKGROUND

Consider the early use of the world-wide web in education as a corollary example at this point. Large scale adoption of web-based e-learning required the development of VLEs to support and simplify common management, instructional, learning, assessment and communication tasks used in e-learning (Cook 1999). The largest scale projects have been aimed at high school students— supporting selected curricula with virtual environments that task the students with solving carefully prepared game-based problems (Barab, Thomas, Dodge, Carteaux & Tuzan, 2005; Nelson & Ketelhut, 2007). Virtual worlds have been usually employed to replicate real world activities, and it has been reported that experiences in the virtual world have a similar effectiveness in terms of learning as in real world (Jarmon, L., Traphagan, T., Mayrath, M. & Trivedi, A., 2009). Virtual environments also allow the creation of learning activities that cannot take place in the real world, thus fostering experiential learning or "learning by doing" (Ellison & Matthews, 2010). VLEs have been reported effectively to support learning of large groups of students both within and across institutions (de Lange et al., 2003; Jefferies et al., 2003). In some virtual environments students are immersed in the virtual world, this provides and enhanced interactivity which would be very difficult in a traditional classroom and that makes the students become protagonists of the learning experience (Bailenson, et al., 2008). To fully benefit from all the described characteristics of the virtual worlds, the course contents must be active and designed following a pedagogical strategy that leverages the potential that virtual worlds offer (Jarmon, Traphagan, Mayrath & Trivedi, 2009).

FOCUS OF THE ARTICLE

Significant milestones in the genesis of VLE are discussed below

EARLY PHASES OF DEVELOPMENT (1960-80)

The first step in virtual learning environment emerged in 1960 with the development of PLATO (Programmed Logic for Automated Teaching Operations), a computer assisted instruction system developed at the University of Illinois at Urbana-Champaign in a project led by Dr. Donald Bitzer. The PLATO system featured multiple roles, including assigning of lessons to students and communicate with teachers through on-line notes/instructors, who could examine student progress, as well as communicate and take lessons themselves, and authors, who could do all of the above activities and in addition, they can create new lessons. There was also a fourth type of user, called a multiple, which was used for demonstrations of the PLATO system (Kraatz, 1984). After sometime, CATO (Compiler for Automatic Teaching Operations) - the first authoring system for developing lessons and courses on a computer system for PLATO was developed in 1964. CATO allowed the development of various forms of "teaching logic" for fields varying from mathematics to the behavioral sciences (Bitzer, Lyman & Easley, 1965). Meanwhile IBM introduced COURSEWRITER for the IBM 1500, an online interactive CAI (Computer Aided Instruction) system in 1965. The system included course management features and roles for the users such as instructor, manager, student, and allowed intercommunication among them (Buck, & Hunka, 1995). Eventually the government organizations also started to develop VLE and led to development of Telesecundaria in 1968 which was a system based on satellite TV for secondary students set up by the

Mexican Government in rural areas. Initially, over 6,500 students were served in 304 classrooms, each one equipped with a satellite dish and a black-and-white TV set (Klees, McAnany, & Mayo, 1975). In the same year, the MITRE Corporations begin development of their Time-shared, Interactive, Computer-Controlled, Information Television (TICCIT) system. It was described as a computer based system of instruction that provides low-cost, high quality education that was completely individualized (Rappaport & Olenbush, 1975). In meantime, R. Allen Avner and Paul Tenczar publish a manual for TUTOR, the authoring language of the PLATO system in 1969 (Denenberg, 1978).

In USA, a seven-year project called Project Solo or Soloworks was started in same year. The idea of "solo" was that the student was in charge of his or her own learning. However, the limitations of the approach were recognized and the group ended up proposing a "Community of Learning" model in 1976 (Dwyer, 1976). London and England developed the "Havering Computer Managed Learning System" in 1970. By 1980 it had been used by over 10,000 students and 100 teachers in applications that included science technology, remedial mathematics, career guidance and industrial training (Brahan, Henneker & Hlady, 1980). Ivan Illich (1971) described computer-based "learning webs" in his book Deschooling Society. Among the features of his proposed system are

- Reference Services to Educational Objects
- Skill Exchanges
- Peer-Matching
- Reference Services to Educators-at-Large

The Learning Research Group was formed at Xerox PARC (Palo Alto Research Center) in California during 1972. It was led by Alan Kay, who advanced the idea of a graphical user interface (GUI) by inventing icons for folders, menus and overlapping windows. Kay and his group envisioned a computer for teaching and learning that they called the "KiddiKomputer". Some educational uses of this computer anticipated during initial level of project included teaching thinking skills, teaching modeling through the simulation of systems, teaching interface skills and tracking what children would do with the computer outside school hours, when left to their own devices. Second level projects for teaching children with a computer included computer evaluation and iconic programming, especially for children under 8 (Buck & Gladden, n.d.). UK set up the National Development Program for Computer Assisted Learning in 1973 (Cooper, 1980). After two years during 1975, the University of Michigan developed a computer sharing operating system the Michigan Terminal System (MTS) that included a program called CONFER developed by Robert Parnes which gave it the capabilities of computer conferencing (Zinn, 1981). Edutech Project of Encinitas California (now Digital ChoreoGraphics) developed DOTTIE, a TV Set-Top device linking the home TV to online services such as CompuServ and the Source via a common household telephone (Pankaja, 2015). The use of satellites for educational teleconferencing and direct-to-home transmission was pioneered by the Canadian federal Department of Communications in 1977 with TVOntario (TVO). The experiment allowed students in California and Toronto to interact via electronic classrooms (Mowlana & Wilson, 1988). Pathlore started developing CBT (computer based training) solutions in 1978. Its PHOENIX software delivered "virtual classrooms" to many corporate networks (Hartley, 2000). British Telecom in 1979 claimed to provide the world's first public viewdata service through Prestel (press telephone) that was running on a cluster of minicomputers. Similar developments were under way in France (Teletel) and Canada (Telidon) (BT Archives, 2016). Success Maker K-12 learning management system was launched during 1980 in New York, that laid an emphasis on reading,

spelling and numeracy. The software was upgraded the to Success Maker version 5.5. in 1997 (Albany, 2018). During same year, TLM (The Learning Manager), originally called LMS (Learning Management System) was released. It had a sophisticated test bank capability and generated tests and practice activities based on a learning objective data structure (Weiss, Nolan, Hunsinger & Trifonas, 2006).

INTERMEDIATE PHASES OF DEVELOPMENT (1981-2000)

In 1981, University of Sussex, UK, implements Poplog, an interactive learning environment for Artificial Intelligence (AI) and computing students. It includes hyperlinked teaching materials, an extensible text editor, multiple programming languages and interactive demonstrations of AI programs (Sloman, 1989). During the same year, UK Open University developed an electronic whiteboard that provides voice conferencing combined with synchronous handwriting and real-time annotation of downloaded graphics called Cyclops which began its field trials in the East Midlands Region of the country and run for two years. Over this period the Open University was also developing its own viewdata (videotex) system, called OPTEL, for use in education (Bates, 2015). Computer Assisted Learning Center (CALC) was founded in 1982 as a small, offline computer-based, adult learning center that became origins of CALCampus (History of Distance Learning and Education Online—CALCampus, 2018). In the meantime, Hermann Maurer invents MUPID, an innovative videotex device later used widely in Austria (Videotex, 1982). In the same period, Carnegie Mellon University and IBM create the Information Technology Center which begins the Andrew Project at Carnegie Mellon. The main purpose of this project was to provide a platform for "computer-aided instruction" using a distributed workstation computing environment with authenticated access to both personal and public file spaces in a distributed file system, authoring tools for computer-based lessons and collaboration tools including bulletin boards and electronic messaging (Borenstein, 1996). Project Athena was initiated by MIT in 1983. This was a 5-year Institute wide experiment that was meant to explore innovative uses of computers for teaching (Cheung, Chow, Li, Koontz & Self, 1999). The Intercultural Learning Network created first online Learning Circle in 1984 by linking schools in Japan, Israel, Mexico, and California and Alaska in the U.S. This effort was funded by an Apple "wheels for the MInd" grant (Cohen & Miyake, 1986). In same year, Doner Caldwell at ComSubLant developed an e-learning program for use on all U.S. submarines to train crewmen at sea which ran on the Tektronix 4052A computer. The program utilized a lesson / test bank covering all submarine sonar publications on large format tape cartridge (Bruckner, 2015). Nova Southeastern University's Graduate School of Computer and Information Sciences became pioneers by accrediting graduate degrees through online courses in 1985 (Jones, 2018). During same period, Daniel V. Klein develops UOLT, a Unix-based On Line aid to Training. This system features presentation of on-line courses and individualized testing and grading (Klein, 1987). In 1986, interactive multimedia software called Intersystem Concepts, Inc. was founded by Steven Okonski and Gary Dickelman for the purposes of developing and bringing to market interactive software, primarily for education and training. It was the first attempt to bring streaming media to a virtual learning environment (History, n.d.). NKI Distance Education in Norway starts its first online distance education courses in 1987. The courses were provided through EKKO (Norwegian acronym for electronic combined education) that was NKI's self-developed Learning Management System (Paulsen, 2001; Rekkedal & Dye, 2007). Glenn Jones created a new system, called Mind Extension University in same period. In this system, telecourses could be provided across a network to various colleges and students can also interact with the

instructors and each other by using email sent over the internet (Almquist, 2011). Meanwhile, Gyrus Systems, a US-based training solutions software company was founded by Robert Dust that provides Learning Management Systems (LMS). It was capable of handling all instructor-led training, eLearning, virtual classrooms, social learning, training documentation, and more (History of Gyrus Systems, 2018). But the first large-scale use of computer conferencing in distance teaching came into existence in 1988 when the Open University UK launched DT200 Introduction to Information Technology, with 1000 students per year (Technological change in the 1980s, 2018). Question Mark introduces a DOS-based Assessment Management System in the same year while Windows-based version was introduced in 1993, and an internet version was introduced in 1995 (Wilson, 2016). A pilot project was launched by Peter Copen in same period called the New York State/Moscow Schools Telecommunications Project to demonstrate that students can learn better through direct interaction online and will become global citizens. Initially, 12 schools of New York State were linked through this project. This pilot project later became iEARN (International Education and Resource Network) (History – iEARN, 2018). Online Learning Circles was developed from the Intercultural Learning Network during same time phase. It was one of the first networks that connected classrooms from around the world in groups of 8-10 classrooms around themes. It was offered on the AT&T Learning Network (Riel, 1990). A world of Virtual Learning changed with a proposal of Tim Berners-Lee for an in-house online document sharing system in 1988, which he described as a "web of notes with links". After the approval of proposal, he called the new system the World Wide Web (Berners-Lee, 1989). Lancaster University (UK) launched the MSc in Information Technology and Learning in 1989 which is now the world's longest continually running Masters programme taught using virtual learning methods (Goodyear, 2005). Networked Educational Online System (NEOS) was developed and deployed at MIT at same period. The system provided coursework exchange between different roles allowing for grading, annotating, and public discussions (Williams, Cattey, French, & Lewis, 1990). Dr. John Sperling and Terri Hedegaard Bishop begin the University of Phoenix Online campus during same period. It was the first private university venture to deliver complete academic degree programs (Master's and bachelor's degrees) and services to a mass audience via asynchronous online technologies (Garten & Hedegaard, 1993). In 1991, the Smart Board was introduced that offers an information space that allows students to engage in active collaboration. According to Johnson-Eilola, "Smart Board system provides a 72-inch, rear projection, touch screen, intelligent whiteboard surface for work" (Johnson-Eilola, 2002). Gyrus Systems introduced Training Administrator in 1992 as the first comprehensive training management software to work in a Windows environment that automate course and schedules, training budgets, resource management, reporting, and mapping training to job function (History of Gyrus Systems, 2018). After one year, Reda Athanasios co-founded Convene International (first to market education via the Internet) and University of Phoenix Online program (Reda Athanasios - AngelList, 2018; Learning Technology Partners, 2018). TeleEducation NB, a provincial distance learning network in the Canadian province of New Brunswick implemented a primitive DOS-based learning management system in 1994, designed by Rory McGreal (McGreal, 2014). A group at Oregon State University developed InterQuest (a database-driven system that added quizzing, grading, and other functionality to web pages) and CalculusQuest, an online calculus course in 1995(Bogley, Dorbolo, Robson, & Sechrest, 1996). Steve Molyneux at University of Wolverhampton in the UK develops WOLF (Wolverhampton Online Learning Framework) one of the first e-Learning environments in the UK in same year (O'Donoghue & Fleetham, 2000). Murray Goldberg at University of British Columbia developed WebCT (World Wide Web Course Tool) in 1996. It provides an interface that facilitates course construction as well as a set of educational and administrative

tools. These tools include student management and access control, grade storage and distribution, a conferencing system, a chat area, electronic mail, group presentation areas, student self evaluation, online quizzes, student progress tracking, course content searching and more (Goldberg, Salari, & Swoboda, 1996; Goldberg, 1997). The "Interactive Learning Network" ILN 1.5 was developed in 1997 that was the first e-learning system of its kind to leverage an install on top of a relational database MySqL. It was installed at several academic institutions including Cornell University, Yale Medical School and University of Pittsburgh (Gilfus & Cane, 1998). While Steven Narmontas during the same period, introduced a small group of faculty members of Western New England College to a software system that worked on as a spare time project. Named as "The Manhattan Project", because it was largely developed in secret, the software enabled teachers to post files to a website for their students to read (O'Donoghue, 2012). Blackboard Inc (a software company that provides learning tools for high school and university classrooms) was founded by Michael Chasen and Matt Pitinsky in Washington, DC during the same time phase. Blackboard LLC was contracted to the IMS Global Learning Consortium, a worldwide non-profit organization within the National Learning Infrastructure Initiative of Educause (Jafari & Sheehan, 2003). Ian D. Thompson at the University of Strathclyde creates version one of the SPIDER VLE (virtual learning environment) system for the School of Pharmacy in 1998 (Timeline - SPIDER help, 2010). Similar initiatives was taken in 1999 by Ian Reid at the University of South Australia who created version one of UniSAnet, its in-house virtual learning environment and John Baker (entrepreneur) a student at the University of Waterloo creates version one of Desire2Learn learning system for faculty in engineering (Reid, 2001; Rogers, 2014). Blackboard Inc. acquires its competitor MadDuck Technologies LLC, developers of "Web Course in a Box" in 2000 and as such emerged as leaders in this field (Bradford, Porciello, Balkon, & Backus, 2007). Cyber Learning Labs, Inc. was founded in July, 2000 and its primary product, the ANGEL Learning Management System (LMS) evolved from research at Indiana University-Purdue University Indianapolis (IUPUI). The company later changed its name to ANGEL Learning, Inc. (ANGEL Learning -- Profile, 2018).

RECENT PHASES OF DEVELOPMENT (2001-2017)

CourseWork Version I (CW), a full-featured course management system, was developed at Stanford University's Academic Computing during 2001. CW supported multiple courses allowing multiple roles for users. CW's consisted of a set of tools for authoring and distributing course websites that incluced: a course homepage, announcements, syllabus, schedule, course materials, assignments, gradebook and asynchronous discussion (Pankaja, 2015). Murray Goldberg (founder of WebCT) and others start a company called Silicon Chalk in same period. Silicon Chalk builds software for the classroom to be used in laptop learning environments. Examples of features include presentation and audio beaming to student laptops, student note taking, student polling, student questions, control of student applications, recording of entire lecture experience for archiving, searching and later replay, etc. (Stephen, 2013). The open source systems came into existence in virtual learning in 2002, when Martin Dougiamas released version 1.0 of Moodle as an open source system to the world. Within months Moodle was being used around the world (About - Moodle, 2018). LogiCampus also released its first open source edition in on sourceforge.net in 2003 (History of virtual learning environments, 2018). Meanwhile, Second Life (SL)- a three dimensional virtual world was developed by Linden Lab and accessible via the Internet. SL is one of the most popular virtual social worlds with a population of millions of residents worldwide today

(Alenezi & Shahi, 2015). The Sakai Project was founded by various universities including University of Michigan, Indiana University, MIT, Stanford University, University of California, etc. in 2004, to develop an open source Collaboration and Learning Environment for the needs of higher education. The java-based Sakai project became freely available in March, 2005(About – Sakai, 2018). Three projects were launched by the European Foundation for Quality in E-learning (EFQUEL) in 2004 viz, EQO (European Quality Observatory), SEEL (Supporting Excellence in eLearning) and SEEQUEL (Sustainable Environment for the Evaluation of Quality in eLearning) at Online Educa Berlin (European Foundation for Quality in E-learning - Researching Virtual Initiatives in Education, 2018). Another step taken is same year for maintaining quality of e-learning was taken by EADTU (European Association of Distance Teaching Universities) launched the "Excellence" project, with the support of the eLearning Program of the European Commission (DG Education and Culture), that set a standard for quality in e-learning. The project is a co-operation between 13 significant partners in the European scene of higher education e-learning together with quality assessment and accreditation (Ossiannilsson & Landgren, 2012). Blackboard was granted AU 780938B in 2005 based on their international patent application filed in 2000. The granted claims are similar to the claims later granted in the US (Bruckner, 2015). Blackboard also filed patent 7,493,396, in same year, requiring that a single user be allowed to have multiple roles, and that the list of course links provided after login vary depending on the user's role for each course (Bruckner, 2015). In 2005, O'Reilly Media purchases Useractive, inc. and starts O'Reilly Learning (which eventually become The O'Reilly School of Technology), which creates online learning courses in programming and system administration skills. This enterprise is the first full-scale effort to expand the use of the user active constructivist model of learning on the internet (Gray, n.d.). Meanwhile, NACON Consulting, LLC also pioneered its distance education system, "VirtualOnDemand", designed to train users on real software using virtual machines, with the only user component needed being a web browser. The Army initiates a pilot program and uses this system to train IT support personnel in various network security software (Bruckner, 2015). During this period, Boston University also launched the first online doctoral program in music education while WebCT merged with the Blackboard Company. Both WebCT and Blackboard VLEs continue to exist as separate software (Carr & Connaughton, 2006; Lederman, 2005). Blackboard is granted US patent 6988138 in 2006 relating to "Internet-based education support systems claiming priority from its provisional patent application of 30 June 1999 (among others). The claims require that a series of educational courses stored on a server be accessible by different users from different computers (Blackboard's US Patent 6988138 seems to cover most of the "commodity" features of a learning environment, 2006).Blackboard announced via press release "The Blackboard Patent Pledge" in 2007. In this pledge to the open source and do-it-yourself course management community, the company vows to forever refrain from asserting its patent rights against open-source developers, except where it is deemed necessary (Nagel, 2007). During same year, Michigan Virtual University launches a learning management system from Meridian Knowledge Solutions to deliver training to 150,000 Michigan public-school teachers and administrators and foster collaboration among these learners via online collaboration spaces (Michigan Virtual University Chooses Meridian Knowledge Solutions to Provide New Learning Management System, 2007). Epignosis also released its web2.0 virtual learning environment (eFront) as Open-Source software (Pankaja, 2015). In 2010, Public release of Chamilo open-source VLE, which is a fork of Dokeos and OLAT 7. New features OLAT 7 are the implementation of important standards like REST API, IMS Global Basic LTI, IMS QTI 2.1 (Warnier, 2017; Evolution of Education Software - Edsys, 2014). Comcept Pvt Ltd Releases Teletaleem a Live Classroom service in 2011(Evolution of Education Software - Edsys, 2014). Blackboard Inc. continued

its success story and acquired two companies in 2012, Moodlerooms (that was a major open-source support provider in North America) and NetSpot (which serves a similar role for Moodle users in Australia). Blackboard also joined the open access movement by developing an "Open Services Support Group" which was aimed at selling support services to colleges that use free, open-source LMS (Blackboard's Open-Source Pivot, 2012). Moodle became the most popular Learning Management System in the world in 2015, with the most number of users worldwide. Moodle launched its SaaS based product offering – MoodleCloud, the cloud-hosted solution for learning environment (About - Moodle, 2018). Kannu was released in 2015 by Kadenze, Inc., a virtual learning environment for Art, Music and Design schools (Siu, 2016). Moodle collaborated with Edu Labs as Partner in 2016, making it the second certified Partner in Colombia. Together, both organisations provided certified Moodle services and assists education institutions - such as schools, universities, colleges - and businesses to develop and use a world class learning management system. Moodle reaches over 100 million registered users across every country in the world (Moodle and Edu Labs Partner to Deliver World-Class Online Learning in Colombia, 2016; About - Moodle, 2018;). Many universities chose Blackboard Learn during 2016, the company's flagship learning management system (LMS), as their preferred method to deliver a rich learning environment for students. One example of a new large client is the North Dakota University System, which serves over 47,000 students. Blackboard is also transitioning clients to the cloud while simultaneously remaining committed to its self-hosted and managed hosted deployment options (Blackboard Delivers Worldwide Growth,2017). Moodle announced investment partnership with Education for The Many and starts to accelerate their five key growth projects in 2017 viz, improving Moodle core, Learn Moodle curriculum, MoodleNet, Moodle Foundation (and opening an office in Barcelona) and expanding their Services & Partnership program (About - Moodle, 2018).

FUTURE RESEARCH DIRECTIONS

3D VLEs have brought a new concept of social interaction which can be researched in future. The role of the user in the use of VLE is another aspect for future research, where one can try to answer what factors influence users (professors/students) perceptions in accepting or not accepting VLE system.

CONCLUSION

With the rapid change in all types of working environment, the need had emerged for such system in which learner can control his learning activities according to his own individual characteristics, thus leading to emergence of VLE. VLE has potentially eliminated the barriers of distance while providing increased convenience, flexibility, currency of material, student retention, individualized learning and feedback. PCs were main tool of VLE during early development period but with advent of World Wide Web (WWW) the whole scenario changed. Over time, a number of projects were established for VLE which started from using text-based virtual worlds to digital virtual world for supporting student, teacher or workplace community development and knowledge sharing or for use in teaching subjects. Large scale adoption of web-based e-learning led to the development of VLEs and as such these can now support instructional, learning, assessment and communication task. While digital virtual worlds have been used in education for a number of years, the advances in the capabilities and spread of technology have led

to development of 2D, 2.5D and 3D VLEs. The 3D VLE were generally designed as learning support, simulation, social interaction, and game environments. 3D settings can afford multi-user discourse options for geographically distant learners. It can be useful asset for student learning and collaboration.

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KEY TERMS AND DEFINITIONS

CMS: These are data repositories that simplify the creation and administration of online content. It may contain authoring, sequencing, and content aggregation tools for fulfilling its objectives.

E-Learning: It is learning by utilizing electronic technologies to access educational curriculum outside of a traditional classroom. Usually, it refers to a course, program or degree delivered completely online.

Learning Environments: A place and setting where learning occurs, it is not limited to a physical classroom and includes the characteristics of the setting. The idea of environment invites a wider range of participants, for example, administrators of various levels and functions, faculty, guest experts, librarians, IT staff, instructional designers, and learning theorists and researchers.

LCMS: A complex piece of software that labels learning objects then organizes and delivers them in infinite combinations. It allows online content to be stored, managed, and reused through integrated database functionality.

LMS: A software application used to simplify the administration of learning/training programs within an organization. It helps an organization to target, deliver, track, analyze, and report on.

Videotex: It refers to various computer-based interactive systems that electronically deliver text, numbers and graphics via telephone lines, two-way cable, computer networks, or any combination of the three, for display on a television set, personal computer, etc. Every interactive online system that has existed, including the Internet, falls under the videotex umbrella.

Virtual Learning Environment: An online system that allows education materials to be transmitted through the internet to transfer knowledge from organization to employee, or teacher to student.

Chapter 51
An Effective Pedagogy Toolkit for Learning in an Intelligent Virtual Environment

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ABSTRACT

Throughout the progression of the pedagogy, educators are striving hard to bring up the systems centering on effective learning. This omnipresent trend has led to the ontogeny of innovative and culmination of many congregation technologies such as virtual reality (VR), artificial intelligence (AI), and natural language processing (NLP) ensuing as intelligent virtual learning environment (IVLE). Technology-enhanced encyclopedism can facilitate pupils with influential and high-quality learning experiences as compared to the traditional learning approach. This chapter portrays learning in intelligent virtual environment as an effective pedagogy approach. The pedagogic tool developed by the authors captures text written in English as an input and creates the envisioned virtual setting. The ability of natural language interface (NLI) for VR-based learning systems is the most significant attainment of the present work, which brings a novel perspective in the field pedagogy.

INTRODUCTION: INTELLIGENT VIRTUAL LEARNING ENVIRONMENT

The formal notion of the Intelligent Virtual Learning Environment (IVLE) as per the reported research divulges the uniting of Artificial Intelligence and Virtual Reality for technology enhanced learning. Technology-enhanced learning which has become a reality with the pervasive penetration of Information and Communication Technology (ICT) in almost all the walks of higher learning is by now not a new concept, but is still quite new in many educational institutions and settings. The simulation itself is not sufficient to ensure effectiveness in pedagogy. This explores the need for more advanced technologies

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in edict to improve learning (Kamath & Kamat, 2015). Technology can be an influential tool for transforming learning. The outgrowth of diverse areas such Computer-Assisted Learning, Mobile-Assisted Learning, and Technology-Enhanced Learning are warmly welcomed the application of technology in pedagogy (Rahimi et al., 2014). Thus the education and technology are seemingly interconnected. Moreover, intermingle of VR and AI technology has unwrapped new possibilities for education (Lugrin et. al., 2006). The virtual learning environments support learning effectiveness through the intelligent behavior and functional richness. In order to assimilate smart learning environments into the educational systems, new pedagogical approaches and innovations need to be implemented. Pedagogic experts believe that merely theoretical explanation without actual implementation makes learning experience invaluable. Instead of listening only to lectures, if students get real experience in a virtual wrapper can achieve the learning outcomes. In this context, the VR technology has found numerous applications in the field of education (Kamath & Kamat, 2018). It provides a visually appealing technique for presentation of teaching material. It motivates student community by encouraging active participation rather than passivity.

The proposed learning model presented here is an amalgamation of VR and AI. The combination of these two diverse domains creates a successful synergy effect, where different entities cooperate advantageously for effective pedagogical outcome. The evolution of the intelligent virtual environment from the simulation and animation techniques explicated through NLI for VR based learning is attributed to progression in pedagogy using sophisticated technology and thereby a tightly coupled interwoven association has seen emerging between the Education and Technology. This chapter presents the design and development of pedagogical toolkit that provides natural language interface for VR based learning system. The main challenge of VR technology is the costs coupled which have been expensive for educational institutes. With an aim bring down the cost, authors propose an amalgamation of natural language interface, inexpensive hardware and simple-to-use software, through which students can enjoy the excitement of learning through the eye-popping three-dimensional (3D) visualizations. This chapter elaborates how educational system based on virtual reality and natural language processing can accomplish creative learning without using sophisticated tools. The aforesaid convergence bridges the gap between pedagogy and technologies. The prime objective of the research presented here is to report the development of an IVLE tool for VR based learning. This toolkit is a text driven system to visually simulate the modeled operation in virtual space. The toolkit presented in this chapter is developed in Visual C Plus Plus (VC++) using OpenGL.

The rest of the chapter is organized as follows: After introducing the theme, the progression in from simulation, virtual reality to IVLE has been explained. A short theoretical retainer of amalgamation of NLP and VR for augmenting pedagogy is presented in third section. Sections four and five elaborate the framework of pedagogy toolkit and its implementation details with results. Conclusion at the end reveals the suitability of the VR based intelligent learning environment for pedagogy.

BACKGROUND: PROGRESSION IN PEDAGOGY FROM SIMULATION, VIRTUAL REALITY TO IVLE

Progress in technologies has changed traditional methods of teaching. With the emerging digital age, there has been passionate discussion all over the globe, about the use of technology in pedagogy. An interesting account of all these developments at the global level has been summarized in this section. Second Life is a virtual world environs emerging convergence of technologies (Jarmon, 2008). Educators

can create virtual classrooms, share VR teaching strategies, and design virtual research projects with the help of capabilities in 3-D Virtual World of Second Life. Author has highlighted intermediary issues in the paradigm shift to virtual learning environments. Learning by simulation is an effective pedagogical approach for students in a traditional learning environment (Dongale et al., 2015) and demonstrated improvement in learning outcomes of academically less-prepared students by incorporating an innovative practical computer-based simulation of a complex nano device. The students are fascinated by cutting-edge technologies like virtual reality, and it has many prospective uses in education (Kamath & Kamat, 2011). Based on the learning through VR, authors described the development of less expensive three dimensional visualization techniques for mechanical engineering students. Authors have reported the issues and limitations regarding VR based learning environment (Rahimi et al., 2014). The survey conducted in Iranian classroom revealed that Iranian teachers were passionate about VR based teaching tool in their classrooms. However at the same time they also felt concern in adopting the new technologies, especially virtual environment tools. Be that as it may, computer based visualization techniques are especially valuable for developing high-performance products (Kamath & Kamat, 2012a; Kamath & Kamat, 2012b). These researches achieved the exploration in light of VR visualization suite that exhibits how a low end, inexpensive VR technique can be used as an instantaneous gambit to generate many of the same effects as high-end viewing.

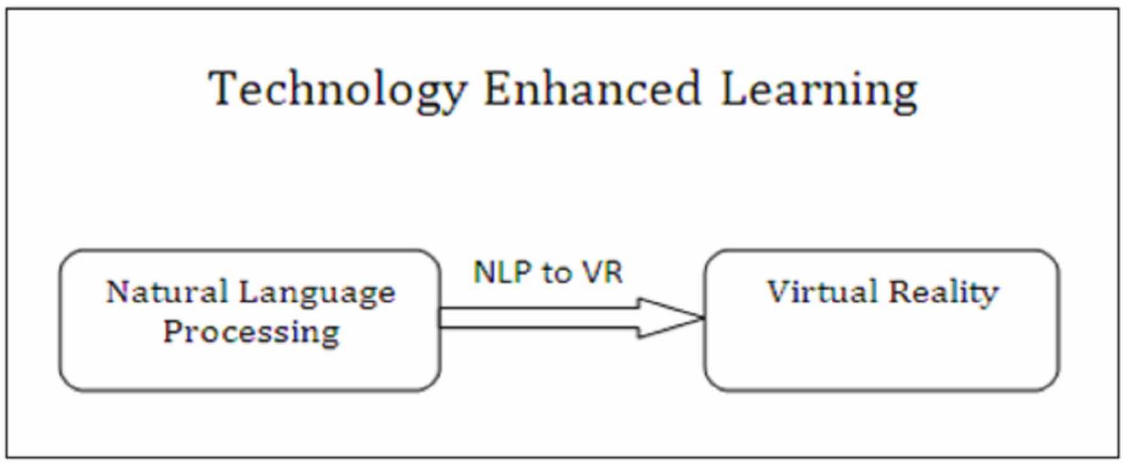
In this way, learning in virtual environment can extensively enhance the proficiency by permitting learner to apply hypothetical information to true issues (Kamath et al., 2012). Kamath et al. have actualized a virtual reality instrument as a quality expansion to the structural promoting so as to train learner's capacity to conceptualize hypothetical perspectives in a three-dimensional space. Further Kamath has presented the prospect of natural language interface to a virtual reality framework (Kamath, 2013). The learner inquires were communicated in normal dialect for which computer system produces relating virtual world. Yet another paper addresses the procedure of regular dialect based learning and its suggestion in the training (Alhawiti, 2014). The study highlights the usage of NLP with exploratory computer projects to improve the procedure of instruction. An immersive virtual learning environment is one incarnation of pedagogical change that underwrites impact of virtual world in educating and learning (Bronack et al., 2008). The authors have portrayed this methodology as 'Presence Pedagogy' a method for instructing and learning, serves as the impetus for social constructivist learning in a virtual world. Virtual media with technologically bolstered teaching method offers imaginative open doors which has reaped noticeable participation, satisfaction and hence achievement from students (Saleeb & Dafoulas, 2013).

In nutshell, learning in intelligent virtual environment is a rising outlook change of instructive advances (Kamath and Kamat, 2013). In the backdrop of the scholarly research presented above, researchers report a new pedagogical paradigm that underscores on creating enthusiasm in learning by the outline of man-machine learning interface. In this proposed system, NLP transforms natural language sentence into a series of commands for the construction of virtual reality environment. The programming suite presented in this paper is embodying intelligent virtual environment that offers natural language interface for virtual reality system. This learning tool empowers the learners to amalgamate with the virtual reality system in request to envisage scenario in the most common way.

INTEGRATION OF NLP AND VR FOR AUGMENTING PEDAGOGY

IVLE toolbox depicted in this paper legitimizes the abilities of joining of innovations as a successful methodology in instructional method which go on similar lines reported earlier in the literature (Everett et. al., 1999). Conceptual model of this toolbox is appeared in figure 1. NLP is an elating field of inter disciplinary Computer Science Research. It gives hypothetical grounds to help with the procedure of creating systems and compelling methodologies for utilizing so as to give help with the exploratory learning the powerful speculations and methodologies. It is the computerized approach to analyzing text that is based on both a set of theories and a set of technologies (Kamath et al., 2015). Natural language analysis requires a way to reformulate grammar rules. VR in this framework achieves an experience of immersion in the computer-generated world. Promoting the user's ability to communicate in natural language in the VR paradigm has been in the forefront for quite some time and the same has served as the motivation of the present work.

Figure 1. Conceptual view of pedagogical toolkit

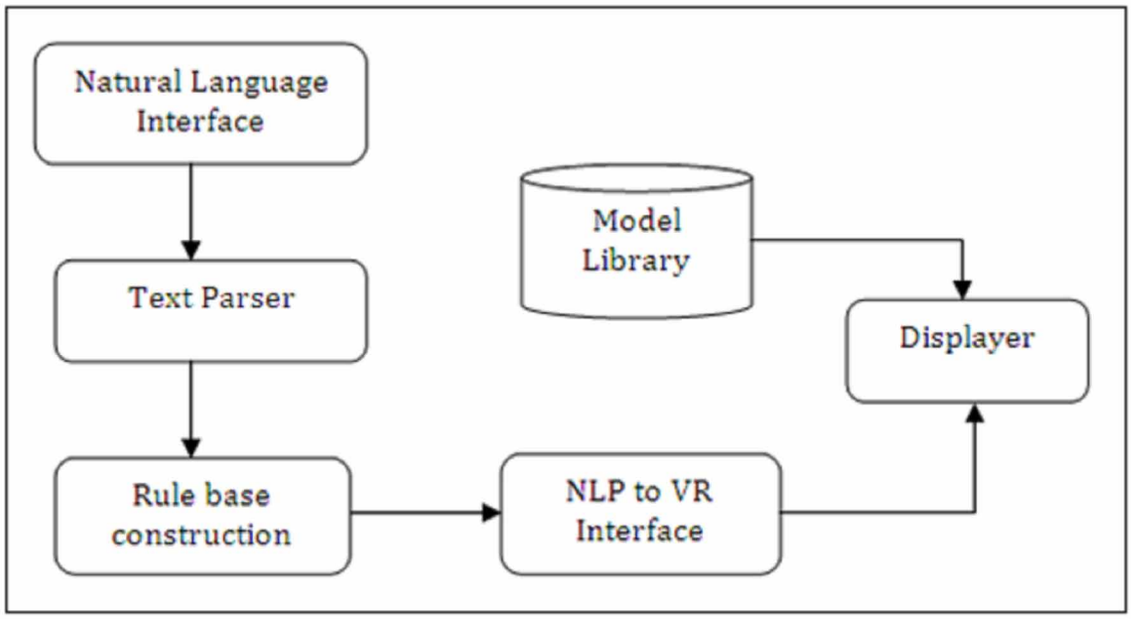


The purpose of the present research is to demonstrate and explore some of the capabilities of a natural language interface to a VR system. IVLE demonstrates the use of a VR based learning for practical experience of real industrial scenario. Authors have designed and developed this new pedagogy tool which acts as an interface for Computer Aided Design (CAD) models. This interface is able to represent complex datasets in virtual environment. Following section presents the details of the toolkit.

IVLE: PEDAGOGY TOOLKIT FRAMEWORK

Present section elaborates the framework and implementation details of pedagogy toolkit. The learning interface consents statements in natural language and directs details for processing and renders desired scenario. Figure 2 demonstrates framework of learning in this intelligent virtual environment.

Figure 2. Design framework of pedagogical toolkit



The natural language interface transforms an inputted sentence which is in natural language into a series of actions for the construction of virtual reality scene. The natural language processing is based on a finite state transition network. Figure 3 gives partial structure of grammar designed and processed by NLP. The grammar pattern extracted by the text parser is processed by a module which constructs rule base for inputted information. Pre-created CAD models in ASCII format are maintained as model library. A displayer module integrates action set forwarded by NLP and corresponding object from model library for the display of desired virtual environment.

This pedagogical toolkit comprises following modules:

1. Natural language interface: this module receives inputs in the form of natural language that is English. The details of virtual scene inputted by the user.
2. Text parser: this module accepts sequence of words in a natural language as input and extracts relevant information. While parsing it gathers features related to objects and further passed as rule base for processing. Then text parser is designed by creating an application explicit dictionary and lexical semantics. Figure 4 shows partial structure of knowledge base maintained by text parser.
3. Rule base construction: this module takes care of constructing rules that denotes the actions required to be performed by renderer for the desired display. Rules are created as per the order inputted by the user.
4. Model library: it is a repository for set of CAD models that are in ASCII formats. These CAD models in ASCII format are taken from CAD software in order to provide the display backdrop.
5. NLP to VR interface: this component takes care of furthering the extracted details from the inputted scenario to the creation of final virtual scene.

6. Displayer: this module transforms user inputted textual details of model in to pictorial mode with relevant attributes. The scene-graph structures are displayed on the screen. Here OpenGL graphics tool is used for the display of objects. The learners can view and interact with 3D visualizations in stereo mode with the help of 3D glasses on a general-purpose computer. Thus it endows with fully functional system thereby facilitating the learner enters into the world of VR.

Figure 3. Partial structure of grammar

sentence → noun_phrase, verb_phrase, terminator

noun_phrase → proper_noun
noun_phrase → determiner, noun

verb_phrase → transitive_verb, noun_phrase
verb_phrase → intransitive_verb

determiner → [a]
determiner → [the]

terminator → ['.']

Figure 4. Knowledge base maintained by text parser

Attribute	Values
Background	No Color, Color, Image,
Material	Copper, Aluminum, Gold, Silver, Iron, Zinc, Bronze, Perl, Brass
View	Top, Front, Left, Right, Back, Bottom, Isometric
Outlook	Vertices, Line, Wireframe,
Tools	Texture, Virtual Walkthrough
Vision	Plain, 3D Vision

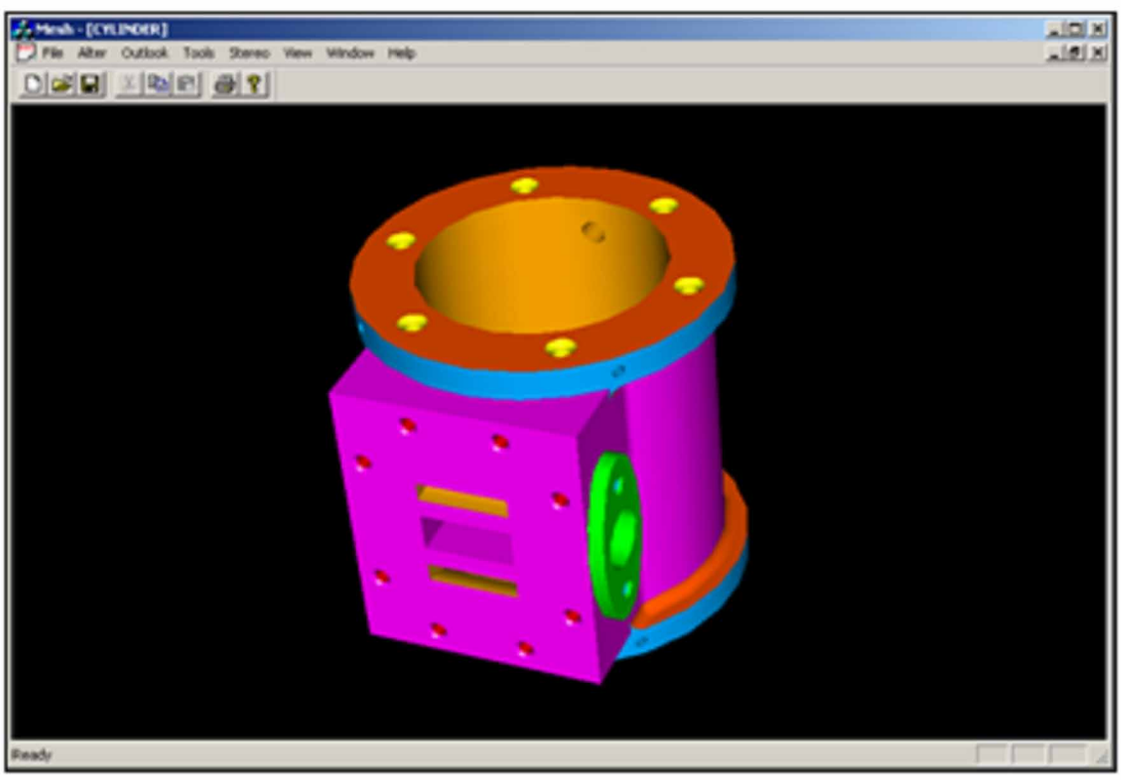
Figure 5. Partial structure of rule base

```
If (Material == "Copper"), applyCopper()
If (Outlook == "Wireframe"), applyWireframe()
If (View == "Isometric"), applyIsometric()
If (Tool == "Texture"), applyTexture()"
```

EXAMPLE SCENARIO: A CASE STUDY

The IVLE tool accepts user input in natural language. A real scenario to exhibit the usefulness of the tool is depicted here. Consider following sentence which is given as an input to the suite, "Show me a

Figure 6. Display of model



copper textured cylinder in wireframe stereo rendering from an isometric view". Text parser extracts the information from user inputted sentence and forwards this to next module. Then the rule base is constructed with this extracted information and from existed knowledge base. Thus constructed rule base is shown in figure 5. Snapshot of display of model shown in figure 6.

For the present contextual analysis, this pedagogical toolbox is explored different avenues regarding cohort of 50 graduate mechanical designing understudies. These understudies were concentrating on model outline and the perception of the same. The students are asked to experiment virtual learning environment after their theory class. Input is gathered from understudies for the investigation of learning effectiveness of this tool kit. Five questions in view of effectiveness of IVLE were specified in the feedback from. The poll is recorded with reference to the following questions:

Questions Used for Feedback

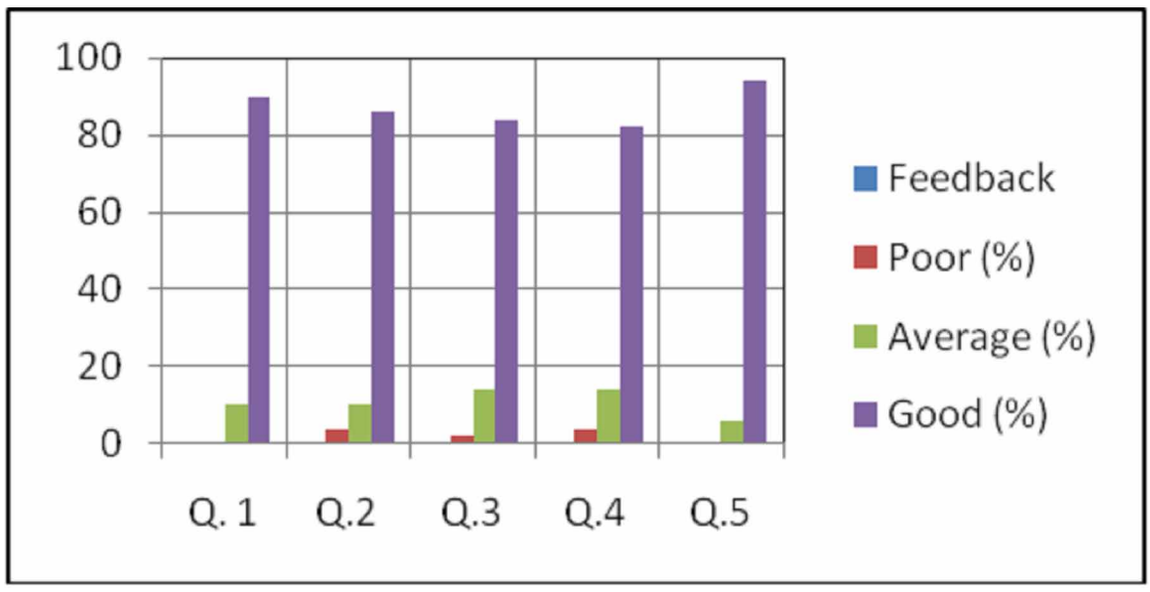
1. Tool creates curiosity in learning
    a. Poor
    b. Average
    c. Good
2. Tool facilitated with user friendly GUI (Graphical User Interface)
    a. Poor
    b. Average
    c. Good
3. Capacity of the toolkit to simulate model visualization in virtual environment.
    a. Poor
    b. Average
    c. Good
4. Effectiveness of this pedagogical tool
    a. Poor
    b. Average
    c. Good
5. Approval for technology enhanced learning
    a. Poor
    b. Average
    c. Good

Feedback answers that uncover learning productivity are organized and analyzed. Figure 7 reveals learners' involvement in this new learning environment. Feedback analysis shows the effectiveness of learning in IVLE. Figure 8 represents the same with percentage wise learners' feedback. The positive result has demonstrated the interest of learning in this new paradigm. As pointed out before, this novel methodology advances understudy inspiration and supports active participation.

Figure 7. Students' feedback on learning experience in IVLE

Question → Feedback ↓	Q. 1	Q.2	Q.3	Q.4	Q.5
Poor (%)	00	04	02	04	00
Average (%)	10	10	14	14	06
Good (%)	90	86	84	82	94

Figure 8. Percentage wise students' feedback



FUTURE RESEARCH DIRECTIONS

This chapter portrayed learning in intelligent virtual environment as an effective pedagogy approach. The pedagogic tool developed by the authors' captures text written in English as an input and creates the envisioned virtual setting. The ability of natural language interface (NLI) for VR based learning system is the most significant attainment of the present work which brings a novel perspective in the field pedagogy. This research can be extended by incorporating learning analytics to identify strong points and weakness of the learner to help individuals to learn them at their pace. Integrating intelligent agents can create impact on the way students interact with information. The reported IVLE extended by designing web application based on client server architecture, so that tool can be accessed online.

CONCLUSION: EFFECTIVENESS IVLE IN PEDAGOGY

Authors have addressed the pedagogical use of VR and AI based learning environment. The reported research stands out mainly in the design of pedagogy toolkit for learning in intelligent virtual environment (IVLE). The significant advantage of the toolkit is the shortening timeframe for the construction of virtual world with the help of natural language interface. The learning approach suggested in this research unfolds innovations in pedagogy. Innovative teaching practices enhanced students learning. This formulates teachers to design curriculum that a self-directed, collaborative learning by offering interactive activities for students. Since students have assorted perspectives, learning styles and background knowledge, this IVLE can provide a plenty of benefits. The aim of this research was to build a new learning epitome and to extend its roadmap for advanced research in this area. The enhanced learning shares the common goal of recognizing the learning benefits from adopting IVLE.

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KEY TERMS AND DEFINITIONS

Artificial Intelligence: A branch of Computer Science that accentuates the creation of intelligent machines exhibit the properties of human beings

Displayer: A computer program which makes an object appears on the screen.

Intelligent Virtual Learning Environment: An innovative pedagogical approach by amalgamating Natural Language Processing and Virtual Reality.

Natural Language Processing: An application of Artificial Intelligence concerned with interactions between computers and natural (human) languages.

OpenGL: A software interface to graphics hardware for displaying object on the screen.

Parser: A module receives ASCII file as input, extracts the required data sets for visualization and creates display structure.

Scene Graph: An arrangement of logical and special representation of a graphical scene.

Stereo Visualization: A computer generated scene viewed using stereo glass to get three-dimensional effect.

Three-Dimensional: A set of geometric three parameters height, width and depth which describes an image.

Virtual Reality: A computer graphics technology that offers a simulated three-dimensional world.

Chapter 52
Online Learning and Quality Practice With Administrative Support and Collaboration

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ABSTRACT

Higher education institutions must innovate and develop new modes of learning, both formal and informal, that meet the demands of the knowledge-driven economy. There is a growing demand for education and a push for non-traditional ways of delivering knowledge and learning. This chapter begins by identifying the technological changes that are affecting all societies and how these changes will specifically impact postsecondary education. The topic of course delivery is viewed as a cultural issue that permeates processes from the design of an online course to the evaluation of an online course. This chapter will examine and review key components of and tools for designing high impact online courses that support student learning and provide suggestions for faculty teaching online courses to assist in creating high-quality online courses that support teaching and, consequently, facilitate opportunities for student learning.

INTRODUCTION

Higher education institutions are moving away from the traditional education systems alone. Levy (2013) found that institutions are proving more broad-based delivery of programs through technology. Higher education is reinventing itself so that it can serve the world's growing and changing needs. Higher education institutions must innovate and develop new modes of learning, both formal and informal, that

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meet the demands of the knowledge-driven economy. There is a growing demand for education and a push for non-traditional ways of delivering knowledge and learning. This chapter begins by identifying the technological changes that are affecting all societies and how these changes will specifically influence postsecondary education. Viewing course delivery as a cultural issue that permeates processes from the design of an online course to its evaluation is essential. This chapter examines and reviews key components of, and tools for; designing high impact online courses that support student learning. It also provides suggestions for faculty teaching online courses to assist in creating high quality online courses that support teaching and, consequently, facilitates opportunities for student learning. Exploring suggestions for conducting course evaluation and a feedback loop for continual improvement of online learning and teaching ensues.

BACKGROUND

Technology, broadly defined, has been transforming human life in one way or another for thousands of years (Jerald, 2009). However, beginning in the 1990s, technological change has come at an exponentially faster rate due to factors such as increased competition in a global economy, automation, workplace change and policies increasing personal responsibility. As the world's labor markets evolve in the digital economy, we cannot predict what specific jobs will exist in the future. However, what is clear is the shift from print to digital is a profound transition in how human beings learn (Marginson, 2016; Pearson Learning, 2014). According to UNESCO (2017), there are more than 207 million students enrolled in higher education worldwide. UNESCO also reported that the percentage of college age students (ages 19-23) has increased from 19% to 34% between the years 2000 and 2014. Craig (2014) projected that the demand for on-line learning will increase by 2025, and that higher education must plan for this growth.

The advent of the personal computer, the Internet and the electronic delivery of information have transformed the world from a manufacturing, physically based economy to an electronic, knowledge-based economy. Whereas the resources of the physically based economy are coal, oil and steel, resources of the new, knowledge-based economy are brainpower and the ability to acquire, deliver and process information effectively. Craig (2015), in his book titled *College Disrupted: The Great Unbundling of College Education* argues that technology may bring more changes to teaching and learning than college leaders have anticipated. Online learning will center the instruction around students rather than the classroom, tailoring education to the needs and abilities of individual learners, and making life-long learning a practical reality for all (Balanko, 2002).

The global economic crisis and especially youth unemployment have prompted the urgency to develop educational systems aligned with the needs of the society it serves. Statistics from the United Nations indicate that one-half of the global population is currently under the age of 25 years. The Organization of Economic Co-operation and Development (OECD, 2012) examined this young population from its 33 member nations and concluded that 39 million or one in four 16-29 year olds were neither employed nor enrolled in some type of education or training program.

Those countries that invest in a 21st century education benefit immediately by transforming an outdated system to a more sustainable approach. Educators worldwide must develop challenging and relevant learning environments to prepare the future workforce. Using digital education to connect students anywhere at any time to educators touts as a viable option especially where access to post-secondary education is limited (Hosie & Schibeci, 2005). The Internet will democratize knowledge, increasing access, lowering

the cost and improving the quality. (Moe, 2000). There should be no doubt that online learning is vital to all disciplines involved in 21st century education (Ternus, et al, 2007).

By 2020, there will be 55 million job openings in the United States. Sixty-five percent will require some postsecondary education (Pearson Education, 2014). Our current system will fail to produce those skilled workers, falling short by 5 million postsecondary credentials (Pearson Education, 2014). Craig (2015) indicated in his book that the future of post-secondary education online degree programs would focus on customizing course offerings. A one-size-fits-all approach is no longer viable for students. Packaged courses and degrees need to be transformed to smaller units, i.e., modules and micro-degrees, allowing students more flexibility in their program of study.

A module is a set of independent units used to construct an online course. An experiment at Massachusetts Institute of Technology is being conducted where students will develop an online course from parts they have assembled themselves online (Craig, 2015). This approach would allow students to retake any module where they possibly struggled and not require them to retake the entire course. Another approach is a micro-degree, which offers online courses in high demand content areas in the job market. Generally, the online courses, which are an outgrowth of a Massive Open Online Course (MOOC) delivery, are shorter and allow the student to work at their own pace. Certificates provide verification of completion of the program.

It may first be helpful to highlight three myths and misconceptions about online teaching and learning. These myths/misconceptions held by students, faculty, and administrators and influence any discussion about the quality of online course delivery are (White, n.d.):

1. Online teaching and learning are 'worse' (or 'better') for meeting student-learning outcomes than face-to-face courses.
2. Online teaching and learning are easier and more convenient for students and faculty than face-to-face courses.
3. Online teaching and learning are less interactive for both student and faculty than face-to-face courses.

All of these statements based upon the premise that there are no special affordances or constraints of the environment, either online or face-to-face, when it comes to teaching or learning means we are comparing apples to apples. It has been argued elsewhere that this is not the case, that there are many fundamental differences that the educational environment both affords or constraints (Anderson, 2004; Matuga, 2001, 2005 & 2007) and that establishing a dichotomist relationship does not adequately reflect the complexity of teaching or learning within either environment. In essence, learning and teaching within online environments is fundamentally different then learning and teaching in face-to-face environments. One is not comparing apples to apples, but more like apples to oranges (Matuga, Wooldridge, & Poirier, 2011).

A useful concept to use as a framework, one that more adequately reflects the complexity of online teaching and learning, would be to view both through the lens of a cultural system. There are many definitions of culture and descriptions of what constitute a cultural system. LeVine (1984), for example, defined culture as "a shared organization of ideas that includes the intellectual, moral, and aesthetic standards prevalent in a community and the meanings of communicative actions" (p. 67). Others have claimed that these organizations of ideas and meanings derived from actions are not static and that culture as systems that may be more complicated and organic collections of cognitive functions, practices, and

meaning (D'Andrade, 2001; Giddens, 1984; Kitayama, 2002). Online teaching and learning viewed as cultural systems; understandings and meanings socially shared within online environments (Courtney, 2001; Mehlinger & Powers, 2002). There are also cultural practices and customs within these environments linked, in various ways, to the values and beliefs of larger cultural systems, like face-to-face educational environments (Courtney, 2001; LeVine, 1984).

A more traditional view of cultural systems, for example, is based upon the idea that they contain within them, nested systems that are interdependent to the functioning of the system as a whole (White, 1975). This view holds that technological (or physical subsystem), social, and psychological factors guide a multitude of functions and influence the behaviors of individuals that are participating in cultural communities (Kitayama, 2002; White, 1975). For example, Kitayama (2002) stated that "each person's psychological processes and structures are organized though the active effort to coordinate his or her behaviors with the pertinent cultural systems of practices and public meanings" (p. 92). While this is may be viewed as a valid proposition, this view does imply that there are somewhat distinct sub-systems that guide or organize psychological processes and practices. It may be quite common to reduce discussions regarding online teaching and learning to cultural sub-systems, like technological ones, for example, because the impact of technology is more explicit within online teaching and learning environments.

This position is arguable in light of contemporary pedagogical theory, however, which holds that psychological and social factors need exploration in conjunction with technological ones. Perhaps one of the most critical characteristics of a cultural system is that it supports the development and transmission of meaning and understanding within and between participants. Rosaldo (1984) argued, "we must appreciate the ways in which such understandings grow, not from an "inner" essence relatively independent of the social world, but from experience in a world of meanings, images, and social bonds, in which all persons are inevitable involved" (p. 139). In the case of meaning making and understanding within online teaching and learning environments, the importance of viewing the psychological in conjunction with social and technological dimensions of cultural systems is implied. These are important points that frame the conversation of designing high impact online courses, providing suggestions for faculty teaching online courses, describing critical administrative support of faculty, and conducting course evaluation and feedback loops for continual improvement of online learning and teaching.

DESIGNING HIGH IMPACT ONLINE COURSES

Viewing online teaching and learning as a cultural system provides a framework to describe and understand 'high impact' online courses. Within education, 'high impact' refers to educational experiences that are meaningful, require student action and participation, and that contribute to the life-long learning of the student (Kuh, 2008). It is important to note that the examples illustrating high impact practices within online courses in this chapter do not represent an exhaustive or comprehensive list, but serve as important points of reference for discussion within this chapter. Two such high impact practices that assist in the design of online courses are pedagogical alignment and meaning making.

Pedagogical Alignment

Pedagogical alignment, also called systematic instructional design (Gagne, Briggs, & Wagner, 1992), entails aligning instructional variables to provide the fundamental framework for online cultural systems,

conveying meanings to community participants, and defining cultural activity. Instructional design is currently in the midst of a paradigm shift towards a more situated view of design activity within cultural systems (Anderson, 2004; Derry & Lesgold, 1996). When designing high impact online courses, pedagogical alignment involves the optimum use of a wide array of instructional features including, but not limited to, instructional goals, instructional strategies, and assessment measures and evaluation practices that support teaching and learning (Matuga, 2005).

The issue of pedagogical alignment in an online course is an important one, for several reasons. While in a face-to-face environment instructional design and alignment may occur in conjunction with the other during instruction, alignment in an online course, in contrast, completes *a priori*. In fact, a clear, comprehensive, and logical course structure may be one of the primary factors students use to judge if an online course is an effective one. Online course alignment further complicated by the affordances and constraints stemming from technology and the social and psychological composition of community participants. Each instructional variable influences the affordances and constraints that encourage technological, social, and psychological subsystems. For example, discussions regarding effective online course alignment must also incorporate pedagogical and technological expertise of students and teachers in the design process (Son, 2019; Kebritchi, Lipshuetz, & Santiague, 2017; Chang, Kurcz, El-Bishouty, & Graf, 2015).

There may be several methods with which to assess whether or not pedagogical alignment was effective, more often than not, discussions regarding the effectiveness of online activities reduced to formal, summative assessment practices such as tests, quizzes, projects, or portfolios. Pedagogical decisions regarding the selection of formal, summative assessments within online courses are important, especially when designing instructional strategies (see Duffy & Cunningham, 2001). However, it is equally important to plan for the manner in which formative assessments and other evaluative information utilized to inform other educational practices within the online environment. Teacher and student self-reflection, as a formative, informal assessment to inform learning is a potentially powerful tool for evaluating pedagogical effectiveness.

Another tool to assess pedagogical alignment is peer evaluation of the course itself. There may be many mechanisms and tools that faculty and administration can use that carry out the peer evaluation of online courses. One is a tiered method at the local level asking more experienced faculty or if available, online instructional designers within the institution to review and constructively evaluate the pedagogical alignment of a particular course. Another method is to have the course formally evaluated by peers through organizations such as Quality Matters. Quality Matters is a peer review system of online courses utilizing a rubric that examines pedagogical alignment. While there are costs involved in the later, the former would take some due diligence on the part of the faculty members involved but would one-step towards assuring quality in online course design.

Meaning Making

Cultural meaning making is a complex activity tied to the cultural systems creating and sharing meaning. One concept that is interesting to explore and is of particular importance to the development of quality online courses is the concept of inter-subjectivity. Inter-subjectivity is a term associated with Vygotskian theory of cognitive development and refers to the shared cultural understanding between two people (Rogoff, 1990; Rosaldo, 1999; Wertsch, 1985). If there is no shared understanding between two people, for example a teacher and a student, then attempts to communicate, create meaning, and

establish understanding are somewhat fruitless endeavors. If the teacher is unable to understand the misconceptions, questions, or understanding of his or her students, then that teacher cannot address the student needs, hampering learning. It is in this manner that the constraints of an online environment may present challenges to establishment of inter-subjectivity (Anderson, 2004). There is the suggestion that, like culture, some meanings may be more explicit due to the "pragmatics of social life and their history for a given society" but not all meanings may be "reduced to its explicit or implicit dimensions" (Le Vine, 1984, p. 77). Social referencing (i.e., gesture, gaze, and other nonverbal communication cues) which is critical for establishing inter-subjectivity (Rogoff, 1990) in a face-to-face environment is not impossible to establish in an online environment It does, however, take a more concentrated effort in high impact online courses.

The culture of online teaching and learning may share similar characteristics with traditional, face-to-face teaching and learning and there may be new territory for future investigations. The critical investigation of how teachers and learners understand, navigate, and utilize the culture of online learning environments to become competent participants is critical to the future of designing high impact courses. As Gardner (1984) stated, "the human being, who, starting from a state of total ignorance about his or her particular culture, must within a decade or two acquire sufficient competence so that he or she can carry out productive work and interact effectively with other individuals to achieve valued ends" (p. 261). The enculturation of teachers and students within online teaching and learning environments requires learning how to use psychological tools within similar, yet dramatically different cultural systems, systems that have different environmental affordances and constraints.

Co-Regulation

Navigating online teaching and learning, or becoming an efficient online teacher and/or online learner, requires that individuals adequately use processes, strategies, and responses to plan and monitor his or her participation in pedagogical activity (Zimmerman, 2001, 1994). This concept, known as self-regulation, reflects those processes that occur at an individual level that play an important role in student academic achievement (Zimmerman, 1994). In many cases, online students are ill-prepared for online courses or drop out of online courses due to their inability to regulate (i.e., plan or monitor) their own learning. Ironically, this relates to the convenience myths/misconceptions of online teaching and learning—a teacher or student need not go to a bricks-and-mortar classroom at a prescribed time, one can learn anytime and any location. In reality, it is very difficult for some students to be self-regulated enough to complete a course online.

McCaslin and Hickey (2001) proposed, however, that co-regulation is a more appropriate concept when discussing regulation of the teaching and learning process within socio-cultural contexts from a Vygotskian perspective (Courtney, 2001). In reference to this position, Zimmerman (1986) states that "self-regulation is not an idiosyncratic product of the child's own discovery experiences; but rather, it is a culturally transmitted method for optimizing and controlling learning events" (p. 311). The processes of regulating teaching and learning does not fall simply on the isolated individual, but is shared between and among students and teachers. In this sense, the self-regulatory functions of the student are influenced by others within the socio-cultural environment (i.e., peers and the teacher), just as others' self-regulatory functions are influenced by that individual student.

Another aspect of co-regulated learning is monitoring strategies. Self-monitoring strategies refer "to students efforts to observe themselves as they evaluate information about specific personal processes

or actions that affect their learning and achievement in school" (Zimmerman & Paulsen, 1995, p. 14). Students who have effective self-monitoring strategies are able to evaluate their own progress towards an established goal, making appropriate strategy changes as they proceed to regulate their learning effectively (Zimmerman & Paulsen, 1995).

The ability to monitor one's own learning processes are also dependent upon a wide array of technical, social, and psychological variables (Zimmerman & Paulsen, 1995). Let us briefly discuss self-monitoring of the writing process as an example. Writing the "old way," before word processing was rudimentary and primitive. An individual first had to prepare quite thoroughly before writing, often generating a detailed outline and/or completing a rough draft in long hand, before moving to type the paper on a typewriter. There was a certain diligence required on the part of the individual making a mistake because it could necessitate starting the entire process all over (unless your professor did not mind a lot of liquid paper). The process described was necessary because there were constraints associated with the technological tool used to write (i.e., typewriters…an electric one if you were lucky). The process, itself also served as a self-regulatory strategy that monitored the writing process. The invention and utilization of word processors has altered the procedural script of writing used by students and, essentially, made obsolete a monitoring strategy used for writing.

Rituals of Participation

One of the ways in which individuals navigate technological, social, and psychological systems are what Courtney (2001) called "rituals of participation" (p. 236). These rituals for participation encompass the norms and behaviour for participating in cultural activities. Learning how to do school, or mastering implicit and explicit academic and social knowledge needed to be successful in school, is an important ritual of participation required for effective teaching and learning (Westby, 1997). This issue is critically important due to the alarming drop rates from online courses by students (Diaz, 2002). Two popular explanations of why online students fail to complete online courses seem to be individual (demographic and/or learning style) or performance (low) differences (Diaz, 2002). However, researchers have suggested that the issue of student preparedness for online classes may be more complicated and include a variety of factors including student, situational, and educational factors (Gibson, 1998).

Suggestions for Faculty Teaching Online Courses

There may be cross-cultural interference between how students conceptualize 'doing school' within face-to-face environments and how this concept is challenged and, by necessity, altered within online teaching and learning environments. For example, one affordance within online environments is the ability, on the part of the faculty, to 'hear' what every student thinks about a particular subject by requiring all students to post on a discussion board, for example. This, of course, requires that each student contribute to the conversation in a concrete and physical way that reflects what was read, in this there is simply a lot of individual accountability and challenges what a student may view of 'doing school'. Many students, it could be argued, have learned what it means to do school by either engaging in discussion or gaining enough inference from what others are discussing in class to participate adequately, or simply keep quiet during discussion.

There may be several strategies to help online students assimilate to 'doing school' online. Perhaps the most utilized strategy is to give student a pre-assessment evaluating certain skills needed to be a

successful online student. Many universities now utilize some sort of instrument that asks students a variety of questions about their learning habits to find a goodness of fit. For example, the University of Georgia uses the Readiness for Education at a Distance Indicator (READI @ http://goml.readi.info/) which is a self-assessment in which the student evaluates him- or herself on a variety of indicators like: life factors, personal attributes, learning styles, reading rate and recall, technical competency, technical knowledge, and typing speed and accuracy. There may be other ways to address the issue of student readiness within online courses, including scaffolding student learning at the beginning of the class and providing assistance by establishing regular activities and other strategies mentioned in this chapter.

Another potential powerful strategy is assigning student-student pairs or each student to a small group and requiring they participate in activities in which they form a bond or rely upon each other to complete course tasks. For example, you may ask groups to define expectations about group standards of behaviour or something a little more fun like identifying a group name, wiki, or mascot. All of these activities are socially binding acts that may help students from dropping out if they feel they have more connections and support for learning in online environments.

There are three primary suggestions for faculty when teaching high quality online courses. First, it is important for faculty to be explicit about how to 'do school' online and ways to assist in the co-regulation of student learning in your course. One promising practice in online courses is to keep the patterns of behavior or interactions similar throughout the duration of the course. For example, always 'open' online course discussions on Mondays and students expected to have their points posted by Friday. Second, faculty should plan for activities to help students identify and address the ways in which there may be differences in how to do school in their online course. Strategies to incorporate must include assisting students in critical or creative thinking, sharing ideas, exploring personal ethos, assessing, receiving feedback, and reflecting (Eison, 2010). Faculty must provide opportunities for on-line learning to engage in deep learning, application of knowledge and immediate feedback. Through ensuring students are engaged in such strategies, students can make gains in problem-solving skills (Cooper, 2015).

Faculty should plan the courses around personalized learning which takes into account the

- Different characteristics of learning,
- Context in which the learning takes place, and
- Types of technologies and emerging technologies available to the learners (Chang, et al., 2015, Oblinger & Oblinger, 2005).

When planning a course, faculty should use flexible instructional methods and a learning pace to address individual student needs. Faculty should also assist students in how they plan to work their online course requirement into their calendar referring to as an 'orienting activity' (Olgren, 1998). Third, faculty should provide guidelines for activities and assessments that address both issues, rituals of participation and co-regulation, to help scaffold these skills throughout the duration of the course. Scaffolding simply means that the faculty member should provide a lot of assistance with these activities at the beginning of the course and as the course progresses; the faculty member slowly withdraws that help as the student gains confidence and masters course material.

There are many resources, books and websites, to assist faculty when teaching high quality online courses (Lohle, 2019; Cooper, 2015; Nedungadi, & Raman, 2012; Eison, 2010; Ko & Rossen, 2001; Koszalka & Ganesan, 2004). There is also assistance to help faculty effectively utilize discussion boards, online tools, blogs, wikis, open-source programs, iPads, iPods, the iGoogle suite, cell phones, etc. within

their online courses. Returning to the framework of viewing online courses as cultural systems, two inter-related important considerations outlined for faculty teaching high quality online courses: rituals of participation and co-regulation.

ADMINISTRATIVE SUPPORT OF FACULTY

Quality online course delivery is contingent upon administrative support of faculty. Additionally, "administrators need to understand their faculty population if they are to support faculty participation in [online teaching and learning]" (Schifter, 2004, p. 25). However, according to Jorge Gaytan (2009) while all valued online teaching and learning there was little agreement among deans, vice presidents for academic affairs, and administrators of distance learning at campuses regarding the organizational structures supporting online teaching and learning. It could be that online teaching and learning, as a field traditionally focused upon the pedagogy of teaching and learning that takes place within online learning environments and contributes to institutional culture. Two important factors that face administrative support of faculty and delivering quality online courses and programs are adequate support for planning and faculty workload.

Adequate Support for Planning

Osika (2006) warns many administrative issues within and across institutions need addressing, thus providing support for online students and faculty beyond the borders of the virtual learning environment. The issue of adequate faculty support, however, is perhaps the most examined administrative issue in distance learning literature (Ko & Rossen, 2001). Levy (2003) outlined critical factors for administrators to take into account when planning for online courses and/or programs; she proposed that planning be systematic and strategic. Levy (2003) stated that "the challenge to colleges in the 21st century is not to decide why they should have an online distance learning program, but to decide how to design and implement such a program" (p. 3).

Effective and innovative leadership plays an important role in the development and delivery of online course and programs (Latchem & Hanna, 2001). Beaudoin (2003) states that "any focused consideration of the dimension of leadership and its impact on the growth and apparent success of distance education at literally hundreds of institutions worldwide" has been largely absent from the literature (p. 3). There appear to be some disconnect, however, between the roles that faculty and administrators play in the development of quality online courses and programs and this disconnect is reflected recent studies on the topic. One of the first steps for administrators to support online students, faculty, and programs would be to understand the demands on online faculty when designing and planning for online courses and programs. Administrators should clarify, in discussions with their faculty, any misconceptions about developing and offering a high-quality online course/program. For example, Gaytan (2009) found that there was a disconnect between administrators' rhetoric and practice and that there was still, on the part of administrators, "an emphasis is on cost savings, remaining competitive, and delivery of information as opposed to instructional quality" (p. 69).

Howell, Williams, and Lindsay (2003) stated that there is a need to pose difficult questions about online programs, but a need to address those questions "from an informed perspective" (p. 1). As Gaytan (2009) found, there were many instances in which administrators and faculty differed in important ways

when discussing online teaching and learning. For example, "while online education coordinators and faculty [in his study] were thinking about the ways to improve the quality of online education, academic administrators had other priorities such as being able to remain competitive" (Gaytan, 2009, p. 69). This illustrates a common assumption, on the part of institutional administrators, that online courses will address the need to service more students for the same costs, often by increasing the number of students within online courses (Concieção & Baldor, 2009). As stated in the beginning of the chapter, both administrators and faculty hold myths and misconceptions about online teaching and learning. Assumptions, myths, and misconceptions need examining and discussion by administrators and faculty members within the context and characteristics (i.e., pedagogical alignment) of a particular course or program. This is a critical first step during the design and planning stage of online courses and programs. Administrative support of faculty for high quality online courses is needed, however, to extend beyond support to encompass adequate planning (Osika, 2006).

Faculty Workload

One issue that has received some attention in the online teaching and learning literature has been that of faculty workload. Lehmann and Chamberlin (2009), for example, illustrate the number and variety of hats that online faculty wear when teaching a high quality online course: (1) teacher, (2) facilitator, (3) instructional technologist, (4) course designer, (5) writer, editor, and proofreader, (6) counselor and mediator, and (7) advisor and registrar. Wearing more hats, however, may not necessarily result in increased compensation for the online faculty member. For example, in Schifter's (2004) research surveying administrators about online teaching and learning issues, both found that there was little consistency with faculty compensation. Additionally, faculty may not be prepared to wear many of those hats and professional development, mentoring programs, or providing other models to those faculties may be critical (Blythe, 2001).

Debates ensure around complications and added workload for faculty teaching online. Some researchers have found as the number of students increase in an online course workload due to more student-teacher interactions and/or more individual assessment feedback, particularly if using a pedagogical alignment for the course that is more student-centered increases (Matuga, 2005). Other researchers, however, have found that placing additional students within an online course may not increase faculty workload substantially, especially if the online faculty member has previous online teaching experience or the course's pedagogical alignment is more teacher-centered and does not require a lot of student-teacher interaction and student monitoring (Anderson & Avery, 2008; DiBiase & Rademacher, 2005; Matuga, 2005). It is very important, however, to realize that many of the studies investigating faculty workload were comparison studies with face-to-face faculty. As stated in the introduction of this chapter, this is a flawed premise, as we are not comparing apples-to-apples therefore, investigating faculty workload from a comparison perspective may not adequately reflect what an online faculty *does.*

Just as it may be more accurate to examine online teaching and learning as a cultural system, it may be necessary to redefine the roles, responsibilities of online faculty members. The supposition that treating online faculty members differently at educational institutions, and this may be a threat to academic quality, has been a recurring theme in the research literature (Concieção & Baldor, 2009). Schifter (2004) found that faculty workload for those teaching online courses were not to consistent within and across institutions (Schifter, 2004). This has given rise to a trend at educational institutions of hiring online adjunct faculty to teach online courses (Puzziferro & Shelton, 2009). On the one hand, while this group

of faculty may have highly specialized skills to teach online, there may still be a perceived threat to the online quality of courses and programs. Regardless, the rise of the online adjunct faculty illustrates the need for an examination of knowledge and skills required to be an effective online faculty member and support from administration for quality online course delivery. It also necessitates the transformation of how we assess and evaluate effective online faculty, especially if we look at online learning environments as complex, cultural systems. A cornerstone of support for online faculty from an administrative perspective should include support for the systematic assessment and evaluation of online courses with an eye toward continual improvement.

Continual Improvement

The last issue explored in this chapter, which of continual improvement, encompasses the various aspects for all the topics features highlighted in this chapter: pedagogical alignment, meaning making, rituals of participation, co-regulation, administrative support for faculty planning courses/programs, and faculty workload. The relationships between and among these different factors illuminate themselves to be reciprocal in nature through the process of continual improvement. It is in this sense that online teaching and learning contributes to the notion of cultural systems discussed at the beginning of the chapter.

Continual improvement is the act of reflecting on the effectiveness of pedagogical alignment within the context of the constraints and affordances of the online teaching and learning environment. Perhaps the most important component for continual improvement, for example, is pedagogical alignment, which, as stated earlier, requires that instructional variables like student learning outcomes, learning activities, and assessment and evaluation practices, supporting student success and learning, and selecting with care during the planning process (Matuga, 2005). Pedagogical alignment provides a blueprint for continual improvement. However, continual improvement also mandates the re-visitation of pedagogical alignment during and after the course with the goal of perfecting the course with an eye towards assuring quality.

Sims and Jones (2002) proposed a three-phased model for continuous improvement in online classes that emphasizes the importance of pedagogical alignment and instructional design. They proposed that there be a "Pre-Delivery" phase in which the focus is on the functionality of the newly designed course be peer evaluated. This could be by utilizing some of the peer-evaluation methods mentioned in this chapter. The second phase is that of an initial delivery, or enhancement stage, and the last stage is an ongoing delivery or course maintenance phase in which the course is modified based upon feedback from students and peers. This approach emphasizes a team approach to course design, evaluation, and redesign. Within socio-cultural literature is creating 'communities of practice'. Sims and Jones (2002) outline that building shared understanding, establishing rituals of participation, and maintaining communication are all critical components of their continuous improvement model. Continuous improvement is by its definition, a dynamic process that examines those shared ideas of what is quality online teaching and learning and is essential for assuring quality.

FUTURE RESEARCH DIRECTIONS

As a review of the online teaching and learning research by Tallen-Runnels and colleagues (2006) illustrated, online teaching and learning can be and has been a field typically organized by following four categories: course environment, learners' outcomes, learners' characteristics, and institutional and administrative factors. There are two issues when designing online courses, the first is the quality of teaching tool and the second is the quality of learning. In this chapter, we have presented a foundation for viewing some of these topics through the lens of cultural systems (Ternus et al, 2002).

Three common myths/misconceptions regarding online teaching and learning presented at the beginning of this chapter, helped frame the discussion. One last myth or misconception not highlighted in this paper is that online teaching and learning is less expensive than face-to-face teaching. Divorcing this myth from the comparison (apples to apples) metaphor, is a topic that was touched upon when the subject of administrative support of faculty but not fully explored. Colleges and universities face pressure in developing online courses and programs, in essence, to meet economic shortfalls. However, as Levy (2003) state "the challenge to colleges in the 21st century is not to decide why they should have an online distance learning program, but to decide how to design and implement such a program" (p. 3). The subject or relationship between how much a course/program cost and quality of learning within that course/program remains a very complex and difficult topic to frame within the topic of assuring quality.

The issue of assuring quality in online courses and programs is a multifaceted one that requires we look at the online teaching and learning environment through a fundamentally different lens—of it as a complex, cultural system with unique affordances and constraints.

CONCLUSION

While an exhaustive list is not presented, this chapter highlighted important factors that influence the design of high impact online courses, offered suggestions for faculty who are teaching online classes that ensure quality, impact administrative support of online faculty, and offer a potential model for continual improvement. All of these factors are aligned with the central premise of this chapter that assuring quality in online course delivery is a complicated communal activity focusing on the alignment of sound instructional features, meaning-making, working together with students to develop new ways 'to do school' online, recognition of faculty work, and continual improvement. By providing quality on-line delivery, we are assuring access to learning for all (McCowan, 2016).

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KEY TERMS AND DEFINITIONS

Assuring Quality: Online course delivery focusing on the alignment of sound instructional features, meaning-making, working together with students to develop new ways 'to do school' online, recognition of faculty work, and continual improvement.

Continual Improvement: The act of reflecting on the effectiveness of pedagogical alignment within the context of the constraints and affordances of the online teaching and learning environment.

Continuous Improvement: A dynamic process that examines those shared ideas of what is quality online teaching and learning and is essential for assuring quality.

Cultural Systems: Within online environments refers to understandings and meanings socially shared.

Evaluation: Examining the content, processes, impact and outcomes of on-line courses in order improve the course quality.

High Impact Practices: Educational experiences that are meaningful and require student action and participation, and that contribute to the life-long learning of the student.

On-Line Teaching and Learning: Faculty-delivered instruction via the Internet or distance learning.

Self-Regulation: Those processes that occur at an individual level that play an important role in student academic achievement.

Chapter 53
Distance Learning From Itinerant Teachers to Cloud-Based Technologies

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ABSTRACT

The knowledge explosion, the increased complexity of human life, and the ubiquitous, 24/7 nature of technology coupled with the globalization of the marketplace herald the need to embrace the most effective methods and platforms of teaching and learning. Currently providing powerful educational opportunities, the science and technology of distance teaching and learning continues to multiply at unprecedented rates. While historically traveling from village to village verbally disseminating knowledge was the only process of training those at a distance, today's learners eagerly embrace the rapidly expanding cloud-based technologies of the 21st century, offering a plethora of informational and educational opportunities. With this exponentially expanding global educational landscape, one must question what exactly distance teaching and learning is, how it has evolved, what the current state of affairs is, and what we anticipate in the future?

INTRODUCTION

The knowledge explosion, the increased complexity of human life, and the ubiquitous, 24/7 nature of technology coupled with the globalization of the marketplace herald the need to embrace the most effective methods and platforms of teaching and learning. Currently providing powerful educational opportunities, the science and technology of distance teaching and learning continues to multiply at unprecedented rates. While historically traveling from village to village verbally disseminating knowledge was the only process of training those at a distance, today's learners eagerly embrace the rapidly expanding cloud-based technologies of the 21st century, offering a plethora of informational and educational opportunities. With this exponentially expanding global educational landscape, one must question, what

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exactly *is* distance teaching and learning, how has it evolved, what is the current state of affairs, and what do we anticipate in the future?

BACKGROUND

In very simplistic terms, distance learning is just that--learning that occurs at a distance (Rumble & Keegan, 1982; Shale, 1990; Shale & Garrison, 1990) or that which is characterized by a separation in geographical proximity and/or time (Holmberg, 1974, 1977, 1981; Kaye, 1981, 1982, 1988; Keegan, 1980; McIsaac & Gunawardena, 1996; Moore, 1973, 1980, 1983, 1989a, 1989b, 1990; Ohler, 1991; Sewart, 1981; Wedemeyer, 1971). Over 30 years ago in his 1986 theory of transactional distance, Moore (Moore & Kearsley, 1996) defined distance not only in terms of place and time but also in terms of structure and dialogue between the learner and the instructor. Dramatically changing the concept of distance learning, in this theory distance became more pedagogical than geographical. As structure increased, so did distance. As dialogue increased, distance declined thus establishing the foundational role interaction plays in the distance learning environment. A few years later, Saba (1998) furthered this concept concluding,

the dynamic and systemic study of distance education has made 'distance' irrelevant, and has made mediated communication and construction of knowledge the relevant issue …. So the proper question is not whether distance education is comparable to a hypothetical 'traditional,' or face-to-face instruction, but if there is enough interaction between the learner and the instructor for the learner to find meaning and develop new knowledge. (p. 5)

To facilitate greater interaction in the geographically and/or organizationally dispersed distance environment, today the convergence or fusion of technologies enables individuals to not only overcome the barrier of separation, affording institutional and learner opportunity to transcend intra- and inter-organizational boundaries, time, and even culture but to virtually erase it. By definition, the paradigm of distance, online, or cloud-based learning revolutionizes the traditional environment; however, even with this change, learning that involves some manner of interaction with content, professor, peers, and even external experts remains at the core of the educational process and also at the hub of the ongoing traditional versus distance argument.

The Traditional versus Distance Argument

Even in today's society with wearable smart technology and information literally at our fingertips, some traditionalists still fear that with anything other than face-to-face instruction, interaction somehow will decrease thus making learning less effective. Compounding that fear, two of the distinguishing characteristics of the nontraditional environment--individualized learning and flexibility--often arouse suspicion and caution among that same group of individuals. Many are convinced that with any form of study outside the confines of the typical brick and mortar, "every vestige of intellectual rigor [will] disappear into oblivion. . . . [In fact, these skeptics interpret] individualized learning as individualized isolation, especially from faculty, and they look on flexibility as no more than a synonym for escape from regulation and responsibility" (Gould, 1972, p. 9). Despite this skepticism, as early as just before the turn of

the century, distance courses have been found to "match conventional on-campus, face-to-face courses in both rigor and quality of outcomes" (Pittman, 1997, p. 42).

As a precedent to this reassuring discovery and recognizing the need to bring integrity and prestige to the rapidly evolving field of distance learning, Shale and Garrison (1990) suggested building a framework based not on isolation but upon interdependence, thus promulgating the need for interaction. Several years later with their introduction of Equivalency Theory, Simonson, Schlosser, and Hanson (1999) accentuated the concept of equivalency as "central to the widespread acceptance of distance education" (p. 72), thus supporting Keegan's (1989) earlier call for parity in quality, quantity, and status.

Concerning learning outcomes, Russell (1999) found no significant difference between traditional and distance courses and in fact, according to the more recent literature, the "no difference" paradigm has now made a diametrical shift. For example, Dumitrache (2014) found that distance learning provided *increased* accessibility and participation of students in the educational process. Simultaneously, Fierbinţeanu and Morariu (2014) claimed that eLearning could actually *strengthen* instruction, directly challenging the typical traditionalist argument. While Grooms (2000) and others (Cacheiro-Gonzales, Medina-Rivilla, Dominguez-Garrido, & Medina-Dominguez, 2019) have reinforced the need for interaction or as it is often now called networked teaching and learning (Zhang & Dong, 2017), no matter its form, interaction remains the key ingredient in the knowledge-building process. So how did we get to where we are now?

FOCUS OF THE ARTICLE

Distance Learning Evolution

As previously mentioned, distance learning has been with us in one form or another virtually since the creation of time. For years, itinerant teachers traveled from village to village verbally disseminating information to those hungry for knowledge; however, the invention of Guttenberg's printing press in 1440, made possible serious distribution of learning to larger numbers of people.

Capitalizing on this broader use of print media, correspondence study became a popular form of distance education, the first record of which was in 1728 when Caleb Philipps' advertised the introduction of shorthand (Battenberg as cited in Baath, 1980 & Holmberg, 1986). Often conjuring thoughts of isolation and autonomy, this record of instruction mirrored those images. In fact, in this account there was no mention of interaction of any type other than what was inherent within the content.

Over a hundred years later in his 1833 Swedish advertisement, although not directly stated, Meuller's offer to study composition seemed to be the first to imply some type of exchange between student and teacher. Seven years later, in 1840, the most acknowledged root of distance learning explicitly employing learner-instructor interaction began in the United Kingdom when Isaac Pittman used passages from the Bible to teach shorthand (Baath, 1980; Holmberg, 1974; Kaye, 1988; Rumble, 1986). Once learners transcribed specific passages, they were returned for correspondence with the teacher via the penny post, thus some called it postal teaching (Dewal, 1988).

As evidenced in those early days of pure correspondence education, any offered guidance transpired through some form of dispatched communication such as the mail (Wedemeyer, 1971) and student contact, even with the instructor, was not necessarily encouraged. This is clearly seen in Keegan's (1980) classic article, *On Defining Distance Education,* where he documented that in its strictest sense, pure

correspondence study advocates specified that "students enrol [sic] with them because they 'want to be left alone'" (p. 31). Directly challenging this belief, two years later, Holmberg (1982) advocated that "any post-graduate distance study must have a truly communicative character if more is meant than merely providing reading lists and odd comments on students' work" (p. 259).

While print remained the primary mode of distance learning until the 1920s and 30s, the introduction of radio broadcasts soon followed with television and satellite delivery systems initiating the labor pains for the birth of the current online technological revolution. Prior to the advent of the World Wide Web (WWW) in the early 1990s, interaction continued to transpire primarily between the learner and the content with occasional interaction between the learner and the instructor through such means as telephone and videoconferencing.

As the distance learning landscape continued to evolve, learner-instructor interaction became increasingly important, thus catapulting the first of two significant paradigm shifts. While some (Daniel & Marquis, 1979) were accentuating the importance of getting the right independence-interaction mixture, others heralded the positive impact (Cookson, 1989; Robinson, 1981) and, even more so, the critical nature of the tension between the role of technology and type of educational process with its accompanying interaction in the distance learning environment (Bocarnea, Grooms, & Reid-Martinez, 2006; Grooms, 2000, 2003; Grooms & Reid-Martinez, 2011, 2012, 2013).

While offering flexibility from traditional geographical proximity and time constraints (Barnes & Greller, 1994; Harasim, 1990; Hiltz & Johnson, 1990; Kaye, 1989; Moore, 1983), computer-mediated communication (CMC; Harasim, 1993; Kaye, 1989; McIsaac & Gunawardena, 1996) and other information and communication technologies (ICTs) served as excellent participation equalizers or what Szecsy (2011) referred to as "leveling devices." These unprecedented technological advances increasingly blurred the line between traditional face-to-face learning and that which occurs at a distance. Reid-Martinez, Grooms, and Bocarnea (2009) and Reid-Martinez and Grooms (2015; 2018) herald this as "the democratization of the learning process."

In fact, in today's 21st century, Reid-Martinez (January 3, 2014, personal communication) heralded,

Learning is no longer 'just in time,' but with adaptive learning and other capacities that allow for learning that is 'just for you' and 'just with you' through wearable smart devices and other advancing technologies. This contemporary and developing technology now allows learning to be fluid with the learner in a simultaneous and continuous nature.

The Current State of Affairs

Promising to deliver increased access, quality, and efficiency of learning in an ever-growing competitive market (Benoit, Benoit, Milyo, & Hansen, 2006), as it moved online, the technology of higher education altered both teaching and learning (Kapitzke, 2000) and instructor and student roles (Stadtlander, 1998). With this in mind and regardless if it is now considered online, e-, m-, or cloud-based, learning is now mediated through synchronous (interactive/real time) or asynchronous (interactive/delayed) means and the most critical consideration continues to remain in aligning the task, the delivery method, and the delivery format or platform.

Distance Learning Delivery Methods

Almost 150 years following the advent of postal teaching and the first record of any form of learner-instructor interaction, Linda Harasim (1989), a pioneer in the online classroom, clearly differentiated three delivery methods that she believed distinguished traditional, distance, and online education: *one-to-many*, as in the traditional lecture method when one instructor addresses many students; *one-to-one,* as in the tutorial method; and *many-to-many*, a collaborative process with students learning from each other, with or without an instructor. In the first method, learners are mere passive recipients of knowledge and information, whereas in the latter two, they are actively involved in the learning process. A clear shift in the role of the instructor transpired: from information dispenser to one who facilitates an environment where knowledge "emerges from active dialogue among those who seek to understand and apply concepts and techniques" (Hiltz, 1990, p. 135).

Although the traditional face-to-face environment is time-place dependent, it allows for the implementation of all three delivery methods contingent upon the instructional task. In contrast, the online, e-, m-, and cloud-based environments are most often time-place independent and whether mediated or not, they facilitate flexibility and reflective response; however, in like manner they also must align method with context. When appropriate, distance learning still uses the *one-to-one* (e.g., print media, programmed instruction, adaptive educational hypermedia, and 3D and immersive virtual worlds) or *one-to-many* (e.g., audio teaching, streaming video, podcasting, videologging such as YouTube, or even Massive Open Online Classrooms or MOOCs) methods, while online classes often additionally employ the *many-to-many* concept, which forces the second paradigm shift: the need for peer interaction, which often uses such platforms as chat rooms, instant messaging, or one of the many web conferencing options.

Distance Learning Delivery Formats/Platforms

Distance learning formats/platforms typically corral into four arenas: print, audio, video, or digital (see Table 1) with all serving as viable options. Apart from media or technology differences, communication within these formats can either be one-way with the learner taking a passive role or two-way with the learner interacting with either the instructor or peers. Whatever the selected format, it is imperative to align content with delivery method.

Whether using syllabi, texts, instructor notes, or other forms of print, today this medium still remains a significant component in distance learning. In contrast, where telephones, audio conferencing, and video technology augmented print in the latter part of the 20th century, today the exponential proliferation of the Internet has provided a plethora of independent and collaborative learning opportunities, both synchronous and asynchronous. Regardless of the format, more than a decade ago, researchers (Beetham & Sharpe, 2007; Rourke & Coleman, 2011) cautioned that rather than technology driving pedagogy, pedagogy should drive technology with the ultimate goal always of learning.

Table 1. Distance learning delivery formats/platforms

MEDIA	PASSIVE One-Way	INTERACTIVE Two-Way	
		Asynchronous Delayed	Synchronous Real time
PRINT	Syllabi Texts Instructor notes Programmed instruction Study guides or workbooks Fax		
AUDIO	Radio Audiotape CD Rom Voicemail		Telephone Audio Conferencing
VIDEO	Videotapes DVD Film Cable, Broadcast, and Digital Television (one-way audio and video)		Satellite Videoconferencing (two-way audio and one-way video)
DIGITAL	CAI (computer assisted instruction) – using the computer as a self-contained teaching machine Webcasts Streaming Video Podcasting & its various forms (e.g. Vodcasting & Phonecasting) Some forms of blogging such as moblogging, linklogging, photologging, edublogging, and videologging such as YouTube Online Educational Resources (OER)	CMI (computer-mediated instruction) E-mail Texting Bulletin Boards (e.g., Threaded Discussions; Newsgroups) Listservs Wikis Web-based instruction (e.g., Blackboard) Cloud Technology (e.g., Google Apps) Open Source Learning Platforms (e.g., Moodle) Social Networking (e.g., Facebook, LinkedIn, and Google+) Some forms of blogging and many of its variations including microblogging (e.g., Twitter, Tumblr, and SnapChat) Adaptive educational hypermedia MOOCS	Chat Rooms Instant Messaging Web Conferencing (e.g., *Webinars, Google Hangouts, *Blackboard Collaborate, Skype, Zoom, GotoMeeting) Shared Whiteboards Interactive Optical Sensory Technology 3D and Immersive Virtual Worlds *once recorded they become asynchronous

While the digital age marked the advent of the 21st century (Leow & Neo, 2016, p. 87), many institutions employed a blended or hybrid learning approach combining some form of the traditional with the digital. In their early article defining blended learning, Osguthorpe and Graham (2003) indicated,

those who use blended approaches base their pedagogy on the assumption that there are inherent benefits in face-to-face interaction (both among learners and between learner and instructor) as well as understanding that there are some inherent advantages to using online methods in their teaching. Thus, the aim of those using blended learning approaches is to find a harmonious balance between online access to knowledge and face-to-face interaction. The balance … will vary for every course [based upon the] instructional goals, student characteristics, instructor background, and online resources [and] no

two courses will be exactly the same …. [The goal] is to ensure that the blend involves the strengths of each type of learning environment and none of the weaknesses. (p. 228)

Citing three typical reasons for using a blended approach--more effective pedagogy, increased convenience and access, and increased cost effectiveness (Graham, Allen, & Ure, 2005)--it is easy to see why progressively more institutions implemented this format.

As time progressed, many prestigious educational institutions began offering instruction through massive open online courses (MOOCs; Conache, Dima, & Mutu, 2016) and by 2015, some such as Ren, Li, and Wu claimed that through the maturity of the use of technology, distance learning systems were becoming a significant teaching means. In fact, Faizi (2018) subsequently claimed, "over the past few years, the Internet has evolved from being a read-only platform that people used to access information into a read-write universal channel in which users are producers and consumers of digital content" (p. 86), forever changing knowledge-building and thus, the educational landscape.

Today, choices abound for learners who merely have to touch a screen or speak into a device and the information is almost instantaneous. Through the proliferation of cloud-based information, open educational content has become the norm and access to that content has taken learning to an entirely new dimension. Learning has become fluid.

Whether employing social technologies (Kear, Jones, Holden, & Curcher, 2016) or mobile and wearable devices to connect collaboratively within the global market (Frantiska, 2017; Ivy, 2017), interactivity (Kent, Laslo, & Rafaeli, 2016) remains the constant thread that connects learners with the content, instructor, and/or peers.

And while Augmented Reality (AR) "has been used in various contexts in recent years in order to enhance user experience in mobile and wearable devices" (Lytridis, Tsinakos, & Kazanidis, 2018, p. 6) and virtual reality (VR) has been used to provide engaging activities in such fields as health care education (King, Tee, Falconer, Angell, Holley, & Mills, 2018) and pharmacy (Coyne, Takemoto, Parmentier, Merritt, & Sharpton, 2018), interactivity continues to be the constant thread. As some move from human-to-human interactions to chatbots (PR Newswire, 2017) or humanoid social robots (Edwards, A., Edwards, C., Westerman, & Spence, 2019), we need to question long-term viability. Do these new technologies enhance or lessen an individual's need to interact?

As previously stated, further blurring the line between traditional and distance learning, the blending and convergence of technologies continue to increase the fluidity and ubiquity of education and allow educators to harness the opportunities technology affords. Today with the tap or swipe of a finger, learners have virtually instant access to a plethora of information via the Internet, which Klinger and Coffman (2011) claimed provides a transformational highway for distance learning. Indeed, the need for interaction is so intense that certain age groups cannot bear to be separated from their mobile or wearable devices. This inherently comes with them into the educational arena. Given the mobility of netbooks, smartphones, and tablets, geographical proximity becomes a non-issue as learners are no longer bound by context and can learn anytime and anywhere with social media producing an ecosystem ripe for interaction. Through time, the mobility of distance learning has remained constant; however, the delivery format or platform has opened virtual horizons far beyond traveling from village to village. Foreshadowing this technological explosion some 20 years ago, futurists McCain and Jukes (2001) projected that "at a certain point, the boundaries between reality and virtual reality will collapse because of the increased sophistication and transparency of these powerful, fused technologies" (p. 60). With the introduction of

such things as cloud-based technology, augmented and virtual reality, that day has already arrived. So, where do we go from here?

FUTURE RESEARCH DIRECTIONS

The future of distance learning will continue to reflect the exponentially growing technological advances. In an April 1965 *Electronics* magazine article, Gordon Moore, cofounder and Chairman Emeritus of Intel, the world's largest silicon chip manufacturing company, predicted that the number of transistors on an integrated circuit would double every 12-18 months. While in 1975, he amended this timeframe to roughly every 24 months, it has been accurate in excess of one-half century. At present, what has become known as Moore's Law shows no signs of slowing down; although, in a 2000 interview with *Time* magazine, Moore did acknowledge that at some point in the next two or three generations, this growth would perhaps slow down to doubling every five years. We are now in that time frame.

Exploring other technological alternatives, since the late 1950s some "wondered whether a better approach to miniaturization might be to 'grow' single molecules that functioned as electronic circuits or components. [They believed] that such molecules might be faster and smaller [than the traditional silicon chip] … and they might also be easier to make" (Kelly & Mody, 2015, ¶8). While this movement has waxed and waned over the years, in 2010, researchers from Japan and Michigan Technological University claimed they had succeeded in building a molecular computer that could "replicate the inner mechanisms of the human brain, repairing itself and mimicking the massive parallelism that allows our brains to process information like no silicon-based computer can" (Borghino, 2010, ¶1). Four years later, Sebastian (2014) unveiled that IBM scientists had created "what some have claimed is the most advanced neuromorphic (brain-like) computer chip to date" (¶1). Even with such remarkable advancements, we are quite a distance from reaching the apex of technological discovery, which history reveals directly affects distance teaching and learning. In reflection, these new discoveries "may very well prove the long-term solution to validate Moore's law well into the next century (Borghino, 2010, ¶2).

CONCLUSION

Whether one views distance as geographical or pedagogical, as the above suggests, the technological explosion of the 21st century provides unprecedented opportunity to render distance virtually irrelevant. If Moore's Law holds fast and technology continues to double every 18-24 months, the exponential growth of distance learning will continue to catapult educators into even more uncharted territory. The question remains, will there still be a place for the staunch traditionalist or will education continue to be so radically transformed that traditional education is hardly recognizable. Regardless of the medium (print, audio, video, or digital), method (one-to-many, one-to-one, or many-to-many), format (passive or interactive), or even device (PC, smartphone, tablet, or some type of wearable), interactive learning continues to remain at the core of the distance educational process.

Negroponte (1995) poignantly prophesied, "Distance means less and less in the digital world. In fact, an Internet user is utterly oblivious to it. On the Internet, distance often seems to function in reverse" (p. 178). Supporting this prediction, science and technology have triggered physical distance to become

truly irrelevant. So, what does the future hold? Where *will* distance learning be in 5, 10, or even 20 years from now? Some would postulate that we are limited only by our imaginations.

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KEY TERMS AND DEFINITIONS

Augmented Reality (AR): Adds to or projects additional information onto what the user is already seeing.

Cloud Computing: Technologies that facilitate the sharing of digital files over the Internet anywhere, anytime.

Correspondence Learning: A form of distance learning using dispatched or one-way communication.

eLearning: Learning that occurs electronically.

Equivalency: Distance learning that possesses equality with learning experienced in the face-to-face venue.

Face-to-Face Learning: Learning that is time-place dependent.

mLearning: Learning that occurs through the use of mobile technology.

Optical Sensory Technology: Technology that provides the ability to track user input within an augmented or a virtual reality.

Three-Dimensional Virtual Learning: A computer-based simulated environment.

Time-Place Dependent: Education that transpires in the same location at the same time.

Time-Place Independent: Learning that does not rely on geographical proximity or time.

Traditional Study: Face-to-face learning.

Virtual Reality: Completely covers or replaces the user's vision taking him or her somewhere else.

Chapter 54
Pre-Service Teachers' Perceptions of the Effectiveness of a Virtual Learning Environment to Support a Learner-Centred Approach:
A Qualitative Study

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ABSTRACT

The aim of the research was to apply a qualitative study approach to explore pre-service teachers' perspectives towards a virtual learning environment to establish the reasons to determine its effectiveness to support learner-centered approach. The population of the research included a total of 94 pre-service teachers, studying the last year of the Degree in Primary Education. The qualitative sample of the study was theoretical sampling, systematic, non-probabilistic, sequential, and cumulative. Qualitative data were collected through individual semi-structured interviews. The findings suggested participants' positive perspectives towards the VLE to support learner-centred approach in which they were placed at the centre of the learning process, created knowledge, and had the opportunity to develop an important set of skills needed in the current society and for lifelong learning. It was favoured a constructivist learning in a constructivist environment that involved the students in the development of knowledge having an active role.

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INTRODUCTION

The intent of this research is to contribute to the overall knowledge base about best practices in Higher Education, Technology and the Learner-Centred pedagogical approach. For many years, teachers have assumed the responsibility of the whole teaching-learning process, being the only ones with the role of communicating knowledge and deciding the learning objectives and contents that students had to meet (Hancock, Bray & Nason, 2003).

Traditional face-to-face lessons were usually used as the primary and only mean of that communication, and learning and teaching materials were broken down into small quantities according to a logical and given sequence (Mascolo, 2009). That tutor-centred approach was based on the idea of considering teachers as experts, and students as apprentices that had to acquire what teachers transmitted to them unilaterally. That pedagogy was linked and rooted in behaviourism (Allan, 2007; Chall, 2002; Ingleby, Joyce & Powell, 2010) in which learning was just defined as the acquisition of new behaviour or the change in behaviour based on environmental conditions and influences. Learners were involved in methods of direct instruction in which there was a clear emphasis on memorizing knowledge transmitted by teachers, where skills were learned in isolation and learning was assessed in different individual oral and written tests in which learners demonstrated mastery the contents repeating that they had memorized previously. Teachers transmitted knowledge without involving students, without showing them the relevance and meaningfulness of what they were learning (Allan, 2007; Ingleby, Joyce & Powell, 2010). Moreover, that learning approach did not take into account learners' personal necessities or interests, or their different learning styles.

These perspectives on the teaching-learning process have shifted in order to provide the best teaching-learning experience for teachers and students of the 21st century society. There have been a change from teacher-centred approach towards learner-centred one in which students are placed at the centre of the teaching-learning process (Collins & O'Brien, 2003).

If we have previously pointed out that the tutor-centred paradigm was reflected in behaviourism, student-centred approach is related to constructivist instruction that promotes learning in a community in which students and teachers collaborate, and in which students are active participants in the acquisition of knowledge, acquiring the necessary skills to solve problems and reflecting on their learning (Attard, 2010).

According to Grabinger, Dunlap and Duffield (1997) constructivism is characterized for being a kind of instruction in which knowledge is not a product to be accumulated, but an active process that requires the collaboration with peers and teachers. People acquire knowledge in different ways and use that knowledge in a meaningful way according to their lives and needs. Allan (2007) adds that *"(…) it is important to create a learning environment that will enable students to work in learning groups and exchange (…) explore their own ideas and meaning of a topic (...) and to share their work and academic experiences with each other."* (p.54).

From his words we can deduce how constructivism is related to cooperative and collaborative learning, to function in groups in which students work together to meet a common learning objective, sharing their sources and exchanging information and points of view (Dillenbourg, 1999; Lewis & Allan, 2005).

Vygotsky (1978) thinks that students are more capable in higher intellectual levels when they work in a collaborative way, in groups, than when they work individually. This leads to the concept of the Zone of Proximal Development (ZPD) that suggests that students' learning is greater when they work with others or when they collaborate with more capable peers. There are many definitions of learner-

centred pedagogy; in this study we emphasize the one developed by Collins and O'Brien (2003) that define learner-centred instruction as *"an approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the centre of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches them in the skills they need to do so effectively. (…) It can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught."* (p.340).

Nowadays, technology occupies a relevant position and has led to changes in different areas of our lives, and of course, in education, its curricula and instructional approach. Information and Communication Technologies (ICT) play an essential role in the way in which curricula are implemented and taught, and they provide the resources that allow carrying out an approach centred in learners in an innovative new way, in different learning environment according to the needs of the population of the 21st century society (Lamoyi, 2012).

The current paper presents a qualitative study about an experience of implementation a virtual learning environment (VLE) in higher education, in the course English Morphosyntax taught in the B-learning modality. The multi-functionality of Learning Management System (LMS) Moodle and its tools were used in its design. The layout of the course was organised into three main sections arranged around the contents of the subject: the parts of speech (determiners, nouns, pronouns, adjectives, adverbs, verbs, & prepositions), kinds of sentences (relative clauses, passive voice, conditional sentences, reported speech & adverbial clauses) and word formation. Each topic section consisted of different materials in several formats (PDF, word documents, PowerPoint presentations, podcast, videocast), assessment and self-assessment activities designed through asynchronous tools (online glossaries, online quizzes, wikis), and virtual spaces in which participants could interact (forums, chats).

In the following section, the researchers review the most current and relevant researches around virtual learner-centred learning environments.

BACKGROUND

In 2013 Amandu, Muliira and Fronda carried a research whose goal was to know if Moodle e-learning platform was used to successfully promote student self-directed learning among undergraduate nursing students. The experiences reported in that paper were based on observations from the different teaching and learning activities developed at the College of Nursing (CON) at Sultan Qaboos University in the Sultanate of Oman, specifically in three undergraduate nursing courses: Health Assessment, Nursing Administration and Health Promotion. In that experience, the VLE designed through Moodle and its tools were described as user friendly and affordable innovative strategies that teachers could use to promote student-centred environment. Moodle was used appropriately to adapt to learners' needs, to engage them in the teaching-learning process and to participate beyond the limits of the official lessons. The cooperative learning facilitated through the interactive online resources of the environment favoured learners' achievement, their self-reliance, as well as the acquisition of lifelong learning skills.

The experience developed by Barker and Gossman (2013) focused on the opinions of 248 second-year students at an English Sixth Form College (SFC), 155 females and 93 males. The researchers carried out a quantitative research and the data were collected through an e-questionnaire. The results stated that the use of a VLE had a positive impact on student learning and promoted individual and autonomous

learning as well as cooperative one. The quantitative data obtained also suggested that the VLE increased the students' motivation to acquire the contents of the course. Moreover, the learners highlighted the opportunity they had to be in the centre of the learning process and in control of learning, having the possibility to learn at the time and place that they chose.

In 2015 Akamavi et al., presented a cross sectional study in which was used a triangulation method, building on qualitative and qualitative data. The data were collected through an online self-administered questionnaire divided into four constructs, Learning Experience, Module Delivery, Diffusion Rate category and level of perceived innovative attributes, which was filled in by 209 university students. The results highlighted how collaboration between the participants had a positive significant effect on their learning experience. The learners had an active role in the teaching-learning process and were engaged in the learning experience in the social virtual community created in the virtual environment.

Dhakal and Sharma (2016) presented an experimental case study research in which it was used a mixed methods research, qualitative and quantitative. It was a part of a longitudinal study carried out at University Campus, Kirtipur, in the Central Department of the Faculty of Education (CDED) with a focus on the Master's course in mathematics education, specifically in the course *Projective Geometry*. Its goal was to explore and analyse how the implementation of a VLE could contribute in interactive and engaged learning between and within students and teachers in higher mathematics education. The sample was composed of 36 participants, 28 male and 5 female. Researchers used different instruments to gather the data as questionnaires, observation, interviews and archive analysis. The results showed that the participants were found more active and interactive in learning through VLE. They were engaged emotionally, socially, and cognitively. Moreover the VLE provided opportunities to learn and re-learn mathematical ideas in order to clarify the concepts.

Finally, in 2017, Herrera carried out a descriptive qualitative research to identify the impact of implementing a VLE in English as a foreign language (EFL) courses at a public university in Colombia according to learners and teachers' perceptions. The sample of the study was composed of 5 teachers and 210 learners. The research instruments used to gather the data were questionnaires, observation, and narratives. The main results showed that the participants felt enthusiastic and motivated towards the use of VLE in EFL courses and increased participation. They were totally involved in the teaching-learning process and development of tasks, trying to connect their previous knowledge and new one. Moreover, it offered different possibilities to adapt to the students' needs what maximized their learning opportunities.

In the following parts of the current study, the researchers provide an overview of the qualitative study carried out at the Pontifical University of Salamanca. First of all, they refer to the research method, the objective and the research questions, the population and the sample of the study, the instrument used to collect the data, the way in which data were collected as well as the data analyses done. Secondly, the researchers present the results obtained from these analyses. Finally, they show the main conclusions of the study according to pre-service teachers' perspectives towards a VLE to establish its effectiveness to support the learner-centred approach.

METHOD

Based on the main goals of the research, it was applied a descriptive study with a qualitative approach (Coleman & Unrau, 2005; Creswell, 2005, 2009; Hernández, Fernández & Baptista, 2010). The process of the Grounded Theory was followed for the categorization of dimensions. The theory emerged and

developed inductively from the research data, not deductively from theoretical frameworks (Glaser & Strauss, 2009). As Glaser and Strauss (2009) point out, that process of analysis is dynamic and creative, and two fundamental strategies are distinguished: the theoretical sampling and the method of constant comparison. The theoretical sampling refers to the process of data collection, and also to the analysis and categorization carried out by researchers until theoretical saturation occurs, that is to say "when no additional data are found that advance, modify, qualify, extend or add to the theory develop" (p.61). On the other hand, the constant comparison method intends to generate theory from a constant comparative analysis of the data collected. Thus, researchers encode and reflect on the type of data they are collecting from the beginning (Trinidad, Carrero & Soriano, 2006).

The qualitative design of the present research was divided into two phases. The first stage involved the choice of the research topic, the location of the fieldwork, the methodological decision, the selection of the instrument to collect data and the population of the study. The researchers also did an exploratory analysis of the previous researches and literature review. In the second stage of the research, it was chosen the data analysis software and the categories and subcategories were defined. The researchers also carried out the tests of validity of the categories (analysis of interjudges) and the test of reliability. After that they proposed the final categories of analysis, designed the concept map, arranged and transformed the data, and carried out the analyses.

Objective and Research Questions

The goal of the study was to explore pre-service teachers' perspectives towards a VLE to establish the intrinsic reasons that could determine its effectiveness or ineffectiveness to support the learner-centred approach.

The research focused on the following research questions:

Q1: How do the pre-service teachers perceive the VLE in terms of effectiveness?
Q2: How do the pre-service teachers describe the learning experience?
Q3: Does the VLE favour the learner-centred approach?

Participants

The population of the research included a total of 94 learners, studying the last year of the Degree in Primary Education (English) at the Pontifical University of Salamanca. All of them were enrolled in the subject English Morphosyntax in the academic year 2016-2017. That course was a compulsory subject at the third year of the Degree and involved a total of 6 ECTS credits, 150 hours. The population was divided into three groups. Each group had a face-to-face lesson of 50 minutes once a month and two compulsory virtual lessons of 45 minutes every week taught through the platform Blackboard. Moreover, each group had two optional hours of individual tutorials every week to solve doubts about the subject. They could connect to the professor through email or phone, or they could assist personally to her office. The final sample of the research was made up of 35 participants, it was theoretical sampling, systematic, non-probabilistic, sequential and cumulative, the necessary one to reach data saturation and get enough information to meet the aim of the study.

Instrument

The researchers decided to use individual semi-structured interviews to collect qualitative data. On one hand, that kind of interview allowed researchers to prepare a set of questions that referred to the specific phenomenon of the study. It was semi-structured interview since although they had a list of questions, they were totally free to reword them, change their order or add a new one according to each situation and participant. On the other hand, it was used an individual interview since it offers a more comprehensive and higher-quality approach to individual discourse, it encourages intimacy and free expression, it is more feasible and more intense and allows easier analysis.

Data Collection and Analyses

Qualitative data were collected in December 2016 and January 2017 at the Faculty of Education at the Pontifical University of Salamanca. Each interview was recorded to facilitate the later transcription and its accuracy. Before starting each interview, each participant was reminded of the research objective and was asked his or her consent to participate in the research and record the interview. Once the fieldwork was finished, the researchers followed the three phases of the scheme proposed by Miles and Huberman (1994) to code and analyse qualitative data: data reduction, data display phase and drawing and verifying conclusions. During the data reduction phase, the researchers carried out the separation of units according to thematic criteria; they decided to use the line as textual unit not to distort the meaning of the texts. They also identified and classified the elements through categorizing and coding of data units to recognize their thematic components and classify them in a certain content category. Categories were defined deductively, with a priori categories, and inductively, introducing modifications when data were examined, so categories were renamed or eliminated. Researchers used the software NVIVO11 to carry out categorizing and coding. Secondly, in the data display phase, the researchers arranged the qualitative data in different tables and figures, using the software Microsoft Office Word, to illustrate the qualitative results. Finally, in the drawing and verifying conclusions phase, they presented the results and their interpretations, and extracted the conclusions from the study.

RESULTS

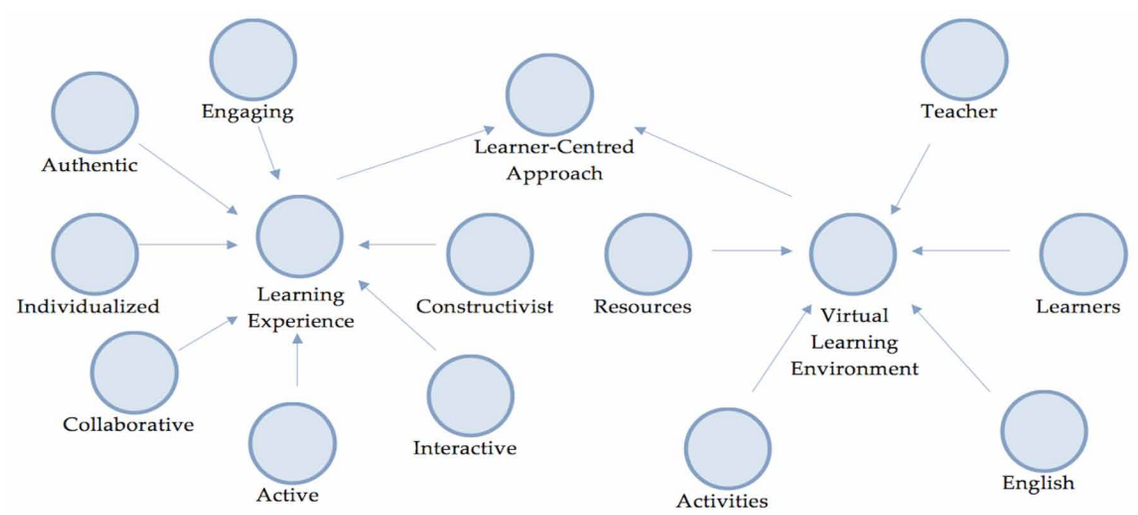
The main results obtained in the qualitative content analysis are presented in the word cloud (Figure 1), which is based on the analysis of the coded nodes done through the software NVivo11. The figure shows the thirty words that appeared with the highest frequency. Regarding to the references to them, the ones that appeared with more frequency in the participants' discourse were: learning (968 references), knowledge (826 references), competences (801 references), constructivism (780 references), technology (776 references), lifelong (714 references), English (705 references), roles (690 references), learner (686 references), protagonist (650 references) and teacher (609 references).

Figure 2 shows the two main categories and their sub-categories extracted from the content analysis: Learning Experience (Engaging, Authentic, Individualized, Collaborative, Active, Interactive, Constructivist) and VLE (Resources, Activities, English, Learners, Teacher)

In the following lines, the researchers present in a more specific way the results of qualitative content analysis, including the verbatim quotes from the participants.

Figure 1. Word cloud

Figure 2. Concept map



The pre-service teachers' valuations about the experience developed around a VLE in the course English Morphosyntax were quite positive.

They considered that they had achieved the learning objectives of the course that referred to the parts of speech (determiners, nouns, pronouns, adjectives, adverbs, verbs, & prepositions), kinds of sentences (relative clauses, passive voice, conditional sentences, reported speech & adverbial clauses) and word formation. Moreover, they emphasized that they were able to integrate the new contents with their prior knowledge what generated significant advances in learning a second language.

The experience developed through the VLE of the course English Morphosyntax has been quite appropriate to achieve the learning objectives and the contents of this subject.

The materials available and the activities developed in the VLE during this course have been very effective and have provided opportunities to practice and acquire the objectives and contents, and to activate our previous knowledge in this second language.

The findings also indicated that the VLE implemented and the instructional approach behind it allowed the participants to reinforce their autonomy and independence in learning, as well as the collaboration between them. Those two ways of learning fit together well, since it was evident that the students improved and developed autonomous learning skills as well as other skills such as respectful attitudes, interpersonal skills (commenting on classmates' contributions), teamwork, task management and communication.

The pre-service teachers pointed out that they had had enough activities and resources to practice and the freedom to manage their pace of learning. They considered that they were the main participants of the teaching-learning process, and that the instructional approach designed in the VLE implemented placed them in the centre of all, what had led to a personalized education and to an autonomous learning, successfully adjusting to the participants' different learning styles.

I emphasize the planning and method of the VLE because it allows us to learn at our own pace. We have decided, taking into account our personal and professional duties and our free time, when we connected to the virtual environment to download the materials or do the activities. In my opinion, I have felt that I have been part of a more personalized education. It has been designed an environment in which it has been taken into account the diversity of the participants. It has adapted to the heterogeneity of us and to the needs of each one.

Undoubtedly the VLE in which I have participated has been much more personalized than any other learning experience I have had. There have been used many technological tools to designed the activities and different resources to provide the contents that have perfectly adapted to our needs and to the different types of learning. It has been a much more personalized education that it is centred in us, taking into account the personal characteristics of all of us, and our needs in the second language.

On the other hand, the participants stated that the environment implemented had allowed them to participate in different activities with their classmates, promoting collaborative learning, interaction and the creation of a learning community. The pre-service teachers believed that it had been possible because they had had the necessary technological tools to promote collaborative learning although they

did not share the same physical space or did not connect at the same time. They also pointed out how the collaborative virtual learning developed had allowed them to help each other to achieve the learning objectives and the contents of the course, to resolve their doubts and improve their knowledge and skills in the second language.

The participants directly connected the possibilities that they had had to develop a collaborative work with the technological tools used in the VLE (online glossary, forums, wikis) since they considered that these asynchronous tools facilitated the completion of different activities in groups as well as a constant communication between the participants of the teaching-learning process in which the solve doubts, share ideas and create knowledge. They even pointed out that it was encouraged participation in a fluid way and there was more teamwork in the VLE implemented in blended learning modality than in traditional face-to-face lessons. The students also pointed out how such participation increased their commitment to doing a good work and helping any member of the formed learning community.

The virtual environment has provided us different technological tools to develop the activities and work as a team, avoiding an individualistic learning. We have had, for example, the forums to work together and solve our doubts about the content of the course, and the design and development of wikis of English grammar lessons or methodological ideas for teaching English. Both tools have allowed us to communicate with our classmates, with whom we have shared the virtual environment, and to work together.

(…) We did some of the activities in groups. We have had different technological tools such as forums to work together and help us to develop the wikis, and to exchange methodological ideas to teach English in primary schools. We have also used these forums to communicate with our classmates.

I also emphasize how the use of some technological tools have allowed us to work as a team. For example, we have designed together different wikis and have used different forums to share our ideas. All this has improved or promoted collaborative learning and teamwork. I consider that we have been the real protagonists of our learning.

It has been a team work. The activities carried out with others have allowed us to have a fluid communication and participate more in the different tasks proposed in the VLE. We are pretty committed to the work developed in the community created in which we have not only depended on ourselves but also on our classmates.

The learning experience made possible to work collaboratively not just during the face-to-face lessons but also in the virtual classes and whenever we wanted since the materials and technological tools provided let us work as a group independently of the place and the time.

The way in which it has been designed has favoured collaborative work in which we have learned together and have shared everything.

The learning experience described, as an active experience was another of the subcategories extracted from the content analysis. The majority of the pre-service teachers emphasized that the VLE implemented and the instructional approach behind it contributed the collective construction of knowledge and the participants' active role in the teaching-learning process (Pinto-Llorente, Sánchez-Gómez, & García-

Peñalvo, 2014). In this environment, the pre-service teachers were active constructors of knowledge rather than passive participants. They did not only download, read and memorized the contents of the course provided by the teachers, but they also analysed them, planned the activities and their contents, they collaborated in the development of the tasks and the creation of knowledge, and helped each other. They were able to construct knowledge working in learning groups, and exchanging their points of views about the different learning objectives and contents of the subject, and they kept an active role during the whole process.

The qualitative results also demonstrated how the learning experience was engaging since the participants were involved in the virtual group work activities. The fact of being an active and engaging learning experience increased the participants' motivation and interest towards the contents of the course.

We have been actively involved in the development of the activities; we have taken the decisions and have assumed individual and group responsibilities.

The way in which everything was planned has engaged us and has encouraged our active participation during the course.

The development of some e-activities through different technological tools has allowed us to participate more actively in the course, to contribute to the construction of knowledge, and to demonstrate what they had learned.

We have been actively involved in creating knowledge, instead of just learning.

The VLE of this course has fostered that we have been active engagement in the learning experience through the development of different activities.

The learning experience, as an interactive experience was another of the main subcategories extracted from the content analysis. Most of the participants considered that the possibilities provided in the VLE for the interaction between the participants of the teaching-learning process were essential for the effectiveness of the learning process. The pre-service teachers specifically emphasized how they could interact with their classmates during the development of the activities or when they wanted to ask a doubt or contribute to solve some questions about the contents of the course because the environment provided them the necessary technological tools to do it. They also referred to the asynchrony of those tools that allowed them to interact accurately and effectively even though they did not share the same place and did not connect at the same time, eliminating all the spatial and temporal barriers, and making the learning experience more dynamic.

The forums available in the virtual environment have allowed us to communicate with all our classmates, to share ideas, to help us to solve our doubts or to divide the tasks. They have provided a fluid interaction between all the participants.

The fact that we could communicate through different technological tools available any day at any time have increased and have contributed to the possibilities to interact between us.

The interactive virtual spaces designed and implemented through technological tools have encouraged active real-time and asynchronous communications, and have improved the learning experience in the VLE of the course.

The findings of the qualitative study also revealed that the resources and activities of the VLE provided English contents in a real context, in a natural environment, in real experiences and situations to learn, practice and achieve the learning objectives and contents of the course of English Morphosyntax. The participants highlighted the access to authentic materials and practices of the second language.

We have had access to authentic materials in the second language taken from several sources through the technological tools available in the VLE and through the files uploaded in the environment.

The majority of the materials and resources were authentic, and placed in real-world contexts.

The use of authentic materials in this course has helped us to improve our level and learn how to communicate most effectively.

Other three main sub-categories extracted from the content analysis that refer to the VLE implemented in the course English Morphosyntax were those related to teacher, learners and resources, specifically these sub-categories made reference to their roles in the environment, and in the development of the teaching-learning process. On one hand, the pre-service teachers stated that the teacher had a relevant role in the success of the course implemented. However, they described that role not as a dominating trainer, as a primarily and only knowledge transmitter, but as a guide and facilitator of the learning and the development of the activities. On the other hand, the participants considered that they had an active role in the learning process; they managed their own learning according to their personal situation, and reflected about their specific needs in the second language to achieve the learning objectives and contents of the course. Finally, the majority of the participants attributed to the resources available in the VLE, specifically to technological resources, a relevant role for the success of the training.

I feel that I have been an active part of the teaching-learning process and have loved the way in which we have had access to all the resources and the tasks that we have been able to develop through the different technological tools. It is clear that all this has increased my interest and motivation for the course. I have felt free to decide and explore all the possibilities offered in the learning experience and in the VLE to achieve the learning objectives and contents of the course.

We have been actively involved in the learning process, in the development of the tasks and the creation of knowledge. We have taken decisions and assumed individual and group responsibilities.

The role of the teacher is completely essential for the success of the VLE of this course.

I considered that the teacher has made a great effort in the previous design of the environment and during the development of the course. She has guided and has helped us during the whole process.

The appropriate use of the technological resources has made possible the implementation of this environment to do the tasks, to communicate with our classmates…

Finally, the results of the analyses of the pre-service teachers' discourse referred to the VLE as a model in which the teacher had provided them diverse kinds of activities that had helped them to achieve the learning objectives and contents of the course, improve specifically their level of English Morphosyntax, and gain or increase their confidence to use the second language.

We have had the necessary activities to practice the contents of the course and improve our level of English.

There were different activities that have helped us to practice and learn the contents of the subject

The resources and activities available in the virtual environment facilitated the acquisition of the contents.

I have definitely improved my level in English and I feel more confidence and motivated to carry on with my training as future primary education teacher.

CONCLUSION

To meet the goal of the current study, the researchers analysed the pre-service teachers' views towards a VLE to establish the intrinsic reasons, which could determine its effectiveness or ineffectiveness to support a learner-centred approach. The results of the study proved that the environment was effective, on one hand, to achieve the learning objectives and contents of the course that referred to the parts of speech (determiners, nouns, pronouns, adjectives, adverbs, verbs, & prepositions), kinds of sentences (relative clauses, passive voice, conditional sentences, reported speech & adverbial clauses) and word formation, and to generate significant advances in learning a second language, and, on the other hand, to facilitate the development of learner-centred pedagogy in higher education. The study clearly provided specific evidences of the pre-service teachers' satisfaction towards the learning experience and a positive attitude to carry on with their training.

From the results, it can gather that the VLE implemented contributed to support not only the participants' autonomous learning but also the collaborative one that led to the foundation of a community of learning in which the pre-service teachers were involved and created knowledge (Baker & Gossman, 2013; Gan, Menkhoff & Smith, 2015; Lee, 2010; Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2017a, 2018a; Twu, 2010). There was a change from the traditional individualism to the collective construction of knowledge that was a dynamic, active process in which the pre-service teachers participated actively. The possibilities offered to work as a group brought them several opportunities of learning, helping and motivating each other (Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2017b).

The fact of providing several individual and collective activities and the use of synchronous and asynchronous technological tools clearly granted that the pre-service teachers could participate in the learning process and could have an active role in the acquisitions of the contents and in their progress in the second language what facilitated their engagement in the course (Altanopoulou et al., 2015; Kessler & Bikowski, 2010; Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2015a, 2018b). All that also favoured a constructivist learning in a constructivist environment that involved the students in the de-

velopment of knowledge by having an active role in the teaching-learning process in which they learned interacting with others (Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2015b, 2016a). The success of the learning experience in the VLE implemented also relied on the teacher's role since she played an essential role as a guide and facilitator of the learning and of the development of the activities (Jeffrey et al., 2014; Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2018a; Yeh & Swinehart, 2017). The results clearly highlighted the potentiality of the design, the resources and technological tools of the VLE implemented to supply a natural environment in which the participants were exposed to authentic and real experiences and situations to practice and improve their level in the target language (Akbari & Razavi, 2016; Mart, 2013; Pinto-Llorente, Sánchez-Gómez, & García-Peñalvo, 2016b). Moreover, the results revealed the flexibility of the VLE that it had been translated into: (1) a universal access to the materials and resources of the model implemented; (2) a fluid interaction between the participants of the learning experience beyond all the temporal or spatial barriers of other kinds of instructions; and (3) an education that allowed the pre-service teachers to reconcile personal and professional obligations with their needs of lifelong learning (Lan, 2015; Sánchez-Gómez, Pinto-Llorente, & García-Peñalvo, 2010).

To sum up, the research and its results have proved the potential of the VLE implemented to support the learner-centred approach. Moreover, it has contributed to the development of good practices in the B-learning modality and in the teaching-learning process of a second language in higher education.

FUTURE RESEARCH DIRECTIONS

The main limitation of the study was the data collection since it was limited to a University, a degree and a small sample. The repetition of the research at different universities and degrees with a larger sample size could allow an appropriate generalizarion of the findings of the study.

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KEY TERMS AND DEFINITIONS

Autonomous Learning: It refers to a situation in which learners are responsible for their learning. They take charge of their own learning and are actively involved, taking individual decisions according to their necessities or preferences focused on the goals they need to achieve.

Blended Learning: A kind of education modality that combines both face-to-face and online lessons.

Collaborative Learning: It refers to a situation in which a group of students learn together and have an active role in creating and sharing knowledge.

Higher Education: It is the third level of education. It is beyond secondary education and is normally provided by universities or colleges.

Learner-Centred Pedagogy: It refers to a pedagogy that places students at the centre of the teaching-learning process. Students are more active and participative, and the process turns knowledge into a negotiation between teachers and students. Furthermore, this pedagogy starts from students' interests and objectives, and it carries out a learning process based on real situations and materials, using the current technologies to favour this process.

Learning Community: It refers to a group of students who work collaboratively, share knowledge and have common learning objectives.

Primary Education: It is the first step of compulsory and formal education. Primary Education in Spain consists of six grades.

Qualitative Research: It is a methodological approach base don an interpretative perspective focused on the understanding of human behaviour. The techniques used to collect qualitative data are observation, interviews (semi-structured interviews, unstructured interviews, structured interviews), group discussions, evaluation of personal experiences, interaction with different communities or recordings of life stories.

Chapter 55
Techno Task:
A Step Ahead in Learning and Teaching English as a Second Language at Elementary Level

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ABSTRACT

Language is all about words and meanings. Language is powerful when it is being used perfectly and relevantly. The more it is used, the better it is learnt. Today, learners want language to be learnt in a holistic and exciting way with a slice of life in it. Language is essential to communicate in our day to day in varied lively situations. Learning happens everywhere and anywhere as the language is embedded in all situations verbally and nonverbally. In this techno world, learners have an abundance of learning materials to improvise their language learning ability extensively. Teacher as a facilitator in the teaching milieu should sieve required tasks for her/his wards to make them comfortable to learn the language interestingly. She/he should select tasks those are embodied with the qualities of observation, analysis, and performance in every learner. The chapter focuses on the various essentialities of teaching and learning English as a second language through techno-tasks.

INTRODUCTION

English as a second language is a widely used language across the world and especially in Asian countries. English language has a universal appeal to the second language learners. The aim of learning a second language is different from one country to another but commonly for the development of the economic status of such a country as well as its subjects. In this techno world, learning a language is just a click away but learning a second language in a classroom is mandatory in all second language using countries, especially in South Asian countries. It is mandatory because learners should be exposed to the learning

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supplementary for honing their learning ability by the teachers in the classroom. This chapter focuses on the availability of e-task resources to teach English as a second language.

Objectives of this chapter

- To identify the use of techno tasks in learning and teaching English as a second language
- To improve the four essential language skills of second language learners at all levels
- To share suggestions on developing the skills of the SLL (Second Language Learners) through techno tasks.

BACKGROUND

Learning English is a necessary evil for many second language learners in South Asian countries because their future prospect is at stake if they are unable to communicate or understand English as a language. It is mandatory in all the south Asian countries to learn English from Class I to tertiary level even though medium of instruction is a regional or country language. The glamour surrounded around the language makes parents from all strata wanted to enroll their children in English teaching school. English learning is always a costly affair for many learners from rural background but technology helps them to overcome the fear of learning a second language with the help of the teacher at the initial stage. The growing popularity of the language ensures that the parents are striving to give their children English language knowledge and language skills (Song, 2011). The move to introduce English at the early education is the wide-spread belief that children find it easier to learn and English enables them to achieve greater overall proficiency (Nunan, 2003). Learning English at an early stage of primary schooling can be beneficial. When children learn the language it will help them to develop the intercultural awareness to build the global citizenship that aid them increasingly interconnect with planets (Read, 2003; Tinsley and Comfort,2012). Learners should be given exposure and teachers should update the knowledge in technology and introduce activities that can build and sustain motivation and positive attitudes among the learners. The activities with a more explicit focus on language analysis are better suited to older young learners (Agullo, 2006; Nikolor and Mihaljevic Djigunovic, 2006). In many situations, there is still a lack of teachers with the requisite pedagogic skills to cater to the needs of young learners. Teachers may struggle to adopt the more communicative approaches, advocated in work with young learners (Butler, 2005) and some may pursue teaching practices more suited for older learners, especially secondary school teachers who are compelled to work with young learners without adequate preparation in the classroom (Gahin and Myhill, 2001, Howard, 2012 cited in Emery 2012). The survey conducted by Emery (2012) suggests that many English teachers have had little substantial overall orientation to the skills and repertoire of classroom activities appropriate for teaching English for children. In the techno-era, teachers can use e-tasks and encourage learners to create autonomy learning environments that aid them to develop confidence and motivation after regular practice of various e-tasks.

Rixon's research (2011) revealed that for young beginners there was an attempt to teach letter sound links, and to focus only in the initial letter and a corresponding phoneme. E-tasks help learners to develop the basic language skills. Learners should be encouraged to observe/imbibe the language rather than learning it. They should enjoy the use of language and promote to increase their second language knowledge repository by indulging and performing various lively e-tasks. L2 researchers such as Nation

(1997), Day and Bamford (1998) and Krashen (2004) have posited that vocabulary gain is available to learners of English as a second language who read widely as well as play interestingly.

Second language acquisition through tasks involves naturalistic exposure to the language. Second language immersion makes learners to have good quality and quantity of input which are different from learners who have only classroom exposure to a second language (Ellis, 1989; Pica, 1983). Native language serves a potential source of knowledge for second language learning. Early morpheme-order studies (Baily Madden & Krashen 1974; Dulay & Burt 1974; Larsen-Freeman, 1975) focused on developmental sequences for second language learners which might be different from first language backgrounds with little effect of the first language (Long, 1991). However, many other studies have analyzed that second language learners are influenced by their native language in the process of acquiring the target language which is called transfer (Dechert&Raupach, 1989; Gass&Selinker, 1992; Odlin, 1989). Transfer can be either positive or negative. Positive transfer helps learners to acquire the properties of the second language easily with less effort and the negative transfer hinders learners in the course of second language acquisition (Odlin, 1989). The level of grammatical categories and features are the general approaches to second language transfer (Schwartz &Sprouse, 1996; Schwartz, 1998; White, 2003).

Chomsky (1965) determined that there were two proportions of language. One was language performance and another one was language competence. Performance deals with a particular language by paying attention to what a person utters, and competence is a deep language knowledge that must be analyzed through careful thinking. Competence is applicable to any principle of language learning. Chomsky stated that children's language acquisition is determined innately. A child is born with a blue print of language rules called the Language Acquisition Device (LAD). Smith & Miller (1966) with their research further enhanced these studies by defining LAD as the ability to know the difference between a speech sound and other sounds, formation of words, phrases, or sentences into patterns to communicate with others.

Learners' communicative skills can be developed by creating opportunities for interaction, group work and pair work. Though such opportunities are prevailed and created by teachers in the classroom, due to time constrain to finish the syllabus, most of the teachers dominate the classroom without providing interactional opportunities. Early studies on classroom interactional analysis pointed out the quantifying aspects of teacher talk and reduction level of interests among learners in the language learning process (Walsh, 2002). However, the quality of interaction and teachers' contribution to interactional situation can create a great impact on the learning outcome of learners.

Task based pedagogy facilitates the cognitive processes involved in second language production (performance) and acquisition (development) and their interrelationship. Willis (1996) has argued that tasks should be seen as small teaching/ learning items used inside the classroom that engage the learner in using the target language with a communicative purpose in order to render an outcome. Any content or topic can yield a variety of tasks, and it is up to the teacher to select relevant topic that will create interest among young learners to perform with motivation.

Tasks can involve listening, speaking, reading or writing or any combination of these skills. Task based approach strongly believes that language can be learnt through communication, as in first language acquisition and naturalistic L2 acquisition. Skehan (1996) defined a task as 'an activity in which: meaning is primary; there is some sort of relationship to the real world; task completion has some priority; and the assessment of task performance is in terms of task outcome'.. Krashen (1981) proposed that learners would acquire language when they are exposed to 'comprehensible input' and are motivated to attend to the input. Long (1996) has argued that acquisition is best served when learners participate in the negotiation of meaning. (i.e. the process by which two or more interlocutors identify and then at-

tempt to resolve a communication breakdown. However, negotiation of meaning may or may not result in mutual understanding). He also suggested that task-based teaching creates opportunities for learners to 'focus on form' and constitute them to acquire the language.

IMPORTANCE OF LEARNING ENGLISH AS A SECOND LANGUAGE

Language is essential for expression or depression. In this techno world language has taken various shapes. E-semiotic usages like emojis, are widely used by mobile users who always replace words with e-signs. Learning happens everywhere with stimulation if the participant is motivated to learn from the surroundings. In this techno world learners have abundance of learning materials to improve their language learning ability. Teacher as a facilitator in the teaching milieu should scrutinize required tasks for her/his wards to make them comfortable to learn the language interestingly. She/he should select tasks that are embodied with the qualities of observation, analysis, and performance in every learner. Learners consider English for communication on the basis of communicative learning structures rather than formal learning structures.

Different types of tasks can be introduced in the classroom by using gadgets. Electronic gadgets like phone, computer are learning tools and e-tasks support the learning system of learners to possess linguistic or grammatical competence (Chomsky, 1980). He further defines

By 'grammatical competence' I mean the cognitive state that encompasses all those aspects of form and meaning and their relation, including underlying structures that enter into that relation, which are properly assigned to the specific subsystem of the human mind that relates representation of form and meaning (Chomsky,1980:59)

Language can be learnt in interactive, innovative and supportive ways and progressive learning happens through e-tasks. Teacher should recognize the potentiality of learners by designing learner-friendly tasks in the classroom to make the learning process easy for them. While designing tasks teachers should consider three important elements and they are application, analysis and observation.

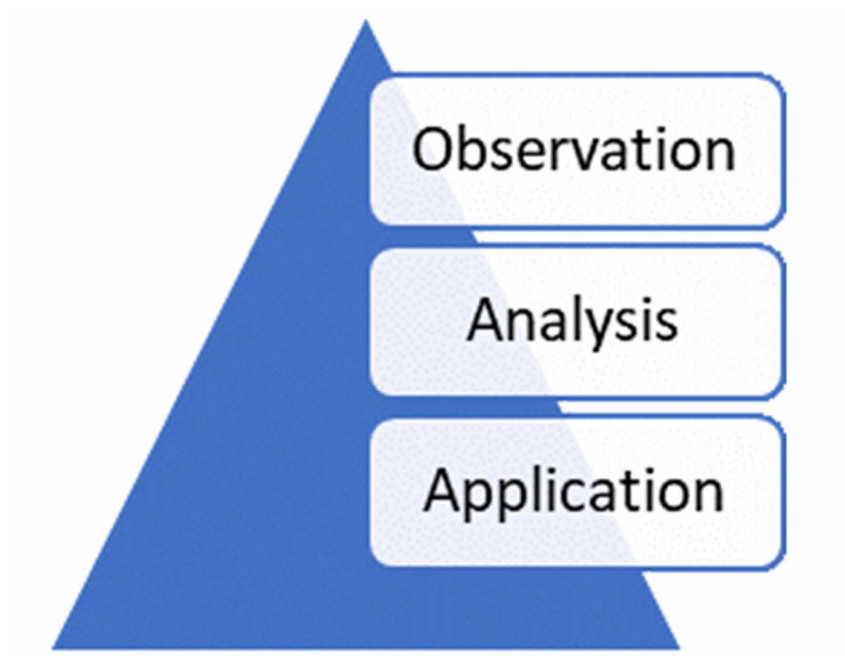
Application

Applying language is an art and students should have the mental calculation of applying language in a sensible way. The sensible ability can be improved only through practice. Using e-tasks in the classroom makes learners to apply language practically in various situations. Teachers should apply authentic materials like video or audio or other social application to make learners understand the quintessence of the language.

Analysis

Analyzing the tasks before introducing it to the classroom should be effectively done by the teacher. Proper analysis of the tasks will help students to enhance sentence structure formation and sentence construction ability implicitly. After the introduction of the tasks, students should analyze their thinking

Figure 1. Elements of learning English through tasks



process in developing all the skills. Some of the tasks are done in groups, so students should blend their judicious analysis with a subconscious language learning of reading and listening skills.

Observation

Observational skill is important in the language learning process because improvising of sentence structures can be done even from fellow beings as well as from surroundings. Observational skill is also essential for teachers as they should understand learners' learning capacity which is considered to be one of the main teaching points. Introducing activities and tasks in the classroom will advocate the facilitator to judge and justify the learning capacity of learners on various circumstances. When learners observe others, they learn and when a teacher observes her/his students, both complement each other in the successful process of language learning.

CONTEXTUAL AND CONCEPTUAL PERCEPTIVE

Contextual and conceptual tasks should be carefully organized and incorporated to enrich the learning content for students in the classroom. Contextual tasks develop the speaking and listening skills and conceptual tasks develop writing and reading skills. Some useful e-applications oriented tasks for making students to learn English in the classroom are described below

These applications, if properly designed, develop language skills and vocabulary to make them speak fluently and easily. Tasks help learners to understand grammatical aspects which attract them to learn the language without negative motivation. When learners are exposed to language through tasks, their

Table 1. Useful e-application for second language learning activities

e-Application	Learning components	Segment usage	Skills
Pinterest	Tense, article, preposition, Degree of comparison	Celebration photo, social gathering photo, moral responsibility photo	Writing and narrative
Instagram	Tense, voice, article, preposition	Favorite sport, compare and contrast visuals, comical strips,	Writing and speaking
Emijos	Active and Passive Voice	(To narrate a story) using emotional expressions	Speaking skill, writing
Facebook	Tense, article, voice, modal auxiliaries and other aspects	Videos	Listening, Writing, speaking and creativity
Twitter	Tense, article, preposition	Incident observation, Story narration, reacting to social issues	Reading, writing and speaking
e-newspaper	Vocabulary, sentence formation, phrasal verbs	Social awareness, news reporting	Reading, listening, writing and speaking
e-magazine	Vocabulary, sentence formation	Visual interpretation, article writing	Reading, listening, writing and speaking
Hike, Wechat, Whatsapp	Tense, verb, voice, article, preposition, sentence formation	voice modiulation, pronunciation,	Speaking and listening
Moviemaker	Sentence narration and formation	Story narration	Speaking
Dubsmash	Sentence formation	Story narration	Speaking and creativity
Memes	Sentence formation	One liner	Writing and creativity

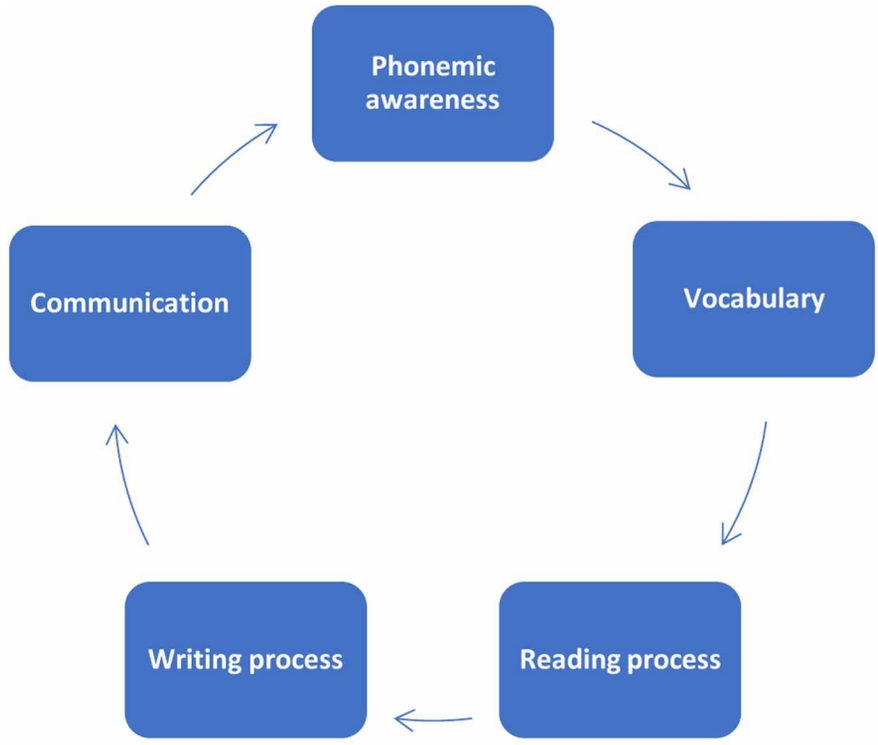
language learning capacity can be evaluated by teacher periodically. Learning with perfection leads to unlearning especially in the case of second language learning. Learners will become conscious of their mistakes if perfection is the prime motif of the tasks as a result they use the language in an imperfect way. Learners will maintain silence if perfection is inhabited in the classroom by the teacher. Tasks should encourage learners to learn from their as well as from others mistakes. If they become conscious of their grammatical errors, then the learning is saturated. Tasks help learners to use the language freely without any hard and fast rule. Tasks make learners to analysis how to observe language subconsciously and apply it consciously.

English Language Teaching and Learning Essentialities

Teachers should have a set of clear and rigorous teaching approaches for their students to make them know how to learn and use second language. Teachers can give importance to the below mentioned five standards while introducing e-tasks using various applications. The five standards are

The five standards help teachers to design effective and relevant e-tasks for a futuristic second language learning atmosphere in the classroom.

Figure 2. Five standards



Teaching Essentialities at the Elementary Level

Teachers should have a set of clear and rigorous developments for their students to make them know how to learn second language as they progress in school at each level. Teachers should aid students to develop language skill by promoting their listening, reading, speaking and writing skills. Students should be given importance in the below mentioned standards for their English competency. They are

- Phonemic awareness, word recognition
- Acquisition of vocabulary
- Reading process
- Writing process
- Communication: oral and visual

Tasks help learners to understand their latent power of language potentiality in various situations. Tasks create a good rapport and make learners to be at ease to share their views in a group as active participants. This section will focus on how the five standards will assist teachers to teach English language at the elementary level.

Children learn language from environment and it resonates to have communicative competency. The quality of English communication will not be evaluated and learners without inhibition can use the language while performing the varied tasks in the classroom. Learners commit errors while they

Table 2. Steps to design tasks for learners

Essential questions	Content	Skills	Resource items
• What role does grammar play in crafting a solid piece of communication? • How does a varied vocabulary and a consideration of word choice improve communication? • How to improve receptivity and creativity? • How can students use clues in the text to figure out words they don't know? • How to develop ideas for narrating a narrative or story? • How do students perform tasks?	• Grammar • Lexicon • Syntax and Semantics input	• Identification of error in sentences • Ability to eliminate any lifeless or misplaced modifiers • Capability to enrich lexical categories • Conceptualizing and applying contextual-oriented knowledge in comprehending L2 • Potential to remember spelling in the process of writing	• Reading books • Classroom magazine • Dictionary • Thesaurus • Library books • Online sources • Newspapers • Visual materials

communicate and most of the errors are developmental and will eventually be replaced by conventional forms without any intervention. Working in groups promotes academic learning of English and social development of learners including self-confidence, aptitude, attitude of learners as they socialize in language learning activities.

Motivation can be instilled in learners through tasks. Learners can understand themselves while performing tasks that is the most influential factors of motivation. Skehan (1991:49) observes, "Motivation can overcome unfavorable circumstances in other aspects of language learning." Gardner's (1960) research has been instrumental in establishing attitudes and motivation as a legitimate field of inquiry in its own right within SLA research. Gardner made the distinction between integrative and instrumental motivation. Integrative motivation relates to the way a learner has a desire to relate or interact and develop second language. Elementary level learners can be good at integrative motivation as they show interest in integrative learning process.

Phonemic Awareness, Word Recognition

Teachers can tap the potential of learners by translating the learning rhythm into communicating rhythm by considering the following points of the atmosphere

- Young learners should be exposed to identify letters, words and sentences as well as distinguish them
- Teachers should demonstrate to students how to understand the letter sound correspondence by uttering the sounds of the variety of letter patterns, such as consonant, long-short vowel patterns and by matching sounds to the corresponding letters.
- Teacher should blend two or four phonemes into words for a better learning
- Teacher can add, delete, or change sounds in a given word to create new or rhyming words for an interesting learning environment
- Using technology, teacher can familiarize young learners of picture words or visual words

- Teacher should read aloud with changes in emphasis, voice, timing and expression that show recognition of punctuation and understanding of comprehension to learners.
- Encourage learners to identify rhyming words with same or different spelling patterns
- Instruct learners to spell multi-syllable words
- Train learners to blend phonemes (sounds) of letters and syllables of unknown words with one or more syllables
- Teacher should develop the knowledge of common words (e.g. ite or ate) to sound out unfamiliar words
- Teacher should read passages slowly and clearly with appropriate voice modulation and expression
- Teacher should read text with automatic decoding skills.

Acquisition of Vocabulary

Vocabulary can be learnt better by understanding the context, concept, structure and resources. Teachers should give much importance in teaching vocabulary to learners to acquire vocabulary.

Contextual Understanding: Teacher should use the knowledge of word order and in-sentence context interpretation to support word identification to the learners. He/she should define unknown words while reading the text in the classroom. Teacher should use knowledge of word order and define unknown words while reading to the learners.

Conceptual Understanding: Teacher should identity words that have similar words, synonyms and antonyms. He/she should classify words into categories like animals, birds, colours. The teacher should help students to recognize common sight words. Teacher should aid learners to understand homophones such as fare and fair. Teacher should

- Identify synonyms and antonyms while reading the text to the learners
- Read accurately with high-frequency sight words
- Classify words into colours, fruits, vegetables etc.,
- Read homophones correctly so as to develop the conceptual understanding of learners.

Structural Understanding: Teacher should make students to predict the meaning of compound words using their existing knowledge of individual words (e.g. laptop, Bluetooth) .

- Teacher should determine the meaning of common compound words by explaining the relationship between the words contained in the compound words
- Teacher should make students to identify contractions and common abbreviations and connect them to words
- Teacher should teach students to determine the meaning of prefixes, suffixes
- Teach them root words (e.g. talk) and their various inflections (e.g. talks, talked, talking) to determine the meaning of words
- Teach them pronunciation by using a beginner's dictionary and techno based activities

Reading Process

Learners' learning ability is varied at all levels, as some of them rely heavily on receptive skills and not bothered about productive skills. This leads to having a lag between the development of receptive competence and that of productive competence in language learning. Some learners are varied in improving their receptive competence on their own by listening to various language learning sources. The habit of learning language happens through practice. School learners imitate their teachers and create their own way of production of utterances. When a learner learns English in school through exposure, he/she learns the second language in a natural way without translation as he/she learnt the first language. However, elementary level learners learn theoretical grammar, yet they do not know how to use verbs and nouns. So, it is necessary to use grammatical conceptualization through habit formation by practice. Making use of cognitive and linguistic processes, students learn the language they listen around them and use it generally to learn vocabulary, sound system, grammatical structure and social conventions of use.

- Teacher should encourage students to do their own interpretation of story using details from the prescribed text
- Teacher should provide opportunities to students to identity with the characters or incidents in a story that he/she narrates in the classroom
- Teacher should read and reread the beginning, middle and ending of a story in the classroom
- Teacher should establish a purpose for reading
- Teacher should predict the content, events and outcomes from illustrations and prior experiences and support students with examples from the text or background knowledge
- Compare and contrast information in texts with prior knowledge and experience
- Teacher should summarize text by recalling main ideas and some supporting details
- Teacher should create graphical representation and visual media with the help of technology to demonstrate comprehension
- Teacher should monitor reading comprehension by identifying word errors of learners and train them to self-correct them
- Encourage students to read books independently for various purposes
- List questions about essential elements from the prescribed texts (e.g. why, who, where, what, when and how) and share answers
- Compare and contrast different versions of the same story
- Describe characters and setting to the relevant milieu
- Encourage students to retell the story

Writing Process

Techno tasks boost learners' confidence and help them to develop language without difficulty. Such tasks give learners a life time experience to have a spontaneous interaction with others so as to prepare them well for their future prospects. Young learners are smart in learning anything new and it is the role of the teacher who possesses a panoramic view in teaching the effective method of writing. The following points should be considered or adopted to develop writing skill in the class room

- Teacher should generate writing ideas through discussion in the classroom

- Teacher should teach to organize writing to include a beginning, middle and end
- Teach children to complete sentences with subjects and verbs
- Use technology to make organizational strategies (e.g. pictures, or videos)
- Use resources or e-resources to teach effective vocabulary
- Encourage students to write, rewrite and illustrate writing samples as well as students' writing samples for display to share ideas with other students
- Create phonetically – spelled written work for students to read casually
- Students should learn the correct spellings of unfamiliar words, correct use of punctuation, use of correct capitalization and correct use of nouns, verbs and adjectives.

Communication: Oral and Visual

English teachers should devote precious classroom time to teach pronunciation for their students' legible speech in English. Communicative methodologies, which stress using the language rather than learning about it, and the pressure of the curriculum may mean there is little motivation or time for learning about derivations and compounds. Learners would learn the inflections of words, prefix, and suffixes, their meaning and increase the level of learning vocabulary through techno tasks. Native e-dictionary with pronouncing facility will improve the corpus and understand words or special register such as technical terms, social items, personal terms, essential terms, and relevant terms. Though acquiring 'native' pronunciation is challenging in a second language learning countries but using technology in a right way will develop learners to hone their pronunciation gradually.

- Teacher should use active listening skills as well eye contact with learners
- Teacher should give simple oral directions
- Teacher should understand learners' learning ability by comparing the poor knowledge and experience
- Teacher should speak clearly and understandably
- Animate simple dramatic presentation of poems, stories and songs to grab the attention of students

This section will describe about the variety of tasks to be used for developing the language skills of learners.

Activity Description

Young learners like to play tasks and if the teacher's own tasks are used to make them learn in an interesting way is a real success. While designing tasks, ideas can also be shared or taken from players that will develop collaborative learning. When the process is structured, start and have fun in playing!

Why Tasks are Helpful

Fun- filled tasks instill interest among learners. Such tasks develop team work, creativity and lateral thinking of the players.

Here's What To Do

- Playing and playing together, players can decide the kind of task she/he wants to play. Simple modifications in the available tasks can make players to change the playing style often.
- While designing a task decide the purpose of it. Will it develop the learning ability of players? Does the task improve the language skill of players?
- Collect all the required materials
- After designing a task on your computer or mobile, save the game in a folder. A few modifications on it will make players to have fun in playing and learning with a variety of commonalities with their fellow players..
- Create tasks in such a way where is can be photocopied or modified for future use.
- While preparing a task, think of presenting it in a simple way without confusion to players.
- Write the instructional plan clearly and the step by step process will help players to understand the task
- Design more attractive tasks to invite players to play for developing their language skills
- When a task is ready, launch it on a trial base to find out the required modifications to be done to make it playable without glitches.
- Play and learn!

Task One: Let's Listen Up

Aim: to improve listening skill

Preparation Time: 3- 5 minutes
Class time: 4-6 minutes
Materials required: a news article, smart phone with voice recorder application and sound system
Procedure

- Divide the class into groups of three each
- Teacher reads a news item to the class with stress and pause that will be recorded on the smartphone
- Instruct students to write down words starting with a particular letter. Each group can be given a specific letter. For instance, group A should write words starting with A.
- Now, instruct each group to read the written words to the class
- Teacher can check the listening capacity of students
- On contrary, even teacher can self-evaluate his/her recorded voice again and again for better modification and improvisation if necessary.

Task Two: Store a Story

Aim: to develop listening and observational skill

Preparation Time: 5- 10 minutes
Class time: 4-6 minutes
Materials required:Smart phone, movie maker application or similar one,. LCD

Procedure

- Select a story
- Divide the class into small groups
- Read the story to the class
- List out a series of words pertaining to the story on the slide or board
- Instruct students to choose words and divide them categorically under various heading items like noun, abstract noun, common noun, verb
- Now prepare slides for common noun, proper noun, abstract noun, verb etc.,
- Teacher should put forth the slides into the movie maker application under headings like verb, noun etc.,
- Play the movie of noun, movie of verb to the students and instruct them to frame sentences on using shown words. Background music is optional but preferable

Tasks for vocabulary development

A few vocabulary tasks are designed to be used in the classroom for the students to improve their lexical skill.

Task Three: Vocabulary E-Card

Aim: to develop vocabulary learning skill

Preparation Time: 3-5 minutes
Class time: 3-5 minutes
Materials required: smart phone, e- dictionary
Procedure

- Teacher should prepare e-card mentioning conceptual words
- Divide the class into small groups
- An e-card can be given to each group to work on
- Instruct students to create sentences in a thematic way
- Set the time
- Now, instruct students to narrate the concept or theme to the class using a new word in the narration
- Advise other groups to jot down the new word that has been shared by each group with the class
- Each group should refer to e-dictionary to write down the meaning of each new word.
- Now, instruct each group to write and share sentences using the lexicon

Task Four: Vocabulary Album

Aim: to develop vocabulary learning skill

Preparation Time: 5-10 minutes
Class time: 3-5 minutes
Materials required: smart phone with internet connection, Instagram application or google images

Procedure

- Divide the class into small groups
- Use Smartphone to view pictures on Instagram or Google images
- Collect pictures which can be interpreted into single words
- Choose pictures according to the level of students
- Create separate album of photos to each group
- Each album can contain at least five pictures
- Now instruct students to write the words that are suitable to the given pictures in the album
- Give turn to each team to present their words to the class

Task Five: = or X

Aim: to develop vocabulary learning skill

Preparation Time: 3-5 minutes
Class time: 2-4 minutes
Materials required: e-dictionary
Procedure

- Divide the class into small groups of two each
- Prepare a set of ten words (antonym and synonym each)with answers in jumbled order
- Each group should find the synonym and antonym with in the stipulated time
- Each group can use e-dictionary as a lifeline at the time of playing
- One participant can select the correct answer and the other participant can help her/him in finding the correct answer by referring to e-dictionary
- This task helps students to learn words in a fun filled way

Tasks to develop speaking skill

Three sample tasks are given below to develop the speaking skills of learners

Task Six: Colour to Speak

Aim: to develop speaking skill

Preparation Time: 1-2 minutes
Class time: 3-5 minutes
Materials required: paper, colour drops
Procedure

- The task will release the creativity of learners that will enable them to speak
- This task can be played individually or as a group of two to three
- Instruct students to take a piece of paper
- Advise them to sprinkle ink or color drops on the paper
- Instruct them to fold the paper
- Advise them to press the paper evenly
- Now, instruct students to unfold the paper

- Different colorful designs will reflect on the paper
- Now, ask each student or the group of students to speak on the unique and innovative design she/he/they created
- Time is set
- Invite each group or individual to narrate the design in a free style description.

Task Seven: Describe ME

Aim: to develop speaking skill

Preparation Time: 1-2 minutes
Class time: 3-5 minutes
Procedure

- Divide the class into small groups of each two
- Instruct each team to get information about both the participants from each other
- Advise each participant of the team to understand a positive point and a negative point of the other participant
- Invite each team to share the positive and negative points of the team partner to the class
- To develop further, each one can share more positive and negative points or goals in life to the class
- The task develops positivism and confidence among students as they happen to know each other easily.

Task Eight: A White Lie

Aim: to develop speaking skill

Preparation Time: 1-2 minutes
Class time: 3-5 minutes
Procedure

- Divide the class into small group of two each
- Instruct students to think of a white lie that they can describe to the class
- Write down non-existing things as white lies in bits of paper and put them into a bowl example: inkless pen, square earth, lightless sun, etc.,
- Provide them clues if necessary
- Instruct them to narrative the concept in a humorous way to the class

SOULTIONS AND RECOMMENDATIONS

Learning is always a fun when it is taught in an innovative way. Learners can learn English using tasks with involvement. Teachers should be noted the below mentioned suggestions and recommendations while designing tasks and they are

- Introduce more fun elements tasks such as using games which are considered to enhance interest and involvement
- Introduce more of listening tasks which is underrepresented in the second language learning process in the classroom
- Ensure the tasks are engaging, authentic and based on the student's level of English knowledge
- Make sure that the tasks are designed with a range of connecting all the four skills
- Tasks should cater to the learners' need of mixed abilities and offer personalized and autonomous learning opportunities.
- Engage students to understand visualize and interpret texts in their own way
- Teacher should be tech-savvy so that he/she so that he/ she can access to high-quality technological applications and resources that can produce good exposure to global learning
- Teacher should understand the learning background of learners so that her/his learning tasks would suit the different needs and levels of learners
- Tasks should develop the skills including societal skills, problem-solving, lateral thinking and critical thinking of learners

FUTURE RESEARCH DIRECTIONS

World is one because technology is making it wholesome. Learners from any part of the world like to use technology to know about anything under the sun. Everyone is a learner pertaining to technology as it updates every minute globally so as to make everyone to learn more about 'latest' techno-related knowledgeable-items. Teachers are not far behind to know about the tentacles of technology as they are born to learn and teach to survive. More knowledge about technology will help them to design more informative and innovative tasks for their students to learn English as a second language.

CONCLUSION

Learners with determination to learn a language will acquire proficiency through e-tasks and learners without determination too will learn language easily through tasks. Tasks boost the confidence of the performers and motivate them to use English language confidently. Every learner is smart to learn and e-learners (electronic learners) are smarter and faster than c-learners (conventional learners) because everything is visually and virally in abundance for them.

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KEY TERMS AND DEFINITIONS

Elementary Level: This level of education at school is the compulsory education for children. This education happens at the prime time of students' life and happens before entering secondary education.

Lateral Thinking: Thinking in a creative way and finding a solution for a problem in a new and unusual approach.

Morphemes: It is a grammatical unit in a language that has meaning on its own.

Non-Native Speakers: Speakers whose source language or mother tongue is not English.

Phonemic Awareness: It is a division of phonological awareness in which learners can listen to sounds that can distinguish meanings. The word "bat" has three phonemes, /b/, /æ/ and /t/ and to separate the the word one requires phonemic awareness.

Second Language Learning: SLL is a process of learning a language other than the source language which is English.

Chapter 56
A Case Study on Extensive Online Reading in Higher Education

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ABSTRACT

The authors have noticed that students tend to focus exclusively on syllabus reading materials, ignoring reading for pleasure outside the classroom. Rarely taught in ordinary university classes, extensive reading skills may play an important part in the foreign language teaching and learning process. Given these facts, the authors decided to pilot an extensive reading program at the academic level, the ultimate aim being to implement it in the future. In addition, the pilot was continued with postgraduate students two years later. Therefore, the purposes of the chapter are to discover students' attitudes towards extensive reading and to assess the results of the pilot as reflected in their opinions with a view to conceiving a large-scale future reading program. The study attempts to shed light on the issues triggered by the introduction of such a program into the curriculum of Humanities students, being mainly concerned with the practical side of the phenomenon and highlighting the interdependence between the findings and the latest theories in the field.

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INTRODUCTION

In the digital age, the traditional manner of reading printed materials competes with reading online books and other web resources. As a matter of fact, it is not the medium, either printed or virtual, that matters, but the act of reading itself. As far as the teaching of English is concerned, the development of the reading skill is indispensable for language acquisition and a great challenge to foreign language programs is how to determine students to read in the context of today's society with its multiple temptations and recreational offers.

There is a general consensus that extensive reading programs are an important tool for teaching English as a second language. But, in spite of their tremendous contribution to the development of students' language skills, the difficulties entailed by the implementation and monitoring of such programs diminish teachers' enthusiasm about integrating them in the instructional process, especially in higher education.

As to university students, they tend to limit their reading activities to the topics of the syllabus, perceiving reading as a compulsory task that can ensure school success and not as a pleasant free-time activity. In other words, students are more interested in extrinsic rewards rather than in being intrinsically motivated readers. As Cambria & Guthrie (2010: 17) put it, 'students who read only for the reward of money, a grade or a future job are not the best readers', their major purpose being the reward itself and not learning. On the other hand, reading for enjoyment is a necessary but not sufficient condition to increase students' motivation for extensive reading. As the same authors point out (2010: 16), motivation includes 'the values, beliefs and behaviors surrounding reading for an individual. Some productive values and beliefs may lead to excitement, yet other values may lead to determine hard work.' This determination, the two authors explain, consists in three factors that propel students to read, that is, interest, dedication and confidence, meaning the combination between reading for pleasure and a planned effort to reach the intended success.

Using the internet as a source for reading may help teachers develop students' intrinsic motivation within a well-organized reading program. It is a fact that students resort to the internet on a regular basis with various purposes: to communicate with their friends, to look for information they are interested in, to enjoy themselves etc. Whatever the reason, they will always turn to the internet as a first choice. Tempted by its tremendous advantages (rapidity, accessibility, huge stock of information etc.), most learners prefer doing their research more on the web and less in a traditional library. Under such circumstances, changing the internet into a tool for developing students' reading skills cannot but contribute to the success of an extensive reading program.

Taking into consideration the power of the internet to motivate students to read, the paper aims to find and evaluate students' attitude towards extensive reading. This assessment was performed by means of a pilot program based on web resources. It lasted two academic years and included graduate and postgraduate students. The results offered by the pilot program were analyzed at the end of the first year of implementation (2013-2014), providing the authors of the chapter with valuable information about the participants' opinions. The analysis also identified the difficulties involved by such a program, and tried to find solutions that may help its application as part of the extracurricular activities of postgraduate students in the field of humanities in the academic year 2015-2016.

BACKGROUND

Before discussing the role of extensive reading in developing students' mastery of English, it is important to highlight the psychological mechanism that leads to successful language acquisition. That is why, before tackling the issue of extensive reading, it is essential to explain what motivation means.

Understood as goal-directed behavior, motivation is crucial to the process of learning, but, as Wentzel and Brophy (2014) show, this concept should be distinguished from other related concepts such as motives (people's reasons for doing something), goals (immediate objectives), and strategies (the methods adopted by people to achieve something). Although these concepts have different meanings, they are interconnected as in the following example: people respond to their needs (motives) by using a strategy in order to reach a specific goal (Wentzel & Brophy, 2014). Starting from these theoretical constructs, students' motivation to learn can be defined as a subjective experience 'reflected in the motives and goals they strive to achieve' (Wentzel &Brophy, 2014: 3) in the classroom context. In other words, it expresses students' 'willingness to engage in lessons and learning activities and their reasons for doing so.' (Brophy, Alleman, Halvorsen, 2018: 4). In the light of the need and goal theories, the definition of student motivation to learn should take into account the distinction between extrinsic and intrinsic motivation. If the former refers to students' responses to external stimuli such as rewords given by school or parents, the latter signifies the individual's pure desire to engage in learning in the absence of any need or external pressure. The shift from motivation built by means of extrinsic forces to motivation as internalized values and self-determination in pursuing goals lies at the basis of the pilot reading program.

The general framework of the research on the implementation of the extensive reading program was provided by two categories of studies, their principles being applicable to reading no matter the medium, printed material or web resources. The first category includes theories dealing with the effectiveness and positive effects of extensive reading on both cognitive and affective levels (Horst, 2005; Farrell, 2009; Nakanishi, 2015), whose synthesis of benefits is suggested by Nakanishi (2015: 9): 'the freedom students have to choose books, the degree of autonomy enjoyed by the students, and the motivation to continue reading'. Moreover, the academic environment seems to be ideal for the application of an extensive reading program because, as Nakanishi (2015: 10) highlights, 'the effect of extensive reading increases with older participants (…), who tend to learn language explicitly drawing on their analytical skills.' The second category refers to the extensive reading activities described by Bamford & Day (2004) who offer a wide variety of useful ideas for an extensive reading program, including complex activities by means of which 'teachers must take into account the effect of a class activity and a reading material not just on students' ability to read, but on students' self-images as readers, and on their feeling toward reading itself.' (Day & Bamford, 1998: 166).

Generally, extensive reading of printed material or online resources implies the same cognitive processes as intensive reading does, presupposing an interactive model that consists in 'constructing meaning from text through the use of both bottom-up and top-down strategies and skills' (Şahin et al., 2014: 65, Nuttall, 1996). In other words, to successfully accomplish a reading activity, students need three types of competences at work: background knowledge to help them understand the possible meaning of the text, information about the distinguishing features of the reading texts (fictional, non-fictional etc.) and a good command of the target language system. In the case of Humanities students, their 'familiarity with the context' and content is supplemented by their awareness of 'literary devices, such as metaphors and flashbacks'. (Jacobs & Farrell, 2012: 15). In brief, as Nuttall shows (1996: 127, 128), extensive reading 'can help readers enter the circle of growth', which she calls 'the virtual circle of the

good reader', on the grounds that it implies a multilateral and interrelated improvement connected with the reading speed, the capacity to understand ideas and a strong feeling of satisfaction while discovering the fictional world of the text.

Besides the characteristics of the reading process in general, the differences between intensive and extensive reading should also be considered when starting an extensive reading program. As shown in Table 1, what fundamentally separates extensive from intensive reading is that the former requires written material within students' language competence, these texts being accessible, easy and enjoyable. Furthermore, students are stimulated to read what they want in their own time and as much as they can.

Table 1. Intensive vs. Extensive reading

Intensive Reading	Extensive Reading
Reading for comprehension	Reading for pleasure
Students have to read	Students are motivated to read
100% comprehension of the text	Less than 100% comprehension
Word for word reading	Inferring the general meaning
Study of individual words and structures	Understanding sentences and discourse rules
Aid of the teacher in reading	Autonomous, independent reading
Reading above level	Reading according to level
Use of various comprehension strategies	Use of already acquired overall comprehension strategies
Use of dictionary for unfamiliar words and structures	Use of dictionary for vital words only
Short texts	Long texts
Reading done in classroom	Reading done outside the classroom
Teachers choose the reading material	Students select what to read

Due to the particular nature of extensive reading, it is essential for students to get familiar with various techniques for inferring meaning, and with the idea of accepting overall comprehension instead of word-for-word understanding, specific to intensive reading. To achieve these goals, regular exercises done during the intensive reading and semi-extensive reading activities as a preparatory stage are necessary because they may form a solid basis for the development of the students' skills within an extensive reading program. Apart from exposing learners to a variety of reading strategies, teachers should also try to develop their critical reading skills, which are needed when choosing or judging the significance of a text. Furthermore, as not all materials may be reliable in the case of an online extensive reading program, students must be able to distinguish the valuable sources from the irrelevant ones. As Watkins (2017: 7) states, the internet 'has many advantages, but it also brings with it challenges, particularly for less experienced readers, because we constantly need to make judgements about what is, and what is not, trustworthy'.

According to numerous researchers (Anderson, 2009; Grabe, 2009; Day et al., 2013; Eva Lai, 2017), extensive reading represents a great opportunity for students to use the target language structures in various situational contexts and develop their vocabulary knowledge in view of the fact that they can 'meet the same lexis repeatedly in communicative contexts' (Nakanishi, 2015: 10, Grabe & Stoller, 2013).

Summarizing the benefits of extensive reading, Day et al. (2016) mention four reasons why it should be applied to the English class: it enables students to practice English outside the classroom, it leads to a personalized contact with the language, emphasizing students' autonomy in learning, it is a pleasurable activity that may lead to a life-long habit, and it helps the development of both the reading and writing skills. As concerns the simultaneous development of the reading and writing skills, Bachiri (2017) also argues that students' exposure to various texts by means of extensive reading enables them to get into contact with different writing styles, sentence structures and rhetorical strategies, largely contributing to the enrichment of their language and their ability to produce language.

As to Humanities students, an extensive reading program would help them become not only proficient readers, but also proficient English speakers, which are indispensable qualities for their future career. According to Coady & Huckin (1997: 228), the great advantages of extensive reading are 'immersion in meaningful texts, incidental language learning, integration of oral and written language, focus on meaning rather than form and the fostering of high intrinsic motivation'. Consequently, the implementation of an extensive reading program based on web resources can help the educational process in higher education to shift the focus from the traditional teacher-centered instruction to a student-centered approach. As Jacobs & Farrell (2012: 3) point out, 'By giving students more control of their own learning, for example, by students choosing what they will read; by students giving their own interpretation of what they read and bringing their own experiences, hopes and beliefs to the text and by students putting their own stamp on what they do while and after reading, ER can fit this student centered paradigm' (2012: 3). Thus, an extensive reading program adapted to the present-day technology may pave the way for a qualitative educational change at academic level.

METHODOLOGY AND METHODS

To make students value reading outside the classroom, an extensive online reading program would be beneficial to adult learners, especially students in Humanities, for the reason that it suits the cognitive processes required in an academic environment.

Piloting this program offered the possibility to see how intensive reading harmonizes with extensive reading within a controlled approach whose final aim was to reinforce and develop students' English language skills.

Starting from the above-mentioned objectives, the following research questions were kept in mind:

RQ1: What are the major gains of an extensive reading program adopted at academic level?
RQ2: What drawbacks can such a program bring about in the educational process?
RQ3: To what extent can extensive online reading motivate students to become proficient readers?

The questions used in the focus group sessions organized with Masters' degree students were:

Q1: Do you consider the fifteen minute reading session was useful or not? Give arguments.
Q2: Do you find the activities within the reading club useful or not? Provide arguments.
Q3: In your opinion, what are the advantages and disadvantages of reading online?
Q4: What other extracurricular activities would you suggest to determine students to read for pleasure?

Q5: If you become an English teacher would you implement these types of activities with your students? Why/ why not?

Participants and Procedure

To put into practice an extensive reading program based on web resources in the University of Ploiesti, instructors constituted 2 groups of learners who volunteered to take part in the research. 64 undergraduate Philology students in the second year were involved, 38 specializing in Romanian and English and 26 in English and French. The program was based on volunteering because the Philology curriculum includes a variety of reading materials for the studied subjects and an extensive reading program would have meant a supplementary effort that not all students were willing to make. Out of the 64 participants in the pilot program 30 students enrolled in the Master's degree and continued the program under the form of extracurricular activities.

The pilot research consisted of 3 major stages with different targets: to examine students' reading experience and establish the list of online reading materials; to implement the extensive reading program; to evaluate its effectiveness and set new strategies for the future.

During the initial stage a survey was administered to discover the participants' experiences, habits and attitudes towards reading in English. They had to answer several closed items to check their reading preferences and several open items focused on the reading time in English, their favorite writers, the difficulties encountered when reading and their perception of their own reading skills. It should be noted that the survey was very useful for orienting the reading list included in the program because it showed the kinds of texts mostly enjoyed. But to establish a coherent and efficient reading approach, it was necessary to identify the reading level of the students by means of a reading assessment test which was conducted at the end of the first semester of the academic year 2013-2014.

The results of the surveys enabled the preparation of the second stage that consisted in making the list of the online reading material. As freedom of choice is the basic criterion of a successful extensive reading program, students were encouraged to express their preferences in point of writers and types of reading texts. After identifying the students' reading tastes and levels, instructors had to establish a cohesive list of texts. It was necessary to do so because, as some skeptical researchers mentioned by Jacobs and Farrell (2012: 16) state, abusing the power of choice or adopting an 'anything goes attitude' to reading may be counter-productive.

The list contained non-fictional material (magazines and newspapers) and fictional prose (novels and short stories). The magazines and newspapers showed students' interests in topics like food, fashion, travelling, science, films etc., whereas the fictional texts, especially prose, referred to classical and modern writers (Emily Brönte, John Fowles, Vladimir Nabokov etc.) reflecting their desire not only to expand their knowledge about the issues studied in courses, but also to read other authors corresponding to their tastes and curiosity.

As students had different levels of competence in reading, the list also included graded fictional materials although some researchers think that 'the use of graded readers in EFL is controversial because some believe that they are not authentic' (Day et al., 2013). Being of real value as they encourage students to read according to their own level, graded materials were intended for intermediate and upper-intermediate learners.

In addition to students' preferences, several basic principles discussed in literature (Nuttall, 1982, Hill, 1997, Bamford & Day, 2004) were taken into consideration when making the reading list. The

reading ease criterion (texts within students' reading level) guided the choice of texts whereas the variety of topics and genres, facilitated by the huge possibilities of the internet, could suit all learners' needs. To stimulate students' interest in reading, as Nuttall points out (1982, 171), texts 'should not smell of the classroom', their value consisting not in the number, but in the purpose for which it was established. Even if the reading list included a limited number of titles, especially at the same language level, as Hill (1997) notes, this may turn into an advantage because 'students will soon read similar titles and they can then share their experiences together' if encouraged during the monitoring activity held by the teacher.

To persuade students to participate in the program a semi-extensive reading activity was performed in the first week of the second semester, during which the whole class had to read the same online material which was a short story corresponding to the average reading level of the class and to their interests. The familiarization stage being achieved, students were invited to enroll in a program dedicated to reading internet-based resources outside the classroom. The students that signed up (64) were given the weekly reading target: three one-page newspaper or magazine articles and one book. Setting the reading target is an important step to be taken because, as the majority of the researchers claim, no progress can be achieved in the absence of a well-defined number of reading materials. This target should be understood 'in terms of the level and the number of books' (Hill, 1997) to be read each week as long as the program lasts. It should be mentioned that, to avoid wasting time when searching for the online material, students were provided with numerous links to access the texts included in the reading list.

To monitor their reading activity, a series of tasks were also conceived for the participants to complete by the end of each week. The tasks were gradual ranging from simple to medium and complex requirements. The first category comprised poster reports and story webs which students had to display on the walls in the classroom, focusing on characters, relationships and actions. The second one included vocabulary and plot logs for which the following vocabulary pattern was suggested as in Table 2:

Table 2. Sample vocabulary log

Student's name:	Title of the book/article:
New word/expression:	Definition:
Example sentence:	
Synonym:	Antonym:

The most complex and creative tasks such as book/article reports/reviews and 'The book/article and me' reports belonged to the third category. The 'me report' activity aimed at students' personal responses, as they had to explain their impression of what they had read and what new things they had learnt.

As concerns the post-implementation stage of the extensive online reading program, this was done in the last week of the second semester and consisted in a report on the advantages and disadvantages of the program, indicating its impact on the students and their attitude towards reading outside the classroom.

Regarding the follow-up of the pilot program with the postgraduate students between 2015 and 2016, the activities dedicated to extensive online reading, which also involved teachers, consisted in fifteen minute reading sessions a day in the classroom before courses and seminars. One month later, students suggested establishing a weekly reading club with the purpose of sharing opinions, ideas and reading suggestions with their group mates and their teachers. This reading club together with the reading activi-

ties performed before classes, and sometimes even during the breaks, lasted two semesters. During the final week of the semester, when the last reunion of the reading club took place, the teachers who were involved in the project organized some focus groups in order to discuss the benefits and the drawbacks of the program as they had been perceived by the students.

RESULTS AND DISCUSSIONS

The implementation of the extensive online reading program was oriented by the initial survey administered to the students. According to the findings, a percentage of 57.69 students spend each week between 0 and 2 hours reading for pleasure in English (printed or electronic material), whereas 38.46% of them indicated between 3 and 5 hours. The surprising fact is that only 3.85% of the students dedicate more than 10 hours a week to reading in their free time.

The relatively high percentage of students who spend a short period of time reading for enjoyment is quite worrying because their philological profile requires not only imposed but also free reading as a way to improve language acquisition. Students' attitude towards reading may derive from the fact that they tend to consider extra-curriculum requirements to be time-consuming and useless. This demonstrates that they base their motivation on extrinsic rewards such as grades, which, as Cambria & Guthrie (2010: 17) explain, 'represent their quality as a student and as a reader. Being a high achiever is a symbol of how they are doing. A high grade is an icon of success and these students strive to feel successful.' Such a view of reading is also supported by their answers to the questions meant to find if they enjoy reading in English, the difficulties they encounter and what their favourite writers are. Almost two thirds of the respondents are fond of reading in English, but only the writers they study. As concerns the difficulties they have, most of them refer to vocabulary problems which hinder overall comprehension, this revealing that students are accustomed with intensive and not with extensive reading.

Another objective of the survey was to discover students' preferences regarding the reading text types. Almost 60% of the students like reading fiction, which is in accordance with the answers to the previous questions reflecting their interest in literature as part of the syllabus. As to their favourite genres, 73.08% mentioned prose and only 15.38% drama, respectively 11.54% poetry. These results may be explained by their perception of prose as more interesting and reader-friendly than drama and especially poetry. With respect to the non-literary texts preferred by the respondents, 30.43% chose science books while 69.57% ticked magazines and newspapers. A possible justification for this high percentage is that reading newspapers and magazines makes students feel connected to real life because the various subject areas they find here respond to their needs and interests.

Interesting viewpoints were also shown by students' opinions of reading in English as a way of improving language abilities. Although all of them gave a favorable answer, they confuse extensive reading skills with the ability to speak, translate and pronounce correctly. Nevertheless, some students (38.63%) mentioned consolidation of vocabulary and grammatical structures among the benefits of reading in English. This percentage together with the one of participants who spent 3 to 5 hours a week reading extensively shows awareness of the advantages of reading outside the classroom.

In connection with students' English reading abilities more than half believe that they are not good readers, the most frequent reasons being linked to poor vocabulary and a loaded timetable that does not allow reading outside the classroom. The overloaded bibliography they are required to study for regular

classes does not give them time to read for pleasure. However, they admit that reading plays an important part in their lives, emphasizing its informative role and the enrichment of their cultural background.

As to the students' final reports, their highly positive opinions on the program are worth analyzing. First, students stated that they liked reading online materials outside the classroom considering it as useful as the compulsory reading syllabus. Second, they pointed out that they could read independently, enjoying the freedom to choose the most interesting articles and books. They also appreciated that they were able to read whenever and wherever they wanted to and at their individual reading speed. Choosing materials in accordance with their level eliminated the vocabulary difficulties that might have hindered the rhythm of the reading. The chance to suit the reading materials to their levels made reading easier and more captivating than their former reading style. At the same time, inferring meaning from context instead of using the dictionary was recognized as a great step forward towards fluent reading. Briefly speaking, participants' answers show that they appreciate the benefits of extensive reading, benefits which, in Nuttall's terms, mean 'speed, enjoyment and comprehension' (1996: 128). Learners' opinions reflect a new attitude to reading, overcoming their former belief that school success depends only on reading what teachers indicate. Such a prejudice might be due to the authoritarian university teaching style according to which the teacher is the main decision factor in the learning process, irrespective of the subject.

Another advantage was that, by reading a large variety of online texts, participants had the opportunity to come across a great number of new words in different contexts, which led to a significant development of their vocabulary. To put it differently, by 'multiple exposures to new words' students can 'learn a large amount of new words'(Grabe, Stoller, 2013: 53). Moreover, 'by reading the same patterns of letters, words, combinations of words again and again students process them more quickly and accurately and thus develop a sight vocabulary (words that are recognized automatically) (Day et al., 2013). Students' perception somehow contradicts the findings reported by Tudor and Hafiz (1989, 1990) in their studies who reached the conclusion that extensive reading cannot be regarded as the best way of improving vocabulary.

In addition, learners pointed out that extensive reading helped them reinforce and develop structures already studied as well as other language abilities, their opinions reflecting what researchers mean by 'spread of effect', that is, development of interconnected skills such as 'writing, speaking and control over syntax' (Day and Bamford, 1998: 33). Although the cognitive mechanisms linking reading to other skills are not completely understood, as Hoey (2005) and Nuttall (1996) state, it stands to reason that the more students are exposed to the new vocabulary and grammatical structures, the more competent they become in speaking and writing.

All in all, students admitted that extensive reading enabled them to develop their general knowledge about the world, to make connections with other fields of interest and to adopt new perspectives on life. This demonstrates the passage from the former extrinsic to intrinsic motivation which, in Farrell's terms, means that they internalized the idea that extensive reading is a way to 'develop themselves both personally and professionally' (Farrell, 2009: 88).

With respect to the findings of the focus groups with Master's degree students, it is noteworthy that all of them appreciated the activities that continued the pilot study in which they initially took part as undergraduate students.

The answers to Q1 revealed the positive impact of the reading sessions on the students who perceived them not only as useful but also as surprising because they involved the teachers' participation too. These contributed to a relaxing atmosphere in the classroom and a very close relationship with their

teachers. The learning environment was more than inspiring and even motivated them for the classes that followed the reading sessions. However, a small number of students mentioned that they felt awkward reading for pleasure in the classroom as they could not concentrate on this kind of activity, being used to reading at home.

The responses to Q2 also showed favorable opinions about the reading club organized during the academic year. In general, students appreciated that they had the opportunity to share opinions about what they were reading, to clarify certain aspects connected with the texts, and to make interpretations of the works of the chosen writers. Although they liked the experience, some students complained about the fact that the reading club reunions took place at weekends and they were not able to participate in them all the time.

As concerns the answers to Q3, students pointed out some of the widely recognized advantages of online reading such as easy access to a variety of resources, quickness in accessing them, time-saving in terms of finding them and the fact that most of them are free of charge. Another advantage emphasized by the students referred to the development of their critical reading skills that would help them in the future to make an appropriate selection of online resources. On the other hand, the disadvantages mentioned by the participants were mainly physical and included the discomfort of spending quite a lot of time on reading on the screen.

A common suggestion regarding the additional extracurricular activities (Q4) was the setting up of a drama club, a public speaking club and a debate club that would help them improve, besides their reading and language competences, their creativity and artistic skills.

Last but not least, because all the participants in the focus group sessions expressed their intention to become English, Romanian and French teachers, they would definitely implement an extensive reading program in their schools (Q5), starting from the assumption that nowadays students read less and less and the present-day technology could motivate them to read both for information and pleasure.

SOLUTIONS AND RECOMMENDATIONS

Students' reports also contained several disadvantages of the extensive online reading program, which should be considered when implementing it on a large-scale. Thus, they complained of the lack of time for extra-reading, mentioning their loaded timetable as well as the amount of compulsory reading as part of the syllabus. They also incriminated the fact that some links were accessed with difficulty or they wasted too much time when searching through different databases.

The dysfunctions of the pilot program as suggested by students will be of great help in improving the implementation of a future one. A possible way to solve the problem of the overloaded reading tasks could consist in a rigorous selection of the material and in harmonizing the compulsory reading with the free time activities. This could be achieved if the extensive reading program becomes part of the curriculum within a reading course based on the principle of alternating intensive reading with extensive reading activities. Besides reading in quantity and regularly, the key to success is to provide students with time for doing it. According to some researchers, 'Reluctant readers simply do not read outside of the classroom, so if we truly believe that students must interact with the text regularly, then our schedules need to be altered to provide time for that during the school day.' (Jacobs, Farrell, 2012: 2). As to the difficulties encountered when accessing the online material, a good idea would be to precede the reading activities by a web-based tutorial to help students search on web catalogues and through databases more efficiently.

As to the drawbacks of the reading club sessions noticed by the Master's degree students, the fact that they took place at weekends may be solved by including such activities in the compulsory curriculum. Also, the other suggestions made by the students, such as the creation of drama, public speaking and debate clubs, could be taken into consideration under the form of holiday courses or summer schools.

FUTURE RESEARCH DIRECTIONS

Although the pilot extensive reading program based on web resources had a very good impact on students, its implementation on a large-scale implies a larger team of teachers that will have to re-analyze the basic findings of the present program in order to replicate it.

As motivating students for reading by means of every resource available, including the internet, is an important objective of any language teacher, the study can develop into a larger analysis of the role of technology in developing reading skills and in making their reading experience most productive.

Another challenging perspective of research would be the implementation of an extensive reading program taking into account the combination between printed materials and internet-based resources. Such a complex program may offer both students and teachers new educational opportunities to explore. Moreover, teachers can conduct specific research to compare the role of printed materials and internet-based resources in developing students' reading skills. Apart from that, a further research direction may focus on the implementation of an extensive reading program, either as part of the curriculum or as part of the extracurricular activities, at pre-academic level, mainly in high schools. The purpose of such a program might be to build or develop the learners' habit of reading for pleasure so that it becomes a life-long attitude towards reading in general.

CONCLUSION

In the context of the 21st century education, the chapter highlighted the importance of using digital skills in order to motivate students to read for pleasure outside the classes.

The implementation of an extensive online reading program at academic level proved to be beneficial for the development of the skills required by the specific field of Humanities Studies. The success of the study in stimulating undergraduate students to read for pleasure was demonstrated by the feedback provided in the final stage. It is worth mentioning that, in spite of an overloaded timetable, the majority of the students volunteered to take part in an activity that was different from their daily routine, even if that required additional effort and work. Thanks to their openness and motivation, the implementation of the program unfolded without serious problems and obstacles. The monitoring process revealed that they got more and more seriously involved in doing their reading-related tasks, meeting deadlines and sharing opinions on the books they read. The follow-up of the pilot with postgraduate students strengthened the initial findings and may set an example of cultivating the pleasure for reading. Although mainly an extracurricular activity, it brought strong satisfaction to both students and teachers involved in it.

One of the greatest gains of extensive reading is the formation of a lifetime habit according to which reading is perceived as a personal experience and interaction with the reading material, irrespective of its kind, printed or electronic, corresponding to varied purposes people may have in life such as to

entertain, to get information, to relax etc. In addition, extensive reading focuses the teaching-learning process on students, enhancing the responsibility for their personal growth.

In conclusion, the successful design, development and implementation of an extensive reading program in higher education may contribute to the creation of a positive environment that will lead to the improving of the learning and teaching process in language instruction.

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KEY TERMS AND DEFINITIONS

Extensive Reading: Reading in quantity, outside the classroom, to get a general understanding of a text.
Fictional Texts: Types of texts including poems, short stories, novels and plays.
Graded Reading: Reading according to the students' language level.
Intensive Reading: Reading in the classroom in order to get a detailed understanding of a text.
Language Motivation: Various factors, such as willingness, desires and attitudes, determining students to learn a second language.
Non-Fictional Texts: Types of texts including newspapers, magazines, textbooks, etc.
Online Library: List of links to download reading material.
Reading Level: The level at which a reader understands a text.

Chapter 57
Towards Disability-Aware Social Media-Enriched Virtual Learning Environments

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ABSTRACT

The increasing use of social media brings about the need to consider learners with disability when designing learning environments incorporating social learning. Additionally, there is need for educational institutions to consider social media-enriched learning environments. By default, designers and developers of virtual learning environments tend to design for learners without disabilities. The consequences for learners with disabilities are enormous. This chapter aims to propose a disability-aware approach to designing social learning environments that advocates that stakeholders consider the needs of learners with disabilities throughout development. The challenges that learners with disabilities face when interacting with learning systems are reviewed, and a disability-aware approach to designing social learning environments is presented, examining how this could be practically implemented. The opinions and recommendations of 48 students with disabilities from two universities in the United Kingdom and Canada are presented.

INTRODUCTION

Social media seem to be present everywhere nowadays and it is difficult for some people to imagine a world without social media. By addictively engaging with social media, either on desktop computers or mobile devices, people increase knowledge as they consume the information, which is pushed to their devices. People are engaging more and more with technological devices which are increasing everyday (Julius T. Nganji, 2018). With the drive to use technology for delivering services online, a lot of the technological developments around these areas by default have often focused on meeting the needs of people without disabilities, thus leaving people with disabilities to seek appropriate assistive technolo-

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gies in order to interact with such systems. In some cases, such assistive technologies might not be compatible with these systems. There are legislations in various countries around the world necessitating that people with disabilities be included in services that are offered, by ensuring that these services are accessible to them; otherwise "reasonable adjustments" or "reasonable accommodations" need to be made in order to meet their needs.

A lot of the difficulties people with disabilities face when interacting with most learning systems are related to the lack of consideration of their needs during the development cycle. In designing technological solutions, designers and developers need to understand that disability could affect different functions related to the senses. Such designers need to develop a new mind set when it comes to designing systems that will be used by everyone. The increasing use of social media in learning in addition to the difficulties and failures of existing learning systems towards learners with disabilities has necessitated the search for a better approach for designing and developing inclusive social learning environments (SLE). Thus, this article aims to propose a disability-aware approach to designing social learning systems in order to ensure that adequate analysis of the needs of potential learners with disabilities is carried out and that their needs are incorporated into the design. It also ensures that a representative group of people are selected and involved in the design process. That way, useful feedback is obtained and cost of production is reduced as designers do not have to spend a lot of money retrofitting accessibility. By developing a disability-aware mentality to learning systems design, the result is an accessible and usable product.

In the following sections, the difficulties that people with disabilities face when using technology will be discussed through a review of literature. The disability-aware approach to learning systems design will then be proposed. The recommendations from 48 students with disabilities from two universities in the United Kingdom and in Canada on how to design e-learning to meet their needs will then be presented after which future research will be discussed, before a conclusion of this article.

LITERATURE REVIEW

To lay the foundation, and in order to better understand some of the requirements for developing disability-aware social media enriched Virtual Learning Environments (VLE), this section reviews literature relating to the difficulties that people with disabilities face while interacting with learning environments, some assistive technologies for interacting with learning environments, social learning and also reviews some approaches used in designing learning systems.

Learning Environment Interaction Challenges Due to Disability

People with disabilities are generally more disadvantaged than those without disabilities when accessing services for various reasons including the way the environment has been designed to accommodate their needs or how society responds to these needs. Environmental factors such as the weather, specifically during winter where there have been heavy snowfalls for instance have been barriers to people with wheelchairs accessing community services (Ripat, Brown, & Ethans, 2015). The way society is designed tends to favor people without disabilities, while some people with mobility difficulties find it challenging to navigate some environments. Thus, it is common even nowadays to see newer buildings being designed without accessibility in mind (e.g. no ramps or elevators for wheelchair access). Nevertheless, there is an increase in awareness of the needs of people with disabilities when constructing buildings,

perhaps because it is mandated by disability legislations. Also, many older buildings are being adapted to meet the needs of people with disabilities, such as adding ramps for wheelchair access, including induction loops in meeting halls, controlling the lighting of buildings to suit people with light sensitivity and many other adaptations. Steyaert (2005) observed that such accessibility principles are not necessarily being translated from the physical environment into the electronic environment, leading to numerous difficulties for learners with disabilities, when considering an educational environment. The zeal with which the physical environment is adjusted to accommodate physical needs should be transposed to the online environment. However, if the social virtual learning environment is designed from the onset to be fully inclusive and thus respond to the needs of the learner, there will be no need for adjusting it to accommodate individual learners.

The severity of disabilities such as visual impairment may range from low vision to complete blindness. In the latter case, medical interventions such as eyeglasses, contact lenses or even surgery might not result in a permanent solution. People with this severity level will have to employ assistive technologies such as screen readers in order to read information that is found in electronic format or through the use of digital Braille amongst other interaction methods. In education, students with visual impairments are often more disadvantaged than students with other disabilities when using technology (Kelly & Smith, 2008). There is no wonder therefore why a lot of the guidelines for designing inclusive solutions tend to use this group of people as example when discussing accessibility. For learners with visual impairments to use web-based learning systems many accessibility considerations, including the need to include alternative texts in images (Julius T. Nganji, Brayshaw, & Tompsett, 2013) need to be adhered to. As visual impairment affects the sense of sight, if social learning environments are not designed accessibly with the needs of such users in mind, the result will be significant difficulties trying to interact with such systems which in extreme cases could also lead to incompatibility with assistive technologies such as screen readers. For people with low vision who do not necessarily have to rely on screen readers to read text on an information system, there is great need to ensure that they can be able to manipulate the text through increasing its size for more visibility in addition to providing responsive design and the ability to magnify certain sections of the environment for more visibility. Visually impaired computer science students for instance who are involved in programming exercises would benefit from such screen magnification as they can have a closer look at their code to debug it.

Dyslexia is the most common disability affecting learning, particularly reading. It affects word level decoding (Hulme & Snowling, 2016) and spelling in an individual. There are a number of assistive technologies that could help students with dyslexia. Tools such as Read&Write (Texthelp, 2014) help with writing and spelling. Kurzweil 3000, an assistive reading software was found to aid students in English word recognition and facilitated reading, writing and spelling (Chiang & Liu, 2011). The amount of information that is presented in a learning environment as well as how the information is presented could determine if an individual with dyslexia would understand the information. Generally, smaller chunks of information that is clearly written could be helpful. For students with dyslexia who are overwhelmed with much text and find this challenging, Kurweil 3000 can also be used to convert text to speech which the student can then listen to. Teachers have also used this assistive technology as an alternative text to speech technology in their teaching (Phayer, 2010). When designing a disability-aware social learning environment, considerations could be made to incorporate such functionalities as text to speech and the ability to spell-check directly within the learning environment. This may be expensive to develop but is worth the money if the educational institution wants to be fully inclusive.

Individuals with hearing impairment may have partial or complete loss of hearing. Depending on the severity of the impairment, individuals may rely on hearing aid or sign language in order to understand information that is being conveyed. The use of hearing aid may reverse the effects of hearing loss on audiovisual integration (Gieseler, Tahden, Thiel, & Colonius, 2018). As hearing impairment directly affects the ears and has no direct link with text based learning content, designers and developers of learning systems need to incorporate the need to provide captions and subtitles to audio/video formats of learning resources or to provide transcripts thereof which can be readily read by the hearing impaired learner.

Amongst people who will also need to access learning environments are people with upper limb mobility difficulties. For these people, using the mouse or keyboard may be difficult. Thus, their needs should be taken into consideration during design. Designers can look at future needs of learners who might not be able to make use of their hands to interact with learning systems and then to build multimodal systems that allow interaction via eye contact such as using an eye tracking system (Stark, Brunken, & Park, 2018). In extraordinary cases of disability, such devices could be used to capture, interpret emotions and convey messages to a personal support worker which could be used to provide the appropriate support to the learner when correctly decoded and interpreted. The reader may be asking how people with such cases of disability could be able to access the learning environment in the first place through authentication if some cannot use their hands to log in. Barpanda et al. (2018) identified three main authentication mechanisms: token-based (such as smart card), knowledge-based (such as pin and password) and biometric-based (such as face, signature). Rather than using the inaccessible CAPTCHA systems for authentication in such learning environments, biometric iris recognition technology could be used to authenticate the learner and log them into the social learning environment.

Assistive Technologies for Accessing Social Learning Environments

To help overcome the difficulties encountered by people with disabilities when using learning systems that are not disability-aware, a wide range of assistive technologies have been implemented. When compatible with learning environments, these technologies can greatly facilitate access to information to those who would otherwise not be able to access such information due to disability. A few of such technologies will be discussed here.

For people with visual impairments ranging from low vision to complete blindness, screen magnifiers and screen readers are the main technologies. Some of the most common screen readers available are JAWS (Job Access with Speech) and NVDA (NonVisual Desktop Access) and have been used in research studying adoption of screen readers (McCarthy, Pal, & Cutrell, 2013). MAC operating systems have a screen reader known as VoiceOver which can be used to read out text. Screen readers generally work by converting text into audio format so that the visually impaired person can then listen to the information they could not otherwise read. A lot of mobile devices nowadays have screen reading software that enable people to interact with information, also incorporating speech-to-text software. Thus, users can search the web through voice input and obtain results, could dial someone through speech commands amidst many other functions. As earlier discussed, screen magnifiers can also help with magnifying information in a VLE for a learner with low vision, thus facilitating improved access.

There are also some assistive technologies for learners with hearing difficulties, which work to improve hearing. These are generally known as assistive listening devices (ALDs). These do not work for people who are completely deaf as they cannot hear any sound. According to Kim and Kim (2014), ALDs "usually use microphones to capture an audio source and broadcast it wirelessly over a frequency

modulation (FM), infra-red, induction loop, or other transmission techniques." For people with hearing impairment and as earlier discussed, videos need to contain captions in order to be accessible to them. When captions are included, users can understand the content of the video. Some readers may be confused over the difference between subtitles and captions. Subtitles are often used to translate the speech in a video into a different language (e.g. the video is in English but subtitles could be in French so that French viewers would understand the video) while captions are subtitles that help people with hearing impairment to understand the video. The captions could be turned on or off but not subtitles. To make videos accessible, transcripts of the video could also be included when there are no captions. The transcript is a text version of the words spoken in the video. Research has shown that users would interact more with subtitles than with transcripts (Grgurovic & Hegelheimer, 2007). Also available to people with hearing impairment are text telephones which enable communication by typing and then displaying the typed information for the individual on the other end to read. When designing the physical learning environment, provisions need to be made to include induction loops to allow learners with hearing difficulties to fully participate in lectures.

For people with dyslexia, various assistive technologies such as word processors and spell checkers help with writing, voice recognition software (e.g. Dragon NaturallySpeaking, Kurzweil) convert speech to text and could be very useful. In a literature review on the use of assistive technologies by students in higher education, Pino and Mortari (2014) found that the spellchecker is useful in finding spelling mistakes but it also displays a list of possible words which, for a student with dyslexia could be difficult to decipher which one is the correct word. They also reported that voice recognition software was very useful to students. However, students did not find tape recording very useful to them due to the amount of time they will spend in listening to the tape.

Social Learning and Learners With Disabilities

Social interaction with other humans leads to knowledge (Vygotsky, 1962). This interaction can be formal or informal, in a physical or virtual environment. Interaction in the physical environment could be a challenge for some people with disabilities such as those with autism spectrum disorder (ASD) (Vincent, Openden, Gentry, Long, & Matthews, 2018). Social interaction using social media has been found to have a positive effect on academic success (Kozuh et al., 2015). Also, those who due to disability experience social anxiety which prevents them from fully participating in physical lecture rooms could fully participate and engage with others in an online social learning environment where they have their "voice" and might also feel that their opinion counts.

Social media appears to have a high adoption rate, given the number of people engaging with Facebook, Twitter and other social media. Humans are not only using these for communication, but are also employing them for educational purposes. The majority of existing research on social learning seem to focus more on Facebook than other social media, showing that it is the top social medium of choice for learning interaction as shown in the following research studies.

In a recent study by Cakir and Tan (2017), participants in a study involved designing an educational game and incorporating it into Facebook were in favour of using social networks for educational purposes. In another study involving Facebook, students seemed to like the ability for social networking sites like Facebook to notify them of new postings (Chang, Huang, & Wu, 2017), which can help them keep up with their learning goals. However, Raspopovic et al. (2017) found that students prefer to receive such notifications via email rather than via Facebook. They also found that the resulting interaction and

collaboration led to a better understanding of the course topics. Research on learning styles and social learning with Facebook using Kolb's Learning Style Model also revealed that learners with the "Assimilating" and "Diverging" learning styles showed a better performance than those with the "Accommodating" and "Converging" learning styles (Chen, 2015).

A lot of the research discussed above and many others focus on social learning for people without disabilities. This study will bridge that gap by proposing how social learning can be designed to be inclusive of people with disabilities.

Approaches and Methodologies for Designing Virtual Learning Environments

There are several approaches to learning systems design from a non-pedagogical perspective. It is worth noting that the focus of this evaluation is on the technological aspect, that is the design and development of the learning environment rather than the pedagogical design. This section will consider traditional methods, often used in software development by discussing the waterfall, spiral and agile methods and will also look at approaches that are common to designing user interfaces such as user-centered design, participatory design and inclusive design. Emphasis will be on the activities that go on during these methods, in order to understand if the needs of learners with disabilities are considered, thus resulting in an inclusive learning environment.

One way to build the learning environment could be to split the processes into different phases such as the case with the waterfall method (Royce, 1987) which was inspired by engineering disciplines such as civil and mechanical engineering. This method is sequential; progressing through the phases of conception, initiation, analysis, design, construction, testing, implementation and maintenance. This method is weak in that the development progresses downwards and each phase must be completed and signed off for the next phase to begin. Thus, designers would have to go back to the phase where a problem has been identified and start again from there. In reality, information systems development does not proceed as such. Although there could be an opportunity to consider the needs of learners with disabilities during the analysis phase when using this method, this is not often the case, thus the resultant product is not accessible to them. With the increasing knowledge on accessibility, those using this method for software development should ensure that they incorporate the needs of all potential users in order to develop an inclusive product.

The spiral method (Boehm, 1988) is intended for large, expensive and complicated projects. It has four phases that are adopted from other methods such as the waterfall method or incremental method, which include: planning (determining objectives), risk analysis (identify and resolve risks), engineering (development and testing) and evaluation (planning the next iteration). This method involves high costs and is suitable for large projects. However, this is not suitable for smaller information systems design projects. There is also the opportunity to be inclusive here by incorporating the needs of people with disabilities and older users when designing.

The agile method has the advantage of taking a shorter time to deliver the product (Gill, Henderson-Sellers, & Niazi, 2018) and is increasingly being used nowadays in web development teams. It could be challenging for an organization which is used to project management utilizing milestones and fixed delivery dates to adopt the agile methodology (Gains & Hawkins, 2007). From my personal experience working within a team implementing the agile methodology, there is often not enough time to consider all the needs of the user to design for them, not to talk about involving them in the development process.

Unless implementers of this methodology start involving real users rather than "product owners" who know more about the product, then there will always have to be the need to retrofit accessibility.

User-centered design (Helander, Landauer, & Prabhu, 1997; Nielsen, 1993; Norman, 1988) focuses on designing information systems that would meet the needs of the user. The user is supposed to be the main focus of the design. However, when this method has been used, the focus has often been on users without disabilities. Thus, the resultant product is not accessible to people with disabilities. Participatory design (Kyng, 1991; Muller, 1996) on the other hand seeks to involve all stakeholders, including the intended users in order to design an information system that is usable to them.

Despite the intention of participatory and user-centered design to develop products that meet the needs of users, Gregor et al. (2005) asserted that these approaches often do not address how to meet the needs of people with disabilities and those of older users. Thus, inclusive design seeks to focus on the needs of people with disabilities. Newell et al. (2010) also asserted that such approaches to not meet the needs of people with disabilities as most of the products might not be usable to older people and people with disabilities.

MODELLING A DISABILITY-AWARE SOCIAL LEARNING ENVIRONMENT

Before discussing the disability-aware approach to learning environments design and development, it is fitting to first discuss some reasons for developing inclusive learning systems. There are numerous reasons but three will be discussed here. Firstly, the number of people with disabilities is on the rise and there is also an increasing number of students with disabilities gaining admissions into educational institutions worldwide (Julius. T. Nganji, Brayshaw, & Tompsett, 2011). The World Health Organization (WHO) estimates that there are over a billion people with disabilities, constituting about 15% of world population (WHO, 2015). It is morally correct to include everyone in society and designing accessible and usable systems is one way to ensure the participation and contribution of everyone, regardless of their ability or disability.

Secondly, the increasing number of people with disabilities also shows that they can contribute to the economy. Bowtell (2015) reports that research has dispelled the myth that people with disabilities are poor; and has on the contrary shown that people with disabilities have a sizable spending power on accessible services. When learners with disabilities are fully included in learning design either through provision of assistive or adaptive technology to meet their needs, provision of appropriate support mechanism and development of inclusive policies, they can study at an equivalent level as other students and graduate to contribute to the society. Today, there are many scientists who are visually impaired for instance and who lead cutting edge research teams because they were provided with the accommodations and support they needed to finish their studies. For designers to be part of this, they need to design accessible and usable systems. Thirdly, it is a legal requirement in most countries to offer accessible services, which include designing accessible information systems. Those who don't comply to legislation such as the Accessibility for Ontarians with Disabilities Act (AODA), the Equality Act 2010 in the United Kingdom and the Americans with Disabilities Act (ADA), just to name these, could be prosecuted.

As already discussed, the focus of most designers and developers of information systems is on meeting the needs of users without disabilities, thus the resultant products are not accessible or usable for people with disabilities. A more inclusive approach to designing information systems is the paradigm of user-sensitive inclusive design (A. F. Newell & Gregor, 2000). The authors assert that "inclusivity" is

more achievable than "universal design" and "design for all". Additionally, in this approach, designers develop an "empathetic" relationship with the end users.

The disability-aware approach in this article is a form of user-sensitive inclusive design approach that focuses on the needs of people with disabilities. It advocates that designers and developers should always think about the needs of the users, particularly those with disabilities when designing learning systems. A common issue with most systems is that even when they are designed to meet the needs of people with disabilities, they often neglect the needs of people with multiple disabilities (J.T. Nganji & Brayshaw, 2015). Designing accessible social learning systems does not only benefit people with disabilities, but will be usable to people without disabilities since needs analysis includes everyone's needs.

A disability-aware approach can be applied to the design of all systems that are required to be used by humans, including in fields such as software engineering (J.T. Nganji & Nggada, 2011). The key components of the approach as depicted in Figure 1 include:

Learners With Disabilities

Learners with disabilities are the focus of this model since learning systems need to be designed to meet their needs. For the social learning environment to be fully inclusive of them and thus meet their needs, they need to participate in the needs analysis phase of the development cycle in order to ensure that the product meets their needs. Given that disability is an individual experience, their input will be very useful. They will need to participate by giving feedback to the designers or developers of the social learning environment through expressing how the system could meet their needs as well as during the quality assurance/testing phase. However, they could be available at any time during development cycle to be consulted.

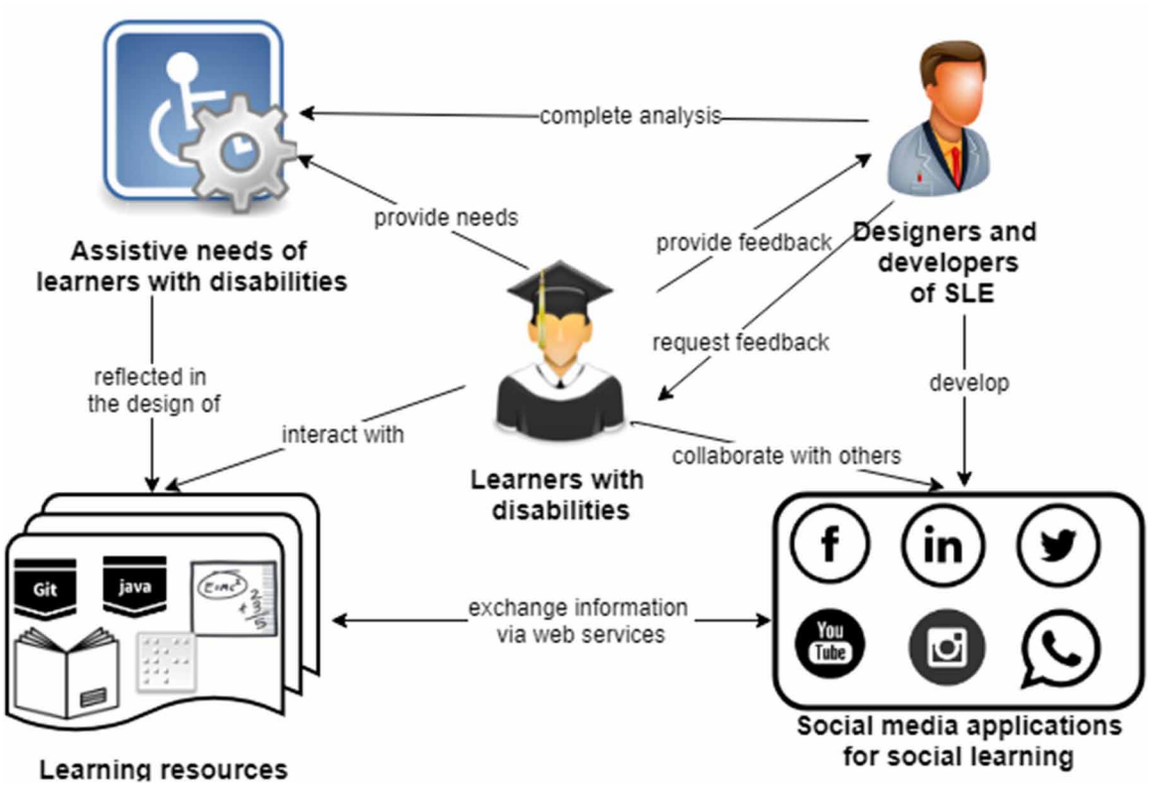
Assistive Needs of Learners With Disabilities

In designing a social learning environment, the assistive needs of learners with disabilities need to be taken into consideration. When this is done at the beginning of the development cycle, designers and developers of such systems could incorporate these needs into the design. When this is done correctly, it could eliminate the need for the user to acquire a standalone assistive technology to use with the system. This also helps to solve incompatibility issues that may arise with using some assistive technologies. If a text to speech functionality is incorporated, this not only helps a learner with dyslexia but could be very useful for a visually impaired learner. In determining the assistive needs of the learners, designers need to involve them but could in addition, consult experts in the domain as well as obtain input from existing literature. Thus, a complete analysis of such needs is necessary to ensure that the product is both accessible and usable.

Designers and Developers of Social Learning Environments

The designers and developers drive the development of the learning environments. They are very important in the process and need to develop the mentality of working with users and constantly thinking about how to meet their needs. Also, developing an empathetic relationship with users as recommended by Newell and Gregor (2000) will ensure that the system is accessible and usable.

Figure 1. Disability-aware social media enriched VLE model



Social Media Applications for Social Learning

Social Media such as Facebook and LinkedIn provide enormous opportunities for learners to interact and share knowledge. When the Learning environment is designed, provisions should be made for web services to allow for information to be exchanged between the learning environment and social media. Thus feeds from social media could be directly displayed on the interface (Julius T. Nganji, 2018) of the learning environment. Also, as earlier discussed, notifications from social media could be pushed directly to the personal learning space of the student. The learner should be have the possibility of choosing which social media applications can push notifications to their learning space and in what format (email, feeds, or directly on a section of their learning interface reserved for push notifications).

IMPLEMENTING A DISABILITY-AWARE APPROACH: RECOMMENDATIONS FROM STUDENTS WITH DISABILITIES

In application to the field of education, 30 students with disabilities at the University of Hull in the United Kingdom and 18 students with disabilities at the University of Ottawa in Canada were consulted on their opinions to designing e-learning environments to meet their needs. This was done during the evaluation of a learning environment which was designed to recommend specific learning content to students

based on their learning goals while considering their disability type and its severity. During that evaluation, the students had some useful recommendations, which could also be applied to the design of other information systems. During the evaluation, the author also observed their interactions and preferences which are also included in the following recommendations, some of which are presented in Figure 2.

Grant Users Control Over Font Sizes and Background Color

Some students with disabilities, particularly those who had low vision and those with dyslexia found it frustrating when they could not manipulate the size of fonts that were used in designing e-learning environments. Students with low vision have limited vision, so, in the absence of a screen magnifier to increase the font size, they would need the ability to increase the font size in order to read the information that is presented. This needs to be done without distorting the presentation. Thus, designers need to consider this. Such considerations should also be made when designing for mobile devices.

Students with dyslexia found the ability to change the type of font as well as its size in combination with the background color very useful. Thus, designers should consider granting users choice over the background color. This color contrast, although it may not be very useful to some people, are very important to others. On meeting their needs in an e-learning environment, a student with both dyslexia and hearing impairment had this recommendation: "the way that learning environments could adapt to my learning disabilities and hearing difficulties would be if I can change the text and the background color so that the text is much clearer for me to read."

Embed Assistive Technology in Learning Environments

During the needs analysis phase of a VLE design, a complete analysis of the needs of the learner is necessary, including assistive needs. Once this is done, there is need to directly include functionalities that act as assistive technologies directly in the design as earlier discussed. For instance, for a user with low vision, it would be useful to include the ability to magnify various sections to facilitate reading. The ability to check spelling, including help with writing could be very useful for some people with dyslexia.

Present Learning Content in Multiple Formats

Learners have preference for different formats of learning resources. In the case of students with disabilities for instance, learning materials could be presented in various formats, including digital Braille, text (e.g. PDF, Word, HTML), audio and video with captions. For learners who are blind, the Braille format will be very useful, as will the audio and text formats. The text formats in this case could be read out loud by an inbuilt screen reader. For an individual with hearing impairment, both audio and video need to be captioned. On designing learning environments to meet their needs, a student with hearing impairment had this to say: "Even if there is no video available, it is nice to pair audio and video formats- it helps to keep track of reading and set a pace".

Consider Implementing Multimodal Interaction

Interacting with information systems and inputting information is not just limited to using a physical or virtual keyboard. In order to fully meet the needs of all users with disabilities when interacting with

Figure 2. Some SLE design considerations for some disabilities

Disability ▪ Low vision ▪ Blindness ▪ Color blindness	**Disability** ▪ Deafness ▪ Hard of hearing	**Disability** ▪ Upper limb mobility difficulty ▪ Cerebral palsy	**Disability** ▪ Learning difficulties ➢ Dyslexia ➢ Dyscalculia ▪ Mental health difficulties
VLE design considerations ▪ Incorporate assistive technologies ▪ Include alt text for images ▪ Grant ability to change font size and background color ▪ Present learning resources in multiple formats	**VLE design considerations** ▪ Captioning ▪ Transcription ▪ Subtitling	**VLE design considerations** ▪ Interaction via eye tracking ▪ Input via speech recognition ▪ Biometric iris recognition for authentication	**VLE design considerations** ▪ Incorporate assistive functionalities for reading, writing and spelling ▪ Incorporate social media applications for collaboration ▪ Incorporate time management and personal planner tools ▪ Grant ability to change font type, size and background color ▪ Present learning resources in multiple formats

information systems, designers need to consider implementing multimodal interaction interfaces. People have different ways of interacting with systems and this may be due to disability. An individual with an upper limb mobility difficulty who cannot use their hands could benefit from using a speech-to-text software. Those suffering from paralysis but could still see and can move their head around could benefit from eye tracking interactions.

FUTURE RESEARCH

Designers and developers of social learning systems are becoming more aware of the needs of people with disabilities, due to the existence of several legislations and also due to many sensitizations and the existence of standards such as the Web Content Accessibility Guidelines (WCAG 2.0). Although it is not yet the case, in future each designer will by default look to the needs of people with disabilities in order to design a learning environment, without which their product will not be adopted by many educational institutions. By default, people will design for accessibility and usability. Future research should look at the possibility of incorporating multimodal interactions in information systems and also automatically adapting to the needs of the user. Provisions should be made for incorporating social media into learning environments to allow for collaboration and social learning.

CONCLUSION

Most virtual learning environments are not designed with the interest of learners with disabilities in mind, thus resulting in inaccessible learning systems. In this age of social media where people spend enormous amount of time interacting with others, it is important to consider developing social media applications that can be directly incorporated into learning environments to allow for collaborative learning. To do this, the needs of learners with disabilities should be considered. By developing a disability-aware mentality, designers of learning systems can develop VLEs that are both usable and accessible not only to students with disabilities, but to everyone.

This article has proposed a disability-aware approach to learning environments design and development and shown with application to e-learning systems that this is what students with disabilities want and recommend such thought processes during design and development.

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KEY TERMS AND DEFINITIONS

Accessibility: The design of information systems such that they can be used by everyone, regardless of their ability or disability.

Assistive Listening Device: This is a device which helps to improve hearing for people with hearing impairment.

Assistive Technology: A piece of software or device that allows a person with disability to interact with an information system without difficulty.

Disability: A physical or mental condition that may limit an individual's ability to fully utilize their senses such as vision and hearing and could thus limit their use of information systems, particularly when they are not designed accessibly.

Disability-Aware Learning System: Learning system that considers the needs of users with disabilities and adjusts to their needs without them having to seek extra assistive technology in order to interact with it.

Induction Loop: Also known as hearing loop, this is an assistive listening device which works by amplifying sound for an individual who can only hear partially and may not be able to distinguish speech when there is noise.

Subtitles: These are texts displayed in a video usually serving as a translation of the words spoken in the video into another language so that people who don't understand the language of the video could understand what it is all about.

Transcript: In the context of this chapter, it is a text version of a video that is produced for an individual with hearing impairment, to facilitate understanding of the words spoken in the video.

Usability: This refers to how easy it is for an end user to use an information system.

Chapter 58
Online Courses Accessible to College Students With Disabilities

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ABSTRACT

More students can attend colleges and universities from a distance due to broader access and technological advances. Therefore, facilitators are facing the challenge of providing more accommodations and modifications to nontraditional students. The provision of these special services, which have traditionally been provided by special educators, are receiving limited attention. Special educators are educated to make these adjustments on an individual basis in the elementary and secondary levels. However, this has not been the traditional role of the university professor. With today's mass enrollments in online courses, procedures for providing accommodations to all students have become a significant challenge. This chapter will review research on online course design and implementation to address the needs of students with disabilities.

INTRODUCTION

Technology trends are creating new challenges in postsecondary education. Community colleges and universities are implementing information technology by expanding distance education opportunities. Online education has grown tremendously. From 2004-2005, 65% of institutions offering face-to-face classes report an 18% growth in online courses at the graduate level and a 33% at the baccalaureate level (Allen & Seaman, 2006). Students with disabilities are also enrolling in distance education courses. According to Kinash, Crichton, and Kim-Rupnow (2004), people with disabilities are among the least

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considered in the educational context of online learning. Failing to proactively address accessibility to information technologies can negatively impact the ability of students with disabilities to thrive in the online environment. This chapter will discuss the accessibility challenges of online learning faced by students with disabilities. It will suggest solutions to these challenges.

BACKGROUND

Special education services for students with disabilities have been addressed in public schools since 1975. However, limited attention has been given to the provision of these services to postsecondary students (Herbert, 2014; Ricardo, Alegre-de-la-Rosa, & López-Aguilar, 2012). Due to privacy issues, disability offices can provide researchers with limited data pertaining to the provision of special services to students. Even with the provision of services under the Americans with Disabilities Act (ADA), only an extended time is given to students through the college or university's office of disability services. This accommodation, often utilized to assist students with access to education, is insufficient in serving the needs of a diverse population (Lewandowski, Cohen, & Lovett, 2012).

Access to content through modern methods of technology can have a positive impact on academic achievement, leading to more success for students with disabilities due to the multimodal nature of online courses (Englert, Zhao, Collings, & Romig, 2005). Students with disabilities may benefit from multimedia-rich courses and modern teaching methodologies addressing different learning styles (Buckley & Smith, 2007).

In public schools (preK-12), students with disabilities can receive instructional modifications and accommodations for assignments and specific programs of study according to the Individuals with Disabilities Education Improvement Act of 2004. These students may require a reduction of written assignments, oral lessons, assistance for loss or reduced vision or hearing, use of technological devices, oral exams, small group instruction, social skills training, and technical training. Postsecondary students with disabilities may require similar accommodations. Unfortunately, most college faculty and course facilitators are not prepared to redesign online courses to address these unique needs. With specific training and resources, postsecondary educators can more appropriately address the needs of students with disabilities in postsecondary online courses (Grabinger, Aplin, & Ponnappa-Brenner, 2008).

Legislative Foundation

There is civil rights legislation associated with access to services for persons with a documented disability. Procedures have been established as defined by the 1990 ADA, Section 504 of the Rehabilitation Act of 1973. To be protected under the ADA, a person must "have a physical or mental impairment that limits major life activities; have a documented history of impairment; or be perceived by others as having an impairment" (ADA, 1990, §12101 et. seq.). Major life activities include such major bodily functions as immune system functions, normal cell growth, digestive, bowel, bladder, neurological, brain, respiratory, circulatory, endocrine, and reproductive functions. Of significance is the fact that the ADA definition of a disability includes both mental and physical impairments.

Colleges or universities may not abide by the "perceived by others" component of the ADA. In 2008 the Americans with Disabilities Amendments Act (ADAAA) clarified who should be covered. It revised

the definition of a disability to include the following (U.S. Equal Employment Opportunity Commission, n.d., para. 4):

- The term "substantially limits" requires a lower degree of functional limitation than the standard previously applied by the courts.
- The term "substantially limits" is to be construed broadly in favor of expansive coverage, to the maximum extent permitted by the terms of the ADA.
- With one exception ("ordinary eyeglasses or contact lenses"), the determination of whether an impairment substantially limits a major life activity shall be made without regard to the ameliorative effects of mitigating measures, such as medication or hearing aids.
- An impairment that is episodic or in remission is a disability if it would substantially limit a major life activity when active.
- The determination of disability should not require extensive analysis.

These regulations are enforced by the United States Department of Labor and the U.S. Equal Employment Opportunity Commission. Postsecondary institutions are required to meet certain regulations, including having knowledge and understanding of who is covered by the law. All colleges and universities receiving federal funding are required by law to provide resources and accommodations to assist students with a disability. The school is not required to change the content of the course. It is not obligated to make any adjustments that would change the fundamental nature of the program or service or result in significant spending or use of resources.

Section 504 of the Rehabilitation Act provides the legal basis for persons with disabilities to receive reasonable accommodations at postsecondary institutions. This law prohibits discrimination based on a physical or mental disability. The Section 504 regulation contains the following requirement relating to a postsecondary school's obligation to provide auxiliary aids to qualified students who have disabilities:

shall take such steps as are necessary to ensure that no handicapped student is denied the benefits of, excluded from participation in, or otherwise subjected to discrimination under the education program or activity operated by the recipient because of the absence of educational auxiliary aids for students with impaired sensory, manual, or speaking skills. (U.S. Department of Education, n.d.)

A postsecondary student with a disability is obligated to provide notice of the nature of the disabling condition to the college office for disability services. The student may be asked to provide adequate information to verify the existence of a disability, as well as the types of auxiliary aids and services required.

Section 508 of the Rehabilitation Act requires that all electronic and information technologies developed and used by any federal government agency must be accessible to people with disabilities. This includes Websites, video and audio tapes, electronic books, televised programs, and other such media. Individuals with disabilities may still need to use special hardware and/or software to access the resources (Section 508, 29 U.S.C. 794d). All states receive funding under the Assistive Technology Act (29 U.S.C. Sec 2202(2)). To access to this funding, each state must assure the federal government they will implement all conditions of Section 508 within their state entities, including higher education. The U.S. Department of Justice Office of Civil Rights (OCR) is charged with enforcing Section 508. When complaints arise, members of the public, students, and employees with disabilities may file with the agency they believe is in violation, with the federal court, or with OCR.

The Assistive Technology Act was first passed as the Technology-Related Assistance Act of 1988. Often called the Tech Act, it was reauthorized in 1994, 1998, and 2004 (29 U.S.C. Sec 2202(2)). The Tech Act is intended to promote access to assistive technology (AT) devices and services. The act seeks to provide AT to persons with disabilities so they can more fully participate in education, employment, and daily activities on a level playing field with other members of their communities. The act covers people with disabilities of all ages, disabilities, and in all environments (early intervention, K-12, post-secondary, vocational rehabilitation, community living, aging services, etc.).

ACCESS, INDEPENDENCE, AND EMPOWERMENT

Transition Planning

Purposeful transition planning for students with disabilities advancing from high school to college is essential for a successful postsecondary experience. The National Joint Council on Learning Disabilities (NJCLD, 2007) prepared a report to outline how families and students can facilitate the move from secondary to postsecondary education. The recommendations in this report include:

1. Find a knowledgeable school-based professional (i.e., school counselor, special education teacher, or general education teacher) who can serve as the student's advocate through their college search and transition process.
2. Save copies of documentation, even if outdated. The documentation generated during a student's K-12 experience will only be maintained by the school system for a limited time after graduation.
3. Participate in the development of the student's summary of performance (SOP) to ensure that all information is accurate and current.
4. Review the documentation requirements of the colleges under consideration. This should be started early in the student's high school career.
5. Meet with the disability service provider during all college visits. Ask the disability service provider for the documentation requirements. Request written information to share with school personnel.
6. Seek a private evaluation if necessary. Provide the clinician with the documentation requirements from the colleges to which the student has applied.

The responsibility for learning and accessing accommodations shifts from parents and K-12 teachers to the students as they enter postsecondary education. These students must be knowledgeable about how their disability impacts their learning and independence. It is important for students with disabilities to possess self-determination skills (Asselin, 2014; Getzel, 2014). Self-determination refers to acting as a causal agent in one's life through quality of life decisions. This includes self-advocacy, goal-setting, self-knowledge, and an awareness of one's learning or thinking processes (Sitlington, Neubert, & Clark, 2010).

Getzel and Thoma (2008) conducted a study with students who were attending two- and four-year postsecondary institutions. Their study aimed to ascertain the self-determination skills needed to succeed in college. The students identified problem-solving, self-awareness (understanding one's disability), goal-setting, and self-management as essential for successful program completion.

Self-determination instruction is beneficial when integrated into secondary school curriculum via individualized education program (IEP) goals or 504 plans. It may be possible to provide opportunities

for students to practice self-determination strategies by actively participating in IEP or 504 meetings, including suggesting and advocating for accommodations and articulating postsecondary education goals (Agran & Hughes, 2008). Students' self-determination skills in preparation for secondary school prepares them to self-identify and request accommodations, services, and assistive technology which will allow them to fully participate in the programs offered at the postsecondary institutions.

ONLINE TEACHING AND LEARNING

What is Online Learning?

The U.S. Department of Education defines online learning as learning that takes place partially or entirely over the Internet. This definition excludes purely print-based correspondence education, broadcast television or radio, videoconferencing, videocassettes, and stand-alone educational software programs that do not have a significant Internet-based instructional component (U.S. Department of Education, 2010).

Allen and Seaman (2010) defined online courses as those in which at least 80% of the content is delivered online. They described blended or hybrid courses as those having 30% to 80% of the content delivered online. Web-facilitated courses are face-to-face classes using a course management system (CMS) to post the syllabus and assignments.

According to a survey conducted by Allen and Seaman (2010), 63% of all reporting postsecondary institutions said that online learning is a critical part of their long-term strategy. Online enrollment has been growing steadily, with the expectation that this trend will continue. More than 5.6 million students were taking at least one online course during the fall 2009 term (Allen & Seaman). In other words, 30% of higher education students are taking at least one course online.

Challenges and Barriers: Possible Solutions

Web-based education relies heavily on written text and online resources. This can be challenging for certain groups of students with disabilities. Richardson (2009) examined degree attainment experiences of students with disabilities in distance education programs. Richardson (2009) suggested that to ensure effective support for students with disabilities, distance education staff should adhere to the following guidelines:

1. Students should be encouraged to disclose disability information to receive the appropriate accommodations in their assessment arrangements and receive support in other areas of their personal and educational development.
2. Institutions should provide assistive technology, including speech production software or magnification software, to benefit these students.

Heiman (2012) conducted a study about female students with learning disabilities who were taking online courses. The study focused on perceptions of the learning environment, coping strategies, and the subjective well-being of these students. The findings indicated that females with learning disabilities perceived the learning environment as less supportive and less satisfactory than the students without learning disabilities. Female students with learning disabilities reported using more task-oriented and

avoidance-oriented coping strategies. They perceived their overall well-being as less satisfactory than the students without learning disabilities. The females with learning disabilities were less content with their academic courses and felt that their special needs were not sufficiently addressed.

Students with visual impairments, hearing impairments, and motor impairments also face challenges in the online learning environment which could impede their progress in their programs of study (Crow, 2008). Three types of visual impairments must be considered when developing instructional Websites: (1) total blindness; (2) low vision; and (3) color blindness. Screen readers are commonly used by students who are totally blind. Unfortunately, screen readers cannot read images such as pictures, graphics, and flash animation. Designers should provide long descriptions for nontext items.

Hearing impairments vary in type and severity. Some students have a diminished ability to hear certain frequencies or may have difficulty with all frequencies. Some students are totally deaf. Designers of online learning environments should provide real-time text captioning for all audio, video, and multimedia presentations on the learning sites. This is a Section 508 requirement (29 U.S.C. 794d). Printed text may also be offered. However, it cannot be substituted for real-time captioning.

Students with physical or motor disabilities may have limited or no use of their hands. Some conditions that lead to or are classified as motor impairments include amputation, arthritis, cerebral palsy, spina bifida, muscular, dystrophy, and multiple sclerosis. Accessing a computer keyboard and mouse may be challenging for some students. Assistive technologies can allow students to access and manipulate the online learning environment.

Students with cognitive impairments have encountered online challenges at the postsecondary level. Cognitive impairment is a condition that involves a wide variety of memory, perception, problem-solving, and conceptualizing difficulties (Crow, 2008; Grabinger et al., 2008). Students with learning disabilities and autism make up a large portion of this group (Raue & Lewis, 2011). Textbooks can be loaded into a Kindle or an iPad to make reading easier due to the accessibility features of these devices (i.e., font size, audio, etc.).

Barriers to successful online course design include instructor anxiety, technology skills deficits, and lack of online teaching experience. Faculty, instructors, and course facilitators who teach in higher education play key roles in online course design and implementation (Baran & Correia, 2014; Burgstahler, 2006). Support and professional development opportunities are essential for all online faculty (Baran & Correia, 2014; Scoppio & Luyt, 2017). Professional development programs that support faculty are critical for successful online course delivery. Collaboration with campus accessibility/support services, technical support, and course design support and pedagogical support are useful and effective components of a professional development program.

Grabinger et al. (n.d.) are advocates of universal design for learning (UDL) framework for approaching the problem of designing more accessible instruction for learners with cognitive impairments. The Center for Applied Special Technology (CAST, 2011, para. 1) defines UDL as:

a set of principles for curriculum development that give all individuals equal opportunities to learn. UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone-not a single one-size-fits-all solution, but rather flexible approaches that can be customized and adjusted for individual needs.

All students bring a variety of skills, needs, and interests to learning. Instruction should be designed for a wide range of diversity in the classroom (or a universal design).

Designers can incorporate practical universal design practices to make materials more accessible to students with impairments. Examples include (Burgstahler, 2018; Crow, 2008; Grabinger et. al., n.d.).:

1. Avoid cluttered or disorganized Web pages.
2. Avoid using unnecessary graphics or pop-up windows.
3. Make Web pages easy to navigate, including page titles and headings.
4. Avoid the use of flashing objects on the screen.
5. Invite students with disabilities to participate in focus groups to critique course accessibility.
6. Use asynchronous discussion forums.
7. Provide long descriptions for nontext items.
8. Avoid information that relies on color recognition.
9. Provide real-time text captioning for audio, video, and multimedia presentations.

FUTURE RESEARCH DIRECTIONS

Continuing advances in digital technologies in learning management systems (LMS), as well as the use of mobile devices (i.e., tablets and smartphones), give students and instructors more control and access to knowledge and information. *2016 Online Education Trends* reported that the use of social media tools (i.e., Wikis, blogs, and podcasts) in teaching has increased. Many of these tools have been incorporated into academic systems. Social tools allow students to personalize their learning experience while maintaining a presence in their online courses.

Massive open online courses (MOOCs) are relatively new in online education (Downs, 2012). MOOCs are online courses that are offered to large numbers of students who are typically not enrolled in the institution. These open access courses are designed for unlimited participation and no tuition is charged. Credits are rarely awarded, however; students can earn a certificate for successful completion of these courses (Allen & Seaman, 2017). Only a small segment of postsecondary institutions is planning to offer MOOCs.

CONCLUSION

Sixty-three percent of all reporting institutions said that online learning was a critical part of their institutions' long-term strategy (Allen & Seaman, 2017). Nearly 30% of higher education students now take at least one online course. Online teaching and learning must consider issuers regarding accessibility for students with disabilities. Universal design is a proactive approach to online course development and instruction. When designers and instructors apply universal design principles, students with a wide variety of abilities and characteristics can access and engage in the Web-based learning environment. Designing courses with universal design principles in mind is also economical because it eliminates the need for retro-fitting or redesigning after a need arises.

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KEY TERMS AND DEFINITIONS

Accommodations: Adjustments in the way students with disabilities access instruction or assessment. Accommodations do not change the construct of the assignment/assessment. Gives equal access to the content without "watering down."

Assistive Technology: Devices or services used to increase, maintain, or improve functional capabilities of a person with a disability. Allows the person with a disability to access the information necessary to accomplish required learning tasks.

E-Learning: Web-based or online learning environments. Students access course material outside of the traditional classroom.

Empowerment: Taking control over one's education and life choices.

Postsecondary Education: Education beyond high school which is typically provided by a technical school, college or university. Any schooling that follows high school.

Self-Determination: A person acts as a causal agent in one's affairs by taking responsibility for events or results. A self- determined person possesses the following skills: (1) choice-making, (2) problem-solving, (3) goal setting and attainment, (4) self-awareness, and (5) self-advocacy.

Special Needs: The students who meet the specific criteria to be classified as having a disability according to the Americans with Disabilities Act (ADAAA) or Section 504 of the Rehabilitation Act.

Transition Planning: A planning process that prepares the student for the passage into postsecondary or higher education.

APPENDIX

Table 1. Proactive Course Design

Instructional Method/Course Design	Potential Barriers/Challenges	Possible Universal Design Solutions
Course management system	Using a course management system that is not accessible to persons with disabilities	Training to address accessibility problems for course designers and technicians (Burgstahler, 2018)
Discussions and live chats	Speed of reply challenges; be physically and cognitively able to write responses	Asynchronous discussion forums (Dukes et al., 2009)
Websites developed by faculty	Inaccessible to students; failure of Websites to open; disabilities not considered	Training to address accessibility for students with disabilities (Burgstahler, 2018) Limit clutter (Crow, 2008) Web 2.0 tools (Brunvard & Abadeh, 2010)
Graphics, charts, tables	Color recognition for colorblind students; see and process visual information	Provide a description of images (Burgstahler, 2018; Crow, 2008)
Video clips	Process visual or aural information	Videos with closed captioning, provide an oral description of images (Burgstahler, 2018; Crow, 2008)
PowerPoint notes, outlines, lecture notes, PDF files	See and process visual information; be able to open PDF files	Embed notes in PowerPoint slides, provide scripts and audio (Dukes et al., 2009)
Audio clips	Be physically or cognitively able to take notes; hear and process aural information	Visual materials, textbook, images, videos with closed captioning (Crow, 2008) Two-tiered captioning (Sapp, 2009)
Students learn content by independently reading textbook chapters	Learn by limited examples in the textbook	Provide extensive lists of online resources organized by topic (Dukes et al., 2009) Arrange a custom Google search engine (Brunvard & Abadeh, 2010) Provide end-of-chapter summary information (Sapp, 2009)
Assessments	Understand and learn the content, regardless of background knowledge or cultural experiences; extract relevant information	Digital version of tests should be compatible with supports like text-to-speech translators (Crow, 2008) Multiple formats like oral reports, short films, papers, and presentations constructed on the computer Flexible time limits allowing time for *all* students to complete tests (Crow, 2008; Dukes et al., 2009)
Group work	Collaborate with classmates; range of skills and experiences; cultural diversity	Provide opportunities for peer feedback on assignments (Dukes et al., 2009)

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