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Dear TOJDE Readers,

Welcome to Volume 21 Issue 3 of TOJDE.

We have moved our Journal Management System to DergiPark. You can now access TOJDE at https://dergipark.org.tr/en/pub/tojde . If you want to submit your manuscript to TOJDE, please go to https://dergipark.org.tr/en/login to submit your manuscript. If you do not have a DergiPark account, please use the link https://dergipark.org.tr/en/register/ to create your account on DergiPark. After the creation of your DergiPark account, you can submit your manuscript.

There are 14 articles in the July 2020 issue of TOJDE. 27 authors from 10 different countries contributed to the issue. These countries are Germany, Greece, Indonesia, Mexico, Phillippines, Saudi Arabia, South Africa, Thailand, Turkey and Ukraine.

FROM ROBO-SAPIENS TO ROBO-LUDENS: RE-THINKING FUTURE LEARNING WITH SMART PERSONAL DIGITAL PLAYMATES authored by Sezan SEZGİN is the first article. This systematic review investigates the ongoing status of smart personal digital assistants in educational contexts and the possible relationship between smart personal digital assistants and gamification elements. This relationship is expressed in almost two new figurative terms, namely, robo-sapiens and robo-ludens and the present study lays on the foundations of these terms by presenting a holistic approach for the review and synthesis of the previous literature. The research findings revealed the most significant fields for the use of smart personal digital assistants are dominantly e-learning and special education. The research also discusses game-related components in smart personal digital assistant use in edu-centric purposes.

The 2nd article TEACHING AND LEARNING SUPPORT FOR STUDENTS WITH DISABILITIES: ISSUES AND PERSPECTIVES IN OPEN DISTANCE E-LEARNING is written by Sithabile NTOMBELA. This paper seeks to initiate discussion about the teaching and learning support needs of students with disabilities, particularly in an Open Distance e-Learning context and to propose strategies that can be employed to increase the quality of their participation and improve their academic outcomes.

INTERNATIONALIZATION PERSPECTIVE OF PANGASINAN STATE UNIVERSITY: OPEN UNIVERSITY SYSTEMS is the title of 3rd article, and the author is Phillip QUERODA. This study was administered to determine the perspective of Pangasinan State University – Open University Systems (PSU-OUS) towards internationalization as perceived by the academic unit's professors as the initial step for its implementation and realization. The results of the study indicate that the level of readiness of PSU-OUS in internationalization as perceived by faculty members is moderately ready. The faculty members' level of understanding towards internationalization is also moderate in extent. Further, faculty members perceived a high extent of opportunity in relation to internationalization. Finally, faculty members discern the internationalization challenges as less serious in PSU-OUS.

Huseyin KAFES and Mustafa CANER are the authors of the 4th article titled IMPACT OF PODCASTING ON PRONUNCIATION SKILLS OF PRE-SERVICE EFL TEACHERS. This explorative qualitative study investigates EFL freshmen's perception of the impact of creating pronunciation podcasts on their pronunciation skills. The results have shown that the participants have positive views of creating pronunciation podcasts and that podcasting freed them to a great extent from the spatio-temporal limitations of the classroom, allowing them to study and practice pronunciation at their own convenience. The findings are discussed with reference to pronunciation, recommendations for EFL freshmen are made, and implications are offered.

The title of the 5th article is TRANSACTIONAL DISTANCE AND STUDENT SATISFACTION IN A POSTGRADUATE DISTANCE LEARNING PROGRAM. Vagelis GAVRILIS, Ilias MAVROIDIS, Yiannis GIOSSOS are the authors. The study examines the three dimensions of the transactional distance theory of Moore and their correlation with student satisfaction, through a quantitative survey with data collected from 115 postgraduate students of the Hellenic Open University (H.O.U). The results indicate that students perceived low levels of teacher-student transactional distance and slightly higher, but still low, levels of student-student and student-content transactional distance. Moreover, they seem to be satisfied by their distant learning studies. Male students perceived lower levels of teacher-student and student-content transactional distance than female ones, while students with previous experience in distance learning perceived lower levels of student-student transactional distance than those without such experience. Statistically significant correlations exist between the three dimensions of transactional distance and satisfaction, with

the strongest, negative correlation, observed between satisfaction and student-content transactional distance. Finally, statistically significant and, moderate to low, positive correlations were observed between the three types of transactional distance, indicating their interlinkages.

INSIGHTS FROM THE IMPLEMENTATION OF A FLIPPED CLASSROOM APPROACH WITH THE USE OF A COMMERCIAL LEARNING MANAGEMENT SYSTEM is the 6th article. Onuma LAKARNCHUA, Sean BALME and Andrew MATTHEWS are the authors. The aims of the study are to determine students' perceptions of first-year English as a foreign language course designed using flipped classroom approach at a large Thai public university and how it affected their second language writing anxiety, in order to improve later versions of the course. The results of quantitative and qualitative analyses show that participants' second language writing anxiety is not significantly affected by the modified course. Their perceptions of the course appear to be impacted by technological difficulties. The results seem to indicate that frustration with technology should be of greater concern when attempting to utilize an LMS or similar platform.

The authors of the 7th article are Ricardo-Adan SALAS-RUEDA, Erika-Patricia SALAS-RUEDA and Rodrigo-David SALAS-RUEDA. The title is IMPACT OF THE WEB APPLICATION FOR THE EDUCATIONAL PROCESS ON THE COMPOUND INTEREST CONSIDERING DATA SCIENCE. This quantitative research analyzes the impact of the Web Application for the Educational Process on Compound Interest (WAEPCI) considering the machine learning and data science. The results of the machine learning (linear regression) indicate that WAEPCI positively influences the assimilation of knowledge and development of mathematical skills on the Compound Interest and Compound Amount. Data science establishes 4 predictive models on the use of WAEPCI in the educational process by means of the decision tree technique. The construction of web applications facilitates the active role of students, improves the assimilation of knowledge and allows the development of skills. Finally, WAEPCI improves the teaching-learning conditions on Financial Mathematics through the data simulation.

Carina DOLCH is the author of the 8th article. The title of this article is TOYS FOR THE BOYS, TOOLS FOR THE GIRLS? GENDER AND MEDIA USAGE PATTERNS IN HIGHER EDUCATION. The study which is conducted at German higher education institutions investigates the use of digital media by male and female higher education students to find out if gender differences still exist in the virtual world and, if they do, what form they take this paper. The study indicates that male students show higher acceptance values for more general web tools than female students, but when it comes to e-learning related tools women show higher acceptance values for a lot more different tools and services than men. The findings indicate that differences in media usage patterns between male and female students are not a question of having access, but of the attitude toward and the reasons for using digital media, and that the fear of women being left out of virtual worlds is not validated.

The 9th article which is authored by Sultan Hammad ALSHAMMARI is titled THE INFLUENCE OF TECHNICAL SUPPORT, PERCEIVED SELF-EFFICACY, AND INSTRUCTIONAL DESIGN ON STUDENTS' USE OF LEARNING MANAGEMENT SYSTEMS. This research aims at examining the influence of Technical Support, Instructional Design and Self-Efficacy on students' use of LMS based on extending Technology Acceptance Model (TAM). The results show that the three proposed external factors have a significant influence on students' use of LMS. These factors hav significant direct effects on both perceived ease of use and perceived usefulness of LMS. The results confirm the validity of the extended TAM model in determining users' usage of LMS.

THE INVESTIGATION OF NOVICE PROGRAMMERS' DEBUGGING BEHAVIORS TO INFORM INTELLIGENT E-LEARNING ENVIRONMENTS: A CASE STUDY is the 10th article authored by Gamze TURKMEN and Sonay CANER. This study aims to provide a comprehensive and in-depth investigation of the debugging process in programming teaching in terms of cognitive and metacognitive aspects, based on programming students who demonstrate low, medium, and high programming performance and to propose instructional strategies for scaffolding novice learners in an effective way. The results reveal that while error detection and correction are significantly high in low difficulty level questions, error detection and error correction attempts for logic errors were substantially higher compared to syntax errors. Further analysis conducted for paper-based markings that were used by students throughout their error detection, correction, and completion attempts also reveal significant relationships between marking availability and error types, as well as difficulty levels.

The 11th article is written by Umut Birkan OZKAN, Harun CIGDEM and Tolga ERDOGAN. The title is ARTIFICIAL NEURAL NETWORK APPROACH TO PREDICT LMS ACCEPTANCE OF VOCATIONAL SCHOOL STUDENTS. The aim of this study is to explore predictors of students' acceptance of Course Portal at a postsecondary vocational school level. The authors utilised a framework suggested by Sezer and Yilmaz (2019) for understanding students' acceptance of LMS. Artificial Neural Network (ANN) analyses in the study reveal that performance expectancy, effort expectancy, social influence and facilitating conditions are important predictors of students' behavioral intention to use LMS. Performance expectancy is found to be the most influencing predictor of LMS use. The analyses of this research provides evidence on the utilization of ANN to predict the determining factors of LMS acceptance.

Seyhmus AYDOGDU is the author of the 12th article titled EDUCATIONAL DATA MINING STUDIES IN TURKEY: A SYSTEMATIC REVIEW. The purpose of this research is a comprehensive review of studies towards educational data mining (EDM) in Turkey. For the purpose of this study, graduate theses and articles conducted in Turkey were examined in detail. The results reveal that EDM studies were mostly aimed at prediction from data mining tasks; artificial neural networks are the most commonly used technique in EDM studies; and studies predominantly aimed at predicting student achievement. It is seen that university students are preferred as the sample in EDM studies, achievement scores are used as data source and SPSS application is used more as an analysis tool.

The 13th article titled TEACHERS' ICT LITERACY AND ICT INTEGRATION IN ELT IN THE INDONESIAN HIGHER EDUCATION SETTING is authored by Gusti Nur HAFIFAH and Gunadi Harry SULISTYO. This is a correlational study that investigates teachers' knowledge, experiences, ICT literacy levels, and to what extent they integrate ICTs in ELT. The result shows that more than 60 % of the respondents' ICT literacy levels are above average and they frequently use ICT in their daily teaching, although they still face problems in internet facility and lack of ICT training. The study also reveals that there is a significant correlation among teachers' ICT literacy levels with their training experiences, internet frequency usage, and ICTs integration in language teaching.

The last article, FUTURE TEACHERS RESOURCE-BASED LEARNING SYSTEM: EXPERIENCE OF HIGHER EDUCATION INSTITUTIONS IN POLTAVA CITY, UKRAINE, is authored by Natalia KONONETS, Olena ILCHENKO, Volodymyr MOKLIAK. The article explores the problem of introducing resource-based learning (RBL) in higher education institutions as a holistic dynamic process of organizing and stimulating the independent cognitive activity of students for mastering the skills of the active transformation of the information environment, which involves the optimal use of the triad "student-teacher-librarian" of the consolidated personnel, logistical, methodological, financial and information resources. The effectiveness of the RBL system in Poltava region is investigated in period of 1.4 years. The study is conducted in two stages: the first (2018) – at the beginning of the experiment, before the introduction of the RBL system; the second (2019) – at the end of the experiment, after the implementation of the RBL system.

Hope to meet again in the next issue of TOJDE.

Cordially,

Dr. T. Volkan YUZER
Editor in Chief

FROM ROBO-SAPIENS TO ROBO-LUDENS: RE-THINKING FUTURE LEARNING WITH SMART PERSONAL DIGITAL PLAYMATES

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ABSTRACT

This systematic review investigates two foci: identifying the ongoing status of smart personal digital assistants in educational contexts and the possible relationship between smart personal digital assistants and gamification elements. This relationship is expressed in almost two new figurative terms, namely, robo-sapiens and robo-ludens and the present study lays on the foundations of these terms. Therefore, this paper presents a holistic approach for the review and synthesis of the previous literature. The data of the study were gathered based on the findings reported in the related research articles, conference papers, dissertations, book chapters and project reports by focusing on 9 sets of generic keywords. As a part of this study, smart personal digital assistants in learning processes were scanned purposively in the lens of gamification. To this end, a two step inclusion criteria was implemented to review the studies of the research scope. Content analysis was the main method used for data analysis. The research findings revealed the most significant fields for the use of smart personal digital assistants are dominantly e-learning and special education. The research also discusses game-related components in smart personal digital assistant use in edu-centric purposes.

Keywords: Smart personal digital assistants, robo sapiens, robo ludens, play behaviour, digital playmates

INTRODUCTION

Technology is a transformative power and shapes human life at a faster pace than ever before (Tirosh-Samuelson & Mossman, 2011). In the current Internet of things (IoT) era in which most of the devices are connected with other devices by broad wireless network technologies and sensors (Gomez, Chessa, Fleury, Roussos, & Preuveneers, 2019), it is a general acceptance that the learning ways of individuals are changing. Therefore, individual differences are at the core point of learning processes in todays data-oriented world and it is crucial for researchers and educators to take into consideration these changes to provide rich educational experiences. This paper fundamentally seeks to emphasise on learning analytics and methods of data gathering from individuals via smart personal digital assistants (SPDAs). The starting point of this emphasis arises from the difficulty of gathering the required datas of individuals in learning contexts. This study was conducted in direct response to this difficulty and aims to spot possible abilities and roles of SPDAs in educational settings. Another topic that is addressed in this study is the game related patterns in SPDA use. Game related contexts and applications are considered to be important agents in the data chaotic world of knowledge due to their attention-grabbing nature. Gamified content/applications will very likely to be a solution and a helper to gather learning analytics.

The paper is organized as follows; a bacground of concepts and figurative terms used to describe the general structure about the SPDAs and gamified assistants is given in the first section starting with background of the study. Section 2 describes the methodological approach and details of inclusion and exclusion criterias as well as limitations of the study. In section 3, findings are given in a coherent manner. Finally, conclusions and future implications are given in section 4.

BACKGROUND

Robo-Sapiens is a term that describes human-like intelligence for intelligent embodied systems, and it is a clear reference to the term Homo Sapiens (Back, Zant & Zwanepol Klinkmeijer, 2001). Another figurative term, namely robo-ludens is originated from the influential book of Huizinga (1955), *Homo Ludens*. This term was used in the PhD dissertation written by Iantorno (2015) and a conference abstract by Soma (2018). Robo ludens describes human-like intelligence that plays a role as the playmates of humans. These terms have been used in different studies, although they are considerably new terms. Studies that includes the terms robo-sapiens and robo-ludens are shown in Table 1. This table actually shows the trend of ongoing transformation in technology inovations between artificial intelligence and human daily life.

Table 1. Studies that includes the terms robo-sapiens and robo-ludens

Author	Year	Name of the paper	
Menzel, P., & d'Aluisio, F.	2001	Robo sapiens: Evolution of a new species	Robo-sapiens
Back, W. D., Zant, T., & Zwanepol Klinkmeijer, L.	2001	Robo Sapiens. Proceedings of the First Dutch Symposium on Embodied Intelligence.	Robo-sapiens
Negrete-Martinez, J.	2005	Three Steps to Robo Sapiens	Robo-sapiens
Robertson, J.	2007	Robo sapiens japanicus: Humanoid robots and the posthuman family	Robo-sapiens
Hayles, N. K.	2010	My mother was a computer: Digital subjects and literary texts	Robo-sapiens
Tirosh-Samuelson, H., & Mossman, K. L.	2012	New perspectives on transhumanism. Building better humans	Robo-sapiens
Watkins, S.	2012	Future Shock: Rewriting the Apocalypse in Contemporary Women's Fiction	Robo-sapiens
Guadagno, R. E., Okdie, B. M., & Muscanell, N. L.	2013	Have we all Just Become "Robo-Sapiens"? Reflections on social influence processes in the Internet age	Robo-sapiens
Kim, M. S., & Kim, E. J.	2013	Humanoid robots as "The Cultural Other": are we able to love our creations?	Robo-sapiens
Gutierrez-Jones, C.	2014	Stealing Kinship: Neuromancer and Artificial Intelligence	Robo-sapiens
van de Gevel, A. J., & Noussair, C. N.	2015	Artificial Intelligence and Economics: from Homo Sapiens to Robo Sapiens.	Robo-sapiens
McCulloch, F.	2016	" No Longer Just Human": The Posthuman Child in Beth Revis's Across the Universe Trilogy	Robo-sapiens
Iantorno, M.	2015	Conceptualizing Robots As Playmates and Playthings	Robo-ludens
Soma, N.	2018	Utopia of 81 Squares: Harmony between homo/robo ludens in Shogi and Chess.	Robo-ludens

Two New Species: Transhumans and Robo-Sapiens

The starting point of this review is the parabolic advancement in SPDA technologies. As a "futuristic vision", SPDAs are supposed to be the major actors as data gathering tools and act as digital playmates of individuals. The significancy this current research lays on the technological transformation progress, is explained briefly in this part of the study according to reach a comprehensive understanding.

Most researchers trace the earliest use of the term "transhumanism" to Julian Huxley's 1957 essay of the same name (Mercer & Trothen, 2014, p. 64). But this term likely appears even earlier in 1927. Huxley described transhumanism as "self-evoluation of humanism" as well as a period when humanism is transcending himself. Huxley seems to be right in this description of the term. Technological kinesis, including super-computers, sensors, wireless connectivity, artificial intelligence, robotics, neural networks, advancements in nature and human modelling, etc., brings new horizons and possibilities for homo-sapiens to eliminate or at least reduce biological barriers (Postman, 1993) and to transform the limits of self (Klinger & Coffman, 2019).

Human-integrated or environmental sensors gather our data, making it possible for us and others to have much more information about our lives (Rushe, 2010). These data are used to improve individuals' health, education, social relations and life skills. Potential improvements can be realized very fast, faster

than the overall human capacity. So, "assisting humans' capacity with technology" is the main subject of transhumanism. It is possible to give an example about a smart optical contact lens: *This lens can focus on and zoom in distant objects optically by eye movements of individuals. Normally a homo-sapien can not see the details of small objects using his unaided eye if the object is too distant. By the assistance of smart lens, the natural capacity of vision can be improved substantially*. Therefore, assisting technology add-ins created a new era that may possibly transform humans into transhumans. Transhumanist age is a period of change that technology may help homo-sapiens to evolve into a new species (Coursen, 2011) called transhuman or "transitional human" (Tirosh-Samuelson & Mossman, 2011), which is much more developed and technologically aided human (Grant, 2019).

Moravec's (1999) hypothesis claims that in the medium run (around 2050, transhumanistic period), smart machines will be capable of performing policy-making, public relations, law or some professions like engineering. Transhumans and artificial intelligence agents will be the major actors together (Hayles, 1999; p.2) of this period. Some futurists argue that transhumanistic period will bring another new species, namely posthumans: "persons of unprecedented physical, intellectual and psychological capacity, self-programming, potentially immortal, unlimited individuals" (More, 2004). Moravec (1999) also states that this will be "an inevitable process" in which robots will replace individuals in many fields.

Although technological improvements develop a similar view, it is not necessary to be so pessimistic. The transhumanist philosophy claims that there is a third alternative. Coursen (2011) specifically argues that this alternative is based on self-reflective capacity of humans stating that "a capacity that seemingly separates it from other biological species". Therefore, humans may design and create a posthuman species that can behave and act as themselves with self-oriented perfectionism but also obedient. The possible new species, namely robo-sapiens, is very likely to appear in the future stage of history. The term robo-sapiens, which is a thinking and conscious robot is a clear reference to the term homo sapiens. In this paper, the term robo-sapiens is used as a representative of human-like intelligence for intelligent embodied systems like todays' smart personal assistants.

Gathering Daily Life Analytics from Learners via Games: Robo-sapiens turns into Robo-Ludens

Play is a very common and one of the basic instinctual actions of humans. Humans begin to learn and to observe the world through the lens of games. Therefore, playing games is one of the most natural ways of learning for homo-sapiens. In this sense, the educational power of games and playing action is an open field for researchers and educators (Sezgin & Yuzer, 2017). Gamification and game based learning are the two approaches that integrate the educational potential of games into learning process (Sezgin, Bozkurt, Yilmaz, & van der Linden, 2018). On the other hand, using game-centered processes is one of the effective ways to interact with people.

In order to establish the effectiveness of teaching and learning processes, those who design such processes must take individual differences into consideration. In regard to the specialised teaching practices, getting and evaluating a number of individual data, learning analytics, is a vital concern for educators. The analyzable and essential educational data (Baker & Inventado, 2014) can be gathered and made available for the analysis by the help of sensors and digital devices. The collection of the data on a sample of learners is generally a difficult process. However, here the real challenge is to gather the data required in situation-based knowledge contexts. In order to avoid this challenge, artificial intelligence agents which uses gaming components and interacts with the learner are one of the common ways of gathering the analytics needed.

One of today's cutting edge technological innovation of ongoing transhumanist age is smart personal digital assistants (SPDAs). The advancement of mobile technologies has made the artificial intelligence very close to daily life (Maedche, Legner, Benlian, Berger, Gimpel, Hess, ... & Sollner, 2019). Smart phones and other mobile devices use SPDAs to help people in organizing their daily routines, managing their time effectively and also having basic decision support. In other words, the SPDAs are used by individuals as "an interactive peer on a daily basis" (Kanda et al. 2004). SPDAs are also representations of human to robot interaction across communication contexts in everyday life (Kim et al. 2011). It is possible to state that playing robo-sapiens which may be called as robo-ludens, are the future game-changer assistants of educators in the near future.

There are several distinct SPDAs used today. Apple's Siri, Google Assistant, Microsoft's Cortana, Bixby, Amazon Alexa, Google's Now, Samsung Viv, Nuance's Nina, True Knowledge Evi, LG Voice Mate, Microsoft's Braina are the most known SPDAs. The usage of SPDAs are generally based on forecasting, navigation, tutoring, translation, infotainment, health care, tutoring and gamifiying.

There are not so many studies that reviews the existing literature about the SPDAs. In Bozkurt and Goksel's (2018) comprehensive review, the intelligent personal assistants (IPAs) were reviewed, and some of the key concepts about IPAs were identified by examining 34 years of IPA research. The study also emphasized the educational use of the IPAs. It was concluded that artificial intelligence is a core concept in the IPA research and that the IPAs emerge as a promising research area for educational settings by increasing the degree of perceived social presence (Bozkurt & Goksel, 2018).

This study deals with the smart personal digital assistants in relation to gamification and their potential roles for educational contexts. In this regard, the study intended to shed light on the following research questions:

1. What are the the most significant fields of application / subject areas for the use of smart personal digital assistants in educational contexts?
2. What are the game-related components and fields of applications in smart personal digital assistant publications in edu-centric purposes?

METHODOLOGY

This study uses a concept-centric holistic approach to systematically review and synthesize the related literature about SPDAs. This type of studies are helpful to form a holistic view about the related research domains and to identify general tendency of knowledge development (Petticrew & Roberts, 2005; Webster & Watson, 2002). The inital aim of a systematic literature review is to provide a comprehensive review and synthesis of the studies available in a particular research area. In line with this, the systematic review of the former studies and meta-synthesis are the two interwoven approaches used in this study to reach a concept-centric holistic view.

This study is also a comprehensive meta-synthesis that seeks to understand the possible roles of the SPDAs in the educational/learning processes and gamification. The meta-synthesis is a research approach that brings together the results of different studies which deal with a similar subject (Walsh & Downe, 2005). Accordingly, peer reviewed research articles, conference papers, book chapters, project reports and dissertations were all used as the main sources for the data collection process. In addition, the educational online artefacts were also used to construct a general overview and to see the different dimensions to get a complete understanding about the research topic. As part of this study, the studies concerning the SPDAs were also reviewed with the lens of gamification in learning contexts.

Inclusion and Exclusion Criteria

In order to find the related studies, the following key terms were used: "smart assistant", "intelligent assistant", "artificial assistant", "interactive assistant", "virtual assistant" and "personal digital assistant", "personal assistant & learning", "personal assistant & teaching", "personal assistant & education". In order to construct a sample of the related studies the snowball sample technique was employed which enabled the authors to reach more related studies. The studies reviewed in this study were found and listed via Google Scholar, Scopus, Web of Science and Proquest indexes. Also project reports listed in Google Scholar and CORDIS (which is the primary source of results from EU-funded projects since 1990) were used to reach the project reports about the topic. It was determined that articles of project reports were mostly indexed by Google Scholar. One important issue about the inclusion criterias was the selection of keywords. This study mainly focuses on the role of SPDAs and partly game related patterns in SPDA use which is frameworked with learning analytics view. Electronic performance support systems (EPSSs) are generally called performance-based systems and focus on the complete job. Also decision support systems (DSS) is focused on supporting and improving decision-making in action. The discrimination between the keywords used in this study and EPSS/DSS is also the difference between learning analytics view which reflects the data gathering step and implementation step (performance support/action view). In line with this, EPSS and DSS were not included to research corpus.

The citation records of the Google Scholar were also benefited to expand the scope of review. A two-step inclusion criteria were used in the study as follows:

First step

At the first step the following criteria were used to choose the proper studies to be reviewed:

1. The studies which include predefined keywords in the titles
2. Those that deal with personal digital assistants which are based on smartness-intelligence
3. Those that evaluate the SPDAs in learning- and/or teaching-related contexts
4. Those studies that were published between 2010 and 2018
5. Those that are peer-reviewed research articles, conference papers, dissertations, book chapters and project reports
6. Those that can be accessible

The following criteria were used to exclude the studies from the scope of review:

1. The studies which are not written in English.
2. Those that were abstracts (one or two pages) or opinion papers or white papers

Second step

At the second step of the inclusion process the following criterion was taken into consideration: "The studies that include gamification or game related elements with the SPDAs".

Table 2. Number of studies included in the initial screening process

Search term	Number of studies screened
"intelligent assistant"	296
"smart assistant"	139
"virtual assistant"	229
"artificial assistant"	53
"interactive assistant"	141
"personal digital assistant"	94
"personal assistant & learning"	6
"personal assistant & teaching"	2
"personal assistant & education"	6

Data Collection and Data Analysis

In the screening process, a total of 966 studies were identified as shown in Table 2. A two round paper identification procedure was implemented after online searching process. In the first phase, after removing duplicates and a set of inclusion and exclusion criteria were implemented, 194 publications identified for the double review. In the second phase, the author and an educational technology expert evaluated the educational relatedness (subject area of publication) of the selected publications once again to provide refinement about actual educational publications. (For example medical or assistive techology solutions, papers about educational software design processes or educational application scenarios were excluded). Researchers continued their analysis with a total of 78 publications that succesfully met the inclusion criteria. In this round of the study, Cohen Kappa statistic was used to determine the coefficient of interrater reliability, in order to increase the dependability/confirmability of the research. The interrater reliability between the raters was calculated as $\kappa = 0.914$ which indicates a perfect fit between the raters (Landis and Koch, 1977). Disagreed issues were also discussed in this process within the raters to reach a final concensus.

In the study also a two-step review and analysis process was used to synthese the related literature. In the first phase, the abstracts of the studies were examined to identify those papers which evaluate the SPDAs in teaching and learning-related contexts. It was continued by examining learning contexts, results and conclusion sections of included papers. At the second step of the study the previously included papers but

with no reference to gamification or game related elements in the teaching and learning process were excluded. The remaining papers (n=16) were analysed in terms of the use of the gamification-related components in the teaching and learning process. Next the thematic analysis and content analysis were employed using the Microsoft Excel and NVivo 12 qualitative analysis software. The data collection and analysis process are summarized in Figure 1.

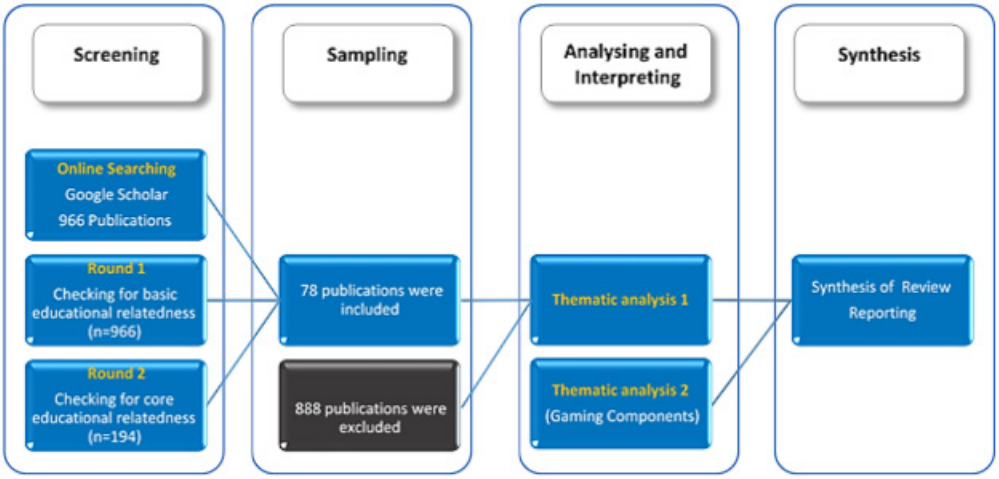

Figure 1. Data collection and data analysis process (adapted from Koseoglu & Bozkurt, 2018)

In the thematic analysis process, the coefficient of interrater reliability was calculated once again. In this round, an intrarater reliability was also determined. The researcher repeated the thematic analysis 30 days after conducting the first analysis to reach an intrarater reliability. The interrater and intrarater reliability coefficients between the raters were respectively calculated as κ =0. 791 and κ =0. 940. Therefore, the reliability of Cohen Kappa values for this study can be considered as quite acceptable.

Limitations and Significance of the Study

The findings of the study are limited to the data taken from the researched articles published in peer-review academic journals, conference papers, dissertations and book chapters. These papers were all selected based on the inclusion criteria explained above. The date 2010 was specially determined because of the fact that influental mobile SPDA Siri was first launched in February 2010 as an iOS application. The mobile SPDAs have been developed and improved much since that year.

The studies reviewed in this study were found and listed via Google Scholar, Scopus, Web of Science, Proquest indexes, CORDIS research repository, and they were all written in English. This criterion limits the sample in that the papers which may also provide significant findings about the topic were to be excluded. Also research reports were screened only from Google Scholar and CORDIS project repository. Although the articles of project reports were mostly indexed by Google Scholar, this may currently limit the research scope. Admittedly, it is very difficult to reach the project reports funded by different institutions. Another limitation of this study is that the data based on Google Scholar's advanced search options were used. More specifically, the "all in title" search option was employed to narrow the research scope to be able to focus on the study subject. In other words, as a result of it some other significant studies may have been excluded from the scope of the present study.

The strengths of the study lie in the review of the studies concerning the gamification-related issues about the SPDAs which defined them as digital playmates of humans, namely roboludens. It is also considered to be significant to describe a novel interaction model/visualisation about learning analytics by this study. This is the main focus and significance of the present study.

FINDINGS AND DISCUSSION

In this study a total of 78 studies about the SPDAs were reviewed and interpreted. The findings obtained are presented in two main sections, namely *context mapping & edu-centric findings* and *game-related findings.*

Context Mapping & Edu-Centric Findings

As shown in Figure 2, the SPDA-related educational studies relatively increased by 2014. Any specific estimation can be done in line with this data but it is possible to argue that this increased number of studies is a reflection of the tendency about using and integrating the SPDAs into educational contexts.

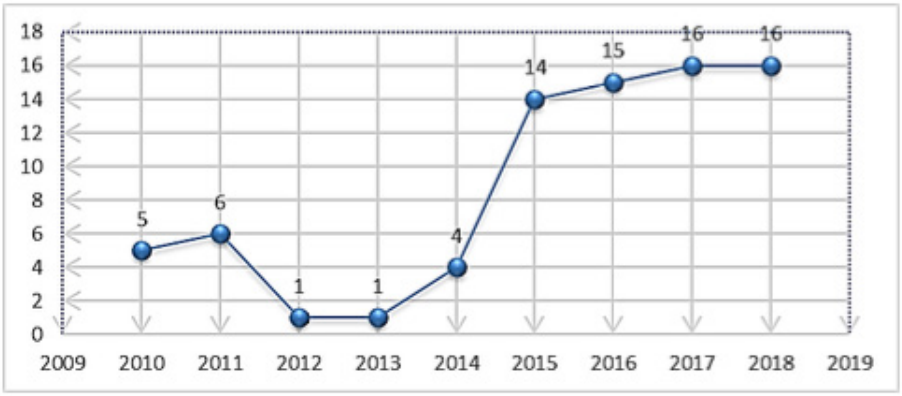

Figure 2. SPDA studies from 2010 to 2018

Another finding related to context mapping & edu-centric findings is nature and designs of the studies. As shown in Figure 3, system arcitecture papers which are explanatory in nature were the most dominant paper designs (48,72%) among the papers reviewed. However, they may not be be considered as a methodological approach. In line with this consideration, it is possible to indicate that descriptive studies (12,82%) and survey designs (10,26%) were together the most frequently used quantitative approaches.

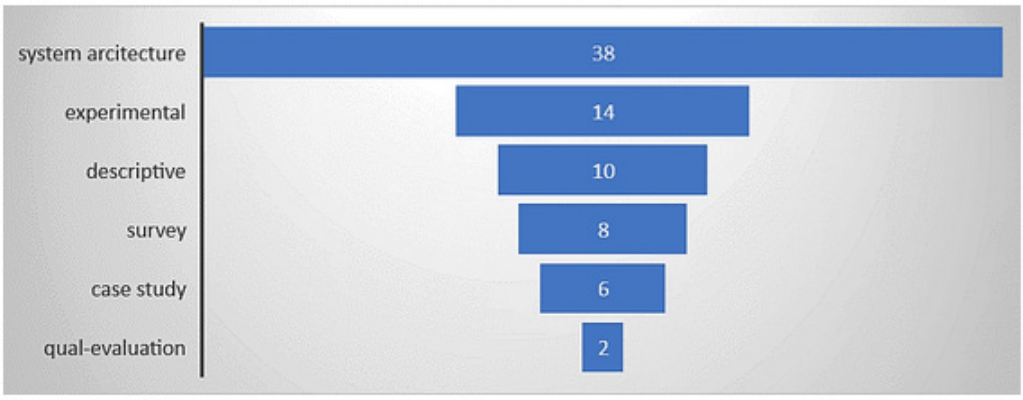

Figure 3. The nature and design of researches

Experimental research designs were also one of the most frequent research types among papers (17,95 %). The relatively small number of experimental designs is not an unexpected result, in line with the difficulties related to randomization in educational settings (Scott & Usher, 2011). According to frequencies in this study, it can be argued that SPDA studies in educational settings are strongly related with the design and experimental control of the design.

Another finding concerning the context mapping is about the genre of the studies reviewed in this study (Figure 4). Although peer reviewed articles, conference papers, academic dissertations, project reports and book chapters were the main data sources, the conference papers were the most frequent publication type (70,5 %).

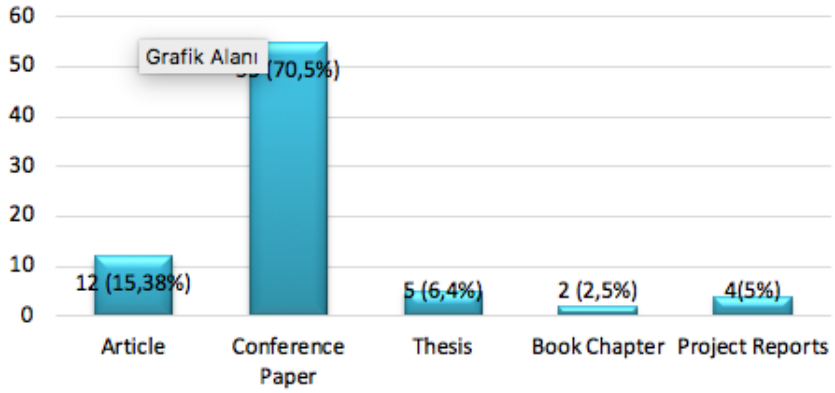

Figure 4. Genres of the studies reviewed

This finding is not surprising given that the SPDA use and integration into the teaching and learning environments are relatively new. The conference presentations are very common way to share, discuss and get immediate feedback about the studies on the new educational technologies. Therefore, it can be argued that the SPDA use and integration into the educational environments are still in primary testing stages and not fully postulated.

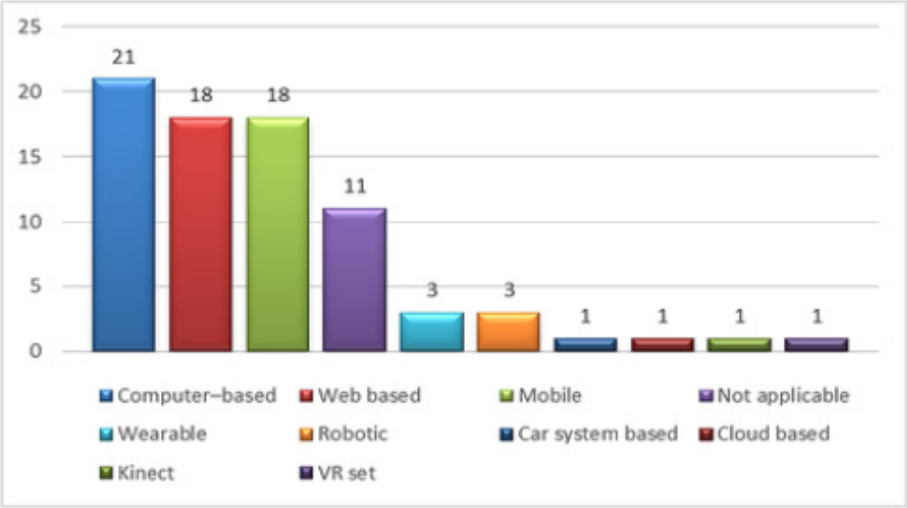

Figure 5. The mediator technologies which SPDAs are involved in

The mediator technologies in which the SPDAs are involved were reviewed in the current study, and the findings are shown in Figure 5. It is seen that computer based, web based, and mobile mediator technologies were dominant mediators for implementing the SPDAs. At this point it is significant to indicate that the computer based use of the SPDAs is not available to be used in mobiles. Also, the web architectured SPDAs seem not to be suitable for both computer based use or mobiles. Therefore, it can also be argued that the SPDA integration into any edu-centric environments is still in infancy period.

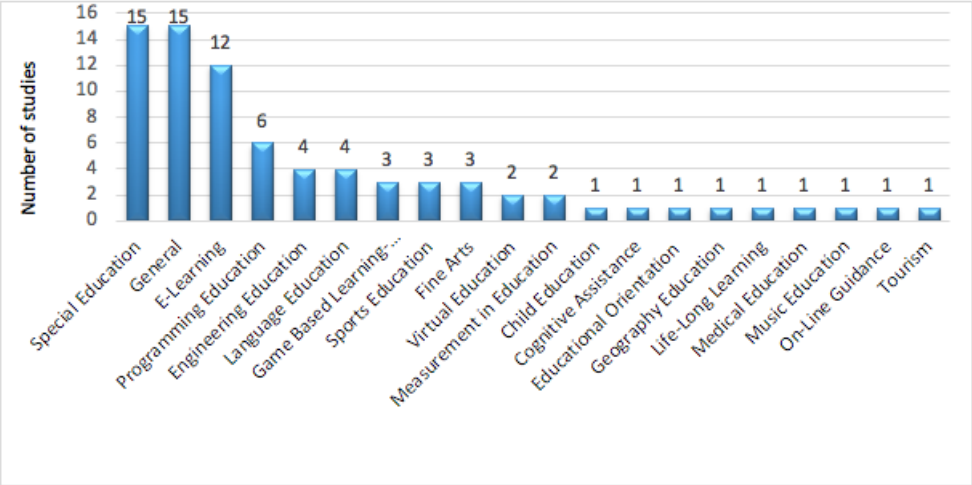

Figure 6. SPDA use in education/learning related domains

The use of the SPDAs in education/learning related domains in the studies reviewed are shown in Figure 6. As a birds-eye perspective, it is seen that the most frequent domains of the use od the SPDAs involve e-learning, special education, programming education and engineering education. The category of "general" reflects the use of the SPDA for general educational purposes, including *achieving the stated goals across the dynamic changes in the environment, assisting students in their learning processes, self-management-supporting timely recovery from possible misunderstandings, supporting users in selecting educational material from learning objects repositories, assisting social networking by promoting user interactions and resource usage, supporting learning performance, helping students to manage their learning, allowing students to access/obtain on-the-fly course materials customized to their needs and preferences and to promote the interaction, helping to visualize datas, stimulating the innovation of teaching of teachers, promoting conversational skills, quick assistance to visitors and students in field trips, simulating real-world experiences and helping students in their campus life*. It can be argued that the current significant fields for the use of the SPDAs are dominantly e-learning and special education. Parallel with the findings of a related research, SPDA use in any field of education is a promising emerging research area (Bozkurt & Goksel, 2018) in line with technological breakthrough.

Game-Related Findings

The studies reviewed in this current study were also analysed in terms of their findings about the game-related components. Of 78 studies reviewed 16 included such components. The possible area of usage of the SPDAs concerning the game related components are identified as follows; *socialising, exploring and accessing educational and cultural resources, simulating real-world experiences, helping students in virtual science experiments, asking questions to learners about specific lessons, mediating interaction with children in some cases (for example entertaining children in the back seat of a car. This is also engaging, entertaining and educating children), improving communication and interaction with authentic learning context, enhancing students' learning experience and has the potential to improve retention, progression and student achievement, learning about home modifications, guiding learners toward a broad array of resources that can help them learn, immediate learning support, providing quick assistance to visitors and students in museum or field trips, providing suitable courseware by identifying a child specifically based on the behavioural patterns that aids the autistic student's learning, providing feedback for personalized education which leads to an improved mentorship quality, helping students in their campus life and providing language rehabilitation.* In addition, the game-based or gamification-based elements of the studies reviewed were analysed, and the findings are shown in Table 3.

Table 3. Game-centric components of the studies reviewed

Game components	n	Game components	n
virtual character	7	rewards	1
chatbot	6	visual aids	1
avatar	3	levels	1
virtual exploratory environment	2	leaderboards	1
points	2	unlocking	1
customization	2	roadmap	1
a real-world scenario	1	real-time monitoring	1
social engagement mechanism	1	immediate feedback	1
jumping to a particular area	1		

One of the notable findings indicates that virtual characters, chatbots and avatars are the most used components of the use of game-centric SPDAs. This finding provides clues in line with gamified use of SPDAs as a playmates of individuals for educational purposes, that is, one of the research questions of this current study. Animated virtual agents and chatbots focus on one to one interaction with the user. They tend to act as playmates of users to assist them in different learning cases. As parallel with the Falloon's research (2010), virtual characters have a high motivational and learning engager value that reflects very positive educational outcomes. Therefore, they may be effective components in gathering learning analytics from learners to be used for educational purposes.

Feedback is the core process in educational processes as well as in any gamified environments (Sezgin, 2018). In the light of this, the author paid special attention to feeedback component given in the studies reviewed. It is concluded that although there is only one study which reported a component about feedback, most of the publications put emphasis on feedback component implicitly. As it is known, feedback is one of the core mechanisms where interaction takes place in all educational processes.

When the subject areas of the studies reviewed at the second part of the study, it is found that e-learning is the predominant field (50%) for the game-centric SPDA studies. In addition, the conference papers (75%) are the most frequent type of the studies reviewed which is parallel to the first step of analysis (general SPDA use in education). Also it can be argued that gamified SPDA use was boomed by 2015 (13 of 16 researches were made between 2015 and 2018). This proves the argument of gamification and SPDA integration in practical use at education-centric environments are new and still in primary testing stages.

One of the interesting findings based on the second part of the analysis reveals that there is an ambiguity between "avatars" and "virtual characters". Even they may have similiar representations and outlook, avatars are the animated representations of users and generally controlled by users in a game environment.

Figure 7. Virtual character (Rajagopal & Babu, 2018) & avatar (Milchus, Swarts, Malesevic & Lee, 2015)

Avatars provide simulation based real time presence to users. However, the animated virtual characters represent any character as part of the initally structured scenerio. As stated earlier the virtual agents and chatbots are very popular due to their animated /gameful presence. One of the most important game-based tools are supposed to be virtual representations of individuals in the gameful world of future. This finding is significant in line with this perspective however it is not the main focus of this review. It is a known fact that emotional engagement and connection are the two important factors supported by virtual agents (Taylor, 2011). Also learners can gather information through interacting with virtual characters (Wu, Lee, Chang, & Liang, 2013). Other game related components like points, rewards, leaderboards, levels, unlocking new features and real-time monitoring, etc. may also play critical roles to gamifying the symbiotic learning process as well as gathering required learning analytics.

According to another finding, it was observed that there is a trend about designing new SPDAs apart from the most known SPDAs including Siri, Cortana and others. Jill Watson (Goel & Polepeddi, 2016), Nicky (Kincaid & Pollock, 2017), Maria (Rajagopal & Babu, 2018) PseduoEye (Daraghmi & Yosef, 2016), LABTA (Yang, 2010), BoBi (Liu & Zhu, 2017), Project Nethra (Weeratunga, Jayawardana, Hasindu, Prashan, & Thelijjagoda, 2015), LiSa (Dibitonto, Leszczynska, Tazzi, & Medaglia, 2018), and Scarlet (Ilhan, Music, Junuz, & Mirza, 2017) are some of the SPDAs specifically designed for educational purposes. There are also studies (Bravo, Paliyawan, Harada, & Thawonmas, 2017; Huang, Chang, Chen, & Chen, 2014; Lv & Li, 2015) that use the body-motion preference systems such as eye-tracking, kinect and VR headsets. In two studies (Bogdan, Yurchenko, Bailo, Rameau, Yoo, & Kweon, 2017; Bouloutian & Kim, 2014) the SPDAs are integrated to wearable technologies. This finding indicate that the SPDAs are in development process as epiphytic systems and can be used as human body- integrated devices. Among these findings, there are only a few negative estimations and concerns about SPDA use in educational contexts. These are; ethical issues in using body integrated devices, personal data privacy in some of the data gathering methods of personal assistants, exhaustive big data components (gathering daily life analytics) and costs of production.

Results of meta-synthesis were clustured into three sections. Accordingly, SPDAs can be used in educational settings as follows:

Possible SPDA use in special education

- Help visually disabled to access social media and other internet based educational services by natural language processing
- Reduces the difficulty of reading a document for the blind or visually impaired person as a personal virtual friend
- Guiding to learn how to program for visually impaired
- Helping interaction with authistic children by virtual characters
- Provide suitable courseware by identifying a child specifically based on the behavioural patterns that aids the autistic student's learning
- Overcoming language defections with natural language processing and provide language rehabilitation
- Assisting hearing-impaired people for communication in learning processes
- Obtain an extensive feedback about their surrounding educational or authentic environment for physically or visually impaired individuals

Possible SPDA use in E-learning

- Guiding learners towards a broad array of resources that can help them learn.
- Answering the learners frequently asked questions at anytime and also provide immediate support
- To guide and assist students in solving their experimental problems.
- To improve communication and interaction with any learning platform.
- Automatically grade student work, provide immediate feedback, and to guide students through the problem-solving process
- Providing individualised "valuable feedback" which leads to an improved mentorship quality
- Enhancing students' learning experience and has the potential to improve retention, progression and student achievement by attention-grabbing interactional features

- Helping learners in virtual science experiments.
- Providing distance training for high probable risk areas like power plant operation

Possible SPDA use in other educational settings

- Removing language barriers with the help of synchronous translation programs, helping learners' pronunciation skills, providing timely recovery from possible misunderstandings.
- Supporting learners with authentic virtual field trips with quick assistance
- Adapting individuals to daily or complex conversations who has social disorders
- Providing support for individuals who have disorders or inabilities about their mental persistence to any learning process
- Supporting learners at hands-on, hands free and learning by doing situations (with wearables or oral commands)
- Complex and stressful problems can be solved as a quick knowledge navigation tools
- Provides 24/7 accessibility, self-paced learning and personalized instructions for shy or more timid students.
- Allowing to implement one-to-one guiding and individualized practical training in programming courses (identifying error codes, helping students practice program tracing, support learners in their programming assignments)
- Automatically suggesting educational or course materials customized to learner analytics hence allowing learners to control their university education
- Providing immediate feedback thus self-evaluation in fine arts or sports education where individual guidance is very significant (Dance-teaching, singing breath control process, doing sketching and shading, learn the art of archery, professional volleyball training).
- Helping learners in their campus life by diversified guidance features
- Providing technical assistant when using electronic components for technical education domains.
- Helping to interact with children in car travels with an engaging and entertaining way for educational purposes.
- Helping learners to relieve some of the pressure in their daily tasks and studies by a conversational friend.

Also according to literature synthesis, SPDAs can be used under the guidance of gamification techniques with mobiles or wearables in educational settings as follows;

- Accessing and processing real daily life logs and learning analytics of learners instantaneously and provide more individualised-specialized learning environments
- Gamifying learning and support learners with motivation and engagement by the power of game elements.
- Supporting learners with quick responses and recommendations in different situational learning scenarios which must be gamified due to strain or difficulty of the learning case
- Engage to authentic learning situations using natural language dialogues

In line with the reviewed publications in this current study, it was seen that there is a strong emphasis on the structural form of SPDAs. The common features of SPDAs were determined as; natural language processing, animated virtual appearance with conversational infrastructure, epiphytic habit, responding to dynamic changes in the learning environment with artificial intelligence, aiding decision making and data gathering abilities.

Based on the synthesis of the findings, a basic level conceptual visualisation was generated as shown in Figure 8. In the new data-oriented world, data gathering process from individuals is a vital requirement for individualised learning. By the help of mobiles and wearables, SPDAs were become widespread. This provided a close relationship between humans and humanoid friends but at this point the critical question revealed: "how can be accessed and gathered real daily life logs and learning analytics of learners instantaneously especially in authentic learning scenarios?". In the new data driven era SPDAs are becoming data gathering

tools via gamified behaviours. Therefore, the figurative term for SPDAs, roboludens, may be an inovative game-changer for the future of learning.

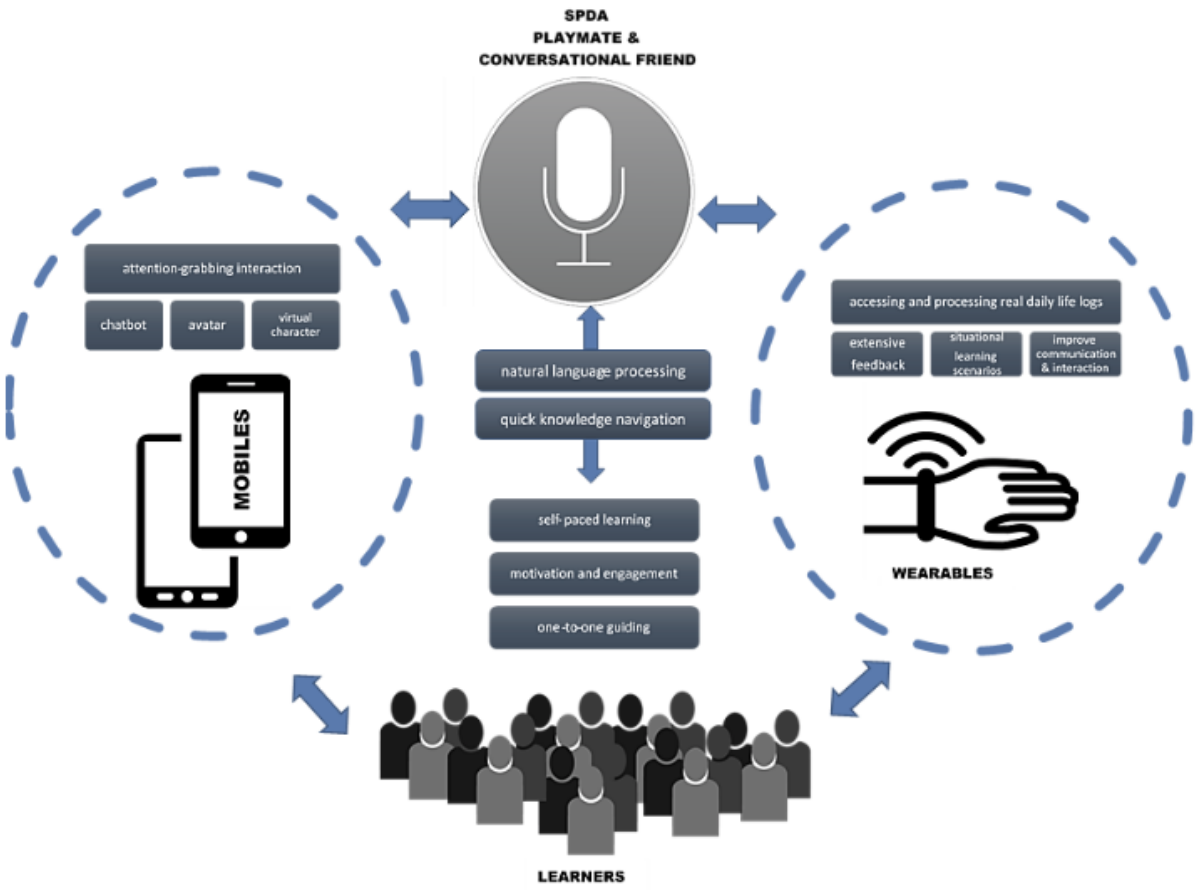

Figure 8. Conceptual visualisation of SPDAs as "data gathering tools"

CONCLUSION AND FUTURE IMPLICATIONS

This current study shows the dispersion of SPDA use in education/learning related subject domains. More than 19 different educational areas for the use of the SPDAs are identified in the study. It provides some insights about the capabilities and abilities of the SPDAs for educational purposes. Among these educational domains e-learning and special education are found to be the outnumbered areas for the use of the SPDAs. Therefore, it can be concluded that the current SPDAs are quite eligible to present rich learning experiences for distance learners and individuals with special needs.

One of the initial aims of this research was tracing the gamified elements among SPDA use in educational/learning settings as playmates of humans. 16 studies were found to be eligible to included. Although virtual characters, chatbots, avatars and other game related components are being integrated with SPDAs, there was no empirical evidence about accessing real daily life logs of users by gamified actions and transfering them into educational settings as a duty of a smart assistant. However, research concludes that the SPDAs are in a transformational period for the use in learning proceses.

Insights and clues gained from this study indicate that SPDAs may have a critical role with embedded gamified actions. Thus, SPDAs are very likely to gain attention for educational settings because they shed light on the very basic instricts of humankind, gamefulness. Based on the findings of the study, the following suggestions can be considered for the future of SPDA use in educentric purposes. First, fully understanding the needs of any learner group is essential for educators or learning designers to integrate SPDAs for adaptive learning plans/scenarios. Because these plans/scenarios are based on the learning /daily life analytics of

learners. Second, new strategies and policies need to be developed to eliminate barriers in ethical and data privacy issues about the data gathering procedures of SPDAs. Third, educational technology labs in different faculties and schools will help to understand the dynamics and features of such artificially intelligent high technology devices. Finally the relationship between the big data, learning analytics, gamification and wearables/mobiles must be explored attentively to provide new technology integration models for different domains of education.

There is a strong relationship between the SPDAs and the gamification in the IoT era. Digital assistants are the artificial structures and possibly living on mobile devices and also wearables. They enrich and ease the life and experiences of individuals through their humanoid artificial intelligence. This is very likely to become a standart in the near future. Education systems of the near future must aim at providing richer and more efficient learning experiences by integrating the whole life experiences into education process. Therefore, gameful virtual friends; roboludens may have a critical role for accessing and processing real daily life logs and learning analytics of learners instantaneously and provide more individualised-specialized learning environments.

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TEACHING AND LEARNING SUPPORT FOR STUDENTS WITH DISABILITIES: ISSUES AND PERSPECTIVES IN OPEN DISTANCE E-LEARNING

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ABSTRACT

The transformation of higher education, in line with the South African Constitution, has led to increased enrolments of students with disabilities. However, limited research has been conducted on teaching and learning support these students receive. Access of students with disabilities in higher education is a human rights issue yet research shows that it has not been linked to increase in instructional support. As such, their participation has been limited. Some of the barriers limiting their participation are lecturers' negative attitudes due to lack of disability awareness and the unavailability or inadequacy of support in teaching and learning. As a result, higher education institutions have not succeeded in creating enabling teaching and learning environments for these students. This paper seeks to initiate discussion about the teaching and learning support needs of students with disabilities, particularly in an Open Distance e-Learning context and to propose strategies that can be employed to increase the quality of their participation and improve their academic outcomes.

Keywords: Students with disabilities; teaching and learning support; Open Distance e-Learning; higher education; access; participation.

INTRODUCTION AND BACKGROUND

The United Nations Convention on the Rights of Persons with Disabilities acknowledges and promotes equality for persons with disabilities (Rieser, 2018). The Convention calls on countries to foster an attitude of respect for the rights of people with disabilities at all levels of their education systems; develop inclusive education systems at all levels such that people with disabilities receive the support they require, and, promote programmes that raise awareness about people with disabilities and their rights (United Nations, 2006). All countries that are signatories to the UN recognise the needs and rights of students with disabilities in education and many have instituted legislation on how to integrate these students into all levels of education (Magnus, 2006).

When South Africa was welcomed back into the general Assembly of the United Nations in June 1994, it became bound by all resolutions taken at that level. As a result, the Constitution and all post-1994 education policies acknowledge access to education as a human right. As such, the transformation of the education system from being elitist and exclusionary to being inclusive has become a priority at both basic and higher education levels with the intention to improve access for all. However, the Convention on the Rights of Persons with Disabilities highlights that the inclusion and support of students with disabilities is still a global implementation challenge (United Nations, 2006). South Africa is also struggling to change attitudes and raise awareness about disability issues. This, in spite of research evidence which shows that education is a critical determinant of social mobility, and that higher education opens doors to better employment and quality of life (Magnus, 2006; Chataika, Mckenzie, Swart & Lyner-Cleophas, 2014; Lyner-Cleophas, Swart, Chataika & Bell, 2014).

Since there is acknowledgement that education is critical in personal and economic development of communities, South Africa has to deal with the impact of past policies which pushed particular groups, including people with disabilities, to the margins of society (Department of Education, 1997a), thereby limiting their participation in all social spheres. After democracy, the South African Department of Education (hereafter DoE) (1997b) acknowledged that many children with disabilities were not benefiting from basic education either because they were refused admission to schools, or, if admitted, they were not given support to succeed in learning. Although there were special schools catering for different disabilities at that time, these were few and not available in marginalised communities (DoE, 2001). Consequently, very few young people with disabilities progressed to higher education. Even those who did, they struggled because the provision of necessary academic support to enable them to succeed was not a priority (Ntombela & Subrayen, 2013).

In 1997, the Department of Education promulgated Education White Paper 3: A programme for the transformation of higher education (DoE, 1997a) with the objective to increase access to and participation of marginalised groups in higher education, including people with disabilities. Sixteen years later, the White Paper for Post-School Education and Training came out, a policy committing government to address post school barriers that limit the development of all students (Department of Higher Education and Training, 2013).

CONCEPTUAL UNDERPINNINGS

This discussion paper is guided by human rights and the philosophy of inclusion as conceptual frameworks. Education is a human right (UNESCO, 2001; RSA, 1996) and, according to the South African Constitution, the state is obliged to make further education available and accessible to everyone (RSA, 1996; DHET, 2013). The philosophy of inclusion promotes everyone's human right to education and challenges exclusionary practices and policies (Ntombela, 2013). This philosophy has been instrumental in influencing the transformation of education systems and societies in general as well as the development of policies that are inclusive (Ntombela, 2013).

In this paper, these two concepts are juxtaposed to highlight progress in transforming the education system as well as challenges that higher education faces in ensuring that all students admitted have support to participate meaningfully in all activities. Since access and participation are part of transformation, these concepts are an important lens in interrogating how higher education institutions (HEIs), particularly Open Distance e-Learning ones, can reach higher levels of student support to improve the participation of SWD and to uphold their right to education.

In the light of the developments highlighted above, this paper seeks to initiate discussion on the following issues:

a. How far has the South African higher education system progressed in addressing barriers that limit the development of students with disabilities (SWD)?
b. What issues affect access and participation of SWD in Open Distance e-Learning context?
c. What can be done to provide relevant teaching and learning support to SWD in higher education, particularly in ODeL contexts?

Towards Addressing Barriers That Limit the Development of Students With Disabilities in South African Higher Education

The adoption of the new South African Constitution promised all citizens equality before the Law and extended human rights to all (RSA, 1996). Similarly, the transformation of higher education in line with the Constitution and the promulgation of Education White Paper 3 (DoE, 1997a) has made it possible for those students previously marginalised to access higher education. The admission and participation of qualifying SWD in higher education is a basic human right protected in the Constitution (Department of Justice and Constitutional Development, 2016). This human right has got to be upheld because when students with and without disabilities enrol into HEIs, their admission has potential to empower them through increased

knowledge base, exposure to debate and discussion, development of social skills and obtaining qualifications (Fuller, Bradley & Healey, 2004). Teferra and Altbach (2004:21) also highlight that universities are leading in the field of knowledge and information production and that "higher education is recognised as a key force for modernization and development", in this century. This suggests that those who pursue university studies get empowered. It is in this vein that Wehman (2006) regards higher education as a means to improve people with disabilities' quality of life because it has potential to increase their employability, their earning power, and to give them independence. Therefore, it is important that as a country and as HEIs we do everything possible to support all students to have positive educational outcomes as this benefits them as well as the country.

In view of the benefits of higher education highlighted above, it is a cause for concern what Engelbrecht & de Beer (2014) highlight, that by 2010, enrolment statistics showed that only 0.8% of students in higher education institutions (HEIs) had indicated they had a disability. This low enrolment could be a confirmation of the influence of past policies, practices of marginalisation and discrimination that limited the participation of people with disabilities in education. The fact that by 2014, "only 2.8% of disabled people have access…" at this level (Engelbrecht & de Beer, 2014: 544), suggests that we have not been aggressive enough in addressing this matter. Although there had been some increase, it remains statistically insignificant when one considers that about 20% of young people with disabilities are enrolled in HEIs (South African Human Rights Commission, 2018). Furthermore, it also shows how critical it is for the country to intensify efforts to support young persons with disabilities to enrol and succeed in higher education.

A South African study also highlights that there are negative attitudes, curricular barriers, lack of appropriate services, poor resourcing and poor infrastructural design which act as barriers to learning, thus limiting the progress of SWD (Tugli et al, 2013). Other local studies confirm that there are still barriers to learning and development that limit the participation of these students at this level (Matshediso, 2007; Goode, 2007; Ntombela & Subrayen, 2013; SAHRC, 2018). In another study exploring access challenges for students with visual disabilities at the University of KwaZulu-Natal, Ntombela and Soobrayen (2013) conclude that students' academic outcomes depend largely on staff's awareness, ability, and willingness to support all students. Similarly, Tugli, Zungu, Ramakuela, Goon and Anyawu (2013: 362) cite inadequacy of learning support materials and negative attitudes towards disability as major barriers to participation that perpetuate the exclusion of these students, impacting their "academic freedom and progress". In addition, Magnus (2006) and the SAHRC (2018) posit that lack of reasonable accommodations, lack of knowledge and general ignorance about disabilities are some of the key barriers that push these students to discontinue studying.

It seems that South Africa is not alone in fighting this access and participation battle that affects SWD. Moswela and Mukhopadhyay (2011: 308) maintain that in developed countries, there is research evidence that SWD still face "attitudinal, structural and resource-related" barriers as well as "curriculum delivery, alternative assessment" challenges which limit their progress and success. They report that things are no different in Southern Africa, as SWD face negative attitudes, teacher-centred teaching and learning processes, inflexible curriculum, inadequate assistive and instructional technologies (Moswela & Mukhopadhyay, 2011:309).

Due to the paucity of support in higher education, fewer SWD progress to postgraduate studies. Such evidence confirms that the educational experiences of young persons with disabilities differ significantly from those of their peers without disabilities (RSA, 2016). This also confirms Nzimande's observation (2010) that large numbers of SWD take longer to graduate and that many drop out, a sentiment that was recently shared by Spassiani, Murchadha, Clince, et al, (2017). This is not surprising, though, if these students face so many challenges during their higher education years. However, these challenges need to be addressed as a matter of urgency because higher education is central to the transformation process. It has a responsibility to address inequalities that past policies and practices created (DoE, 1997a), which makes higher education important for all students, but more so for those with disabilities as it can provide opportunities to improve the quality of their lives.

What is evident though is that prejudice still prevails against SWD. This could explain why the Foundation of Tertiary Institutions of the Northern Metropolis (FOTIM) study (2011) found it difficult to get accurate statistics of registered SWD because many choose not to disclose their disability status. Taylor et al (nd) also

found that students were not keen to disclose their status out of fear that their chances of admission could be negatively affected by this disclosure. The issue of non-disclosure is also highlighted by Kendall (2016) who highlights that students are sometimes reluctant to disclose their disability for fear that they may be viewed negatively or treated differently. This reluctance to disclose a disability could also work against them in that if there is no up-to-date information on the types of disabilities that institutions need to make provisions for, it can be difficult to plan and provide meaningful support (Kendall, 2016). Students could also be deprived reasonable accommodations that they qualify for simply because they have not declared an impairment. As such, the report that DHET is working on promoting the social inclusion of persons with disabilities in higher education (SAHRC, 2018) is welcomed, although such a move only addresses social access and not academic access and participation.

It appears that whilst many studies have been done on the experiences of SWD in contact institution, there seems to be much less known about the challenges of SWD studying through open distance e-Learning (ODeL), a gap that this paper seeks to initiate discussion on. Non-contact institutions, by their very nature, will attract far more SWD than contact institutions. The question is, do their SWD fare better than those in contact institutions? Increasing access and participation is part of transformation and Ntombela and Mahlangu (2019) highlight how complex transforming a system is, arguing that increasing access without paying attention to participation does not bring about change in how institutions work. If indeed there are more SWD studying at a distance, how aware are those working there of the students' teaching and learning support needs? How critical are they of the dominant culture which informs programmes and services within the institution so that they do not perpetuate practices that keep SWD on the margins?

Barriers to Access and Participation of SWD in an ODeL Context

Discourses Shaping our Provision of Teaching and Learning Opportunities for SWD

Disability, according to the World Health Organization (1980: 14) is a result of "impairment in terms of functional performance and activity by an individual" whereas an impairment is an abnormality in the body structure or organ function. Although in everyday language the concepts are used interchangeably, a disability is a limitation that a person may experience socially due to the existence of an impairment. For example, deafness is an impairment but a deaf person experiences no disability in an environment where everyone is fluent in sign language and where videos have sub-titles. However, in a context where no one understands sign language they are totally disabled.

Since there is evidence that the universities are transforming and the number of SWD enrolled in higher education is increasing (Engelbrecht & de Beer, 2014), the question remains, what is informing this increase? This question is important because there could be different discourses influencing the admission of these students. If we do the right thing for the wrong reasons, the change we hope to see remains superficial and short-lived. We do not want transformation that is driven by the medical/deficit model which continues to dominate service provision in many parts of the country (Ntombela & Soobrayen, 2013) even though the Constitution and policies developed post democracy have moved away from this model. The medical/deficit model views disability just as an impairment and a limitation to participate (UNESCO, 2001) at the exclusion of the context. Within this model, admitting SWD is seen as a favour, as such, they are expected to find ways to fit in with very little support. Such an attitude continues to keep them on the periphery (Ntombela & Soobrayen, 2013).

Then there is the social model which is promoted by the Constitution and all post democracy policies. This model emphasizes the 'disabling' and exclusionary impact of physical and social environments in the lives of people with disabilities (UNESCO, 2001; Ntombela & Soobrayen, 2013). This is the model we need to embrace in our programmes and it should inform our support strategies as it forces us to scrutinise our beliefs and attitudes towards people with disabilities. In an ODeL context, it is very easy not to be aware of issues affecting SWD because the students may not be physically present at the institution, and therefore, remain invisible. Although this is changing rapidly at the University of South Africa, it is still the case for SWD. As such, it is very possible to remain immune to developments that challenge oppressive beliefs and practices, and academic and administrative staff could remain detached from disability advocacy debates and discussions.

Access and Participation as Two Sides of the Same Coin

As the movement to increase the admission of SWD intensifies, we should look for strategies to increase their participation as well. This is necessary because increased access has no value unless linked to meaningful and quality participation and support (retention) strategies that lead to students' success. All students require various levels and forms of support to succeed in their learning, regardless of ability/disability and level of study, especially if they are studying at a distance. How, then, can an ODeL institution provide teaching and learning support that meets the needs of SWD? Currently there is minimal or no interaction between the disability unit (named the Advocacy and Resource Centre for Students with Disabilities) and academics, which leaves one wondering whose students are these. This unit is there to coordinate advocacy campaigns and motivate for resources. It is run by administrators who are not knowledgeable about the demands of the curriculum. Therefore, it is important for those responsible for teaching and learning to understand what support do the SWD need and, with the assistance of the unit, develop strategies that support teaching and learning for all.

Meaningful participation for SWD depends largely on academic support like curriculum delivery and alternate assessment procedures (Moswela & Mukhopadhyay, 2011). However, it is worrisome to learn that university staff tends to lack awareness about disability policies and the support needs of SWD (FOTIM, 2011; Lyner-Cleophas et al 2014; SAHRC, 2018). The danger is that when staff is unable to provide support to these students, it increases their vulnerability, renders the students 'invisible' and susceptible to dropping out. Spassiani et al (2017) researching and writing with students with disabilities, also report that sometimes students with disabilities feel that students without disabilities receive preferential treatment. It is in this vein that Nzimande (2010) calls on universities to find relevant strategies to support these students and ensure that policies and practices do not exacerbate their vulnerability, a sentiment shared by Spassiani et al (2017).

Researching the experiences of SWD at an urban contact university, Ntombela and Soobrayen (2013) showed that systemic barriers (how things are organised and done) can reduce the level and quality of support available to these students. In another study based at a rural, contact university, Tugli et al (2013) investigated SWD' perceptions of access and support. They argue that poor resourcing and poor infrastructural designs negatively affect these students in as far as access, equity and support are concerned, and they concluded that increased access and support services are critical to enable SWD to participate equally in academic and social life (Tugli et al, 2006).

Negative Attitudes

Studies over the past decade have shed light on how SWD face negative attitudes in the higher education learning environment (Nzimande, 2010; Moswela & Mukhopadhyay, 2011; Tugli et al, 2013; Engelbrecht & de Beer, 2014). Negative staff attitudes make these students feel judged and embarrassed (Spassiani et al (2017), and negatively impact their academic outcomes. It is a cause for concern what Tugli et al (2013: 362) highlight, that students with disabilities felt that they were not welcome in the lecture halls and felt rejected by non-disabled students, staff and the institution. Then we wonder why many are reluctant to disclose their disability.

If SWD in contact institutions face all these challenges, how much more those studying at a distance where there is a real physical and emotional distance between them and their lecturers and the institution? When individual students request support and reasonable accommodations, how are those requests received? How soon do they get responses? Do lecturers understand the issue of accommodations? Just recently Unisa changed a parking block to parking for people with disabilities. Whilst we were surprised by that, we were even more surprised to see that those who had used those bays before they became designated bays are still using them now although they have no disabilities. This takes me back to the question I asked earlier, what is informing our transformation? Is it a matter of compliance or do we sincerely realise that how we operate can keep others on the margins?

The next sections attempts to explore possible solutions that can assist an ODeL institution to address these challenges.

How Can We Remove or Reduce These Barriers in an ODeL Context?

Mainstreaming Disability at Institutional Level

Nzimande (2010) expressed concern that some of the barriers to learning experienced by SWD were linked to institutional culture and lack of sensitivity to their needs. So how can we re-culture our institution? Disability mainstreaming is a radical transformation approach to addressing issues facing persons with disabilities. It simply means placing disability at the centre of everything, making disability everyone's problem and concern. In a university context this means a review of "policies, budgets, plans and programmes" to ensure they respond to the needs of staff and students with disabilities (Republic of South Africa, 2016: 45). In ODeL context, unlike in contact institutions, it is difficult for SWD to mobilise or to engage the Student Representative Council about their issues, therefore, it is important that the institution is proactive and explore strategies that can be used to support all students, including those with disabilities. Having a unit that provides resources to SWD is not adequate as their main concerns are resource related whereas students are affected by lack of support in teaching and learning which limits their participation and affects their educational outcomes.

In his address, the then Minister of Higher Education, emphasized that issues affecting students with disabilities are cross-cutting (Nzimande, 2010). Implied is that institutions should seek to adopt cross-cutting strategies in addressing these issues. Cross-cutting strategies mean all stakeholders in higher education need to be appraised about issues of disabilities and how to remove barriers to participation.

However, a cause for concern highlighted by Matshedisho (2007:689) is the absence of policy 'compelling' academics in South Africa to support students with disabilities in their courses. He maintains that in many universities academic staff can choose whether to support or not support students with disabilities (Matshediso, 2007). How can staff have such a right when they have admitted these students? Besides, what makes SWD's needs for support different from those of other students? When those who teach are not aware of, or sensitive to, the learning needs of their students with disabilities, the students are disadvantaged and further disabled by the learning environment they find themselves in. Further, Tugli, Zungu, Ramuuela et al (2013) argue that when SWD are deprived of access and support, it leads to their social and academic exclusion.

The establishment of centres dedicated to supporting students with disabilities (Disability Units), in the case of Unisa, Advocasy and Resource Centre for Students with Disabilities (ARCSWiD), is an attempt to promote the inclusion of SWD. On the other hand, if the services of these units are not crosscutting and influencing the overall culture of institutions, then their presence could be reinforcing perceptions that issues of disability are not everybody's problem but should be handled by these offices only whilst for the rest of us it remains business as usual..

Curriculum Transformation and Support

Curriculum transformation in the form of programme design, format and methods of teaching is important as HEI respond to the support needs of SWD in the teaching and learning process (Nzimande, 2010). Engelbrecht and de Beer (2014) highlight that students with disabilities are often disempowered, and that they tend to struggle to find information about the availability of learning and assessment support. In a UK study, Sanderson (2001) cited in Taylor et al (n.d.) found that students with disabilities needed more specific information about what support is available to address their learning and assessment needs before deciding to enrol. This is important to note and very critical for an ODeL institution because of the distance between students and the institution.

It is also important to note what Taylor et al (n.d.) suggest, that lecturers need to be attentive to barriers that students with disabilities face when they develop assessment packages for their modules. Ntombela and Soobrayen's (2013) findings highlighted the need to provide staff development and support programmes on a regular basis. Similarly, Gertzel (2008:213) also emphasized the need to provide staff with professional development so that institutions develop "instructionally accessible environments".

All this suggests a closer working relationship with ARCSWiD so that lecturers are aware of which students have special needs that require reasonable accommodations. Currently there is very little communication (if at all) between academic departments and ARCSWiD, which leaves SWD at the mercy of this unit in as far their support needs are concerned. The challenge with this is that lecturers do not get opportunities to understand and to explore how to support their students because someone else is taking this responsibility. It also delays the execution of support as students wait for lecturers to send information/documents then the students redirect it to ARCSWiD for conversion to appropriate format and then it is sent back to them.

CONCLUSION

The potential for empowerment that university study has for students is not always realised for SWD due to barriers to learning that they face (Fuller et al, 2004). What this discussion paper has attempted to highlight is that physical access does not mean epistemological access. SWD require accommodations/ support to benefit from teaching and learning processes. It is a good move that the ODeL institution has established a unit that is dedicated to providing support to SWD, it indicates commitment to address the needs of these students. Having a central place that students can go to for advice and support is good. However, the presence of this unit is also a problem that prevents the institution from fully transforming and placing disability at the centre. The disability coordinators end up being the only source of support for SWD whilst academics choose whether to render a service or not (Matshedisho, 2007). As long as there are people regarded as 'dedicated' staff employed to attend to the academic support needs of SWD, the rest of staff think they are free to carry on with their business as usual, or, if they do offer support, they might think they are doing these students a favour, that they are being benevolent. Therefore, the current support structure, ARCSWiD, cannot succeed in its function to support students if it works in isolation from the academics who have responsibility for the curriculum.

In conclusion, what this paper has shown is that although higher education has opened doors to SWD, the lives of these students have not changed much in spite of all that the Constitution and democratic policies promise. Their participation remains limited by the presence of a number of barriers to learning they experience in the system, even at an ODeL institution. The biggest barriers are negative attitudes, inadequate curriculum support due to lack of awareness on the part of faculty which negatively affect the ability of students with disabilities' to succeed in learning. When lecturers lack awareness about the (academic) needs of students with disabilities, it adds to the barriers the students already experience. The institutions also violate their human rights when they fail to provide students with quality education as enshrined in the Constitution. Without support from those who teach them, it is very difficult for many students with disabilities to participate meaningfully in higher education and to achieve positive outcomes. This means that staff development has to be prioritised to promote awareness and to ensure that there is adequate academic support to enable students with disabilities to participate fully in the teaching and learning process. This development should also target attitude change. Rieser (2018: 235) refers to this as teachers using a social model of "thinking about disabled people". When attitudes towards those who are different change, the scene is set for the transformation of how our communities view difference, including disability. Such transformation would also contribute towards building a human and social just society where no citizens remain on the margins.

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INTERNATIONALIZATION PERSPECTIVE OF PANGASINAN STATE UNIVERSITY: OPEN UNIVERSITY SYSTEMS

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ABSTRACT

This study was administered to determine the perspective of Pangasinan State University – Open University Systems (PSU-OUS) towards internationalization as perceived by the academic unit's professors as the initial step for its implementation and realization.

The method of research that was used in the study is descriptive. Total population sampling technique was used in determining the respondents, all of whom 20 faculty members of PSU-OUS. Mean average and 4-point Likert scale were used in analyzing and interpreting the data gathered. The questionnaire was validated by experts which include deans and directors in the graduate school level to ensure its validity and reliability. Google Forms were used as data gathering tool.

The level of readiness of PSU-OUS in internationalization as perceived by faculty members is moderately ready. The faculty members' level of understanding towards internationalization is also moderate in extent. Further, faculty members perceived a high extent of opportunity in relation to internationalization. Finally, faculty members discern the internationalization challenges as less serious in PSU-OUS.

PSU-OUS and other institutions across the world should give emphasis on indicators in the understanding of internationalization such as international students' recruitment, facilities and support system and diversity of income generation. Institutions should intensify its awareness on internationalization through seminars and forums. Further, the institutions should review its policies regarding the perceived very serious challenges of internationalization such as high cost of investing in building and infrastructure, lack of efficient quality assurance mechanism, and lack of stakeholders' and staff orientation.

Keywords: Internationalization Perspective, Open University Internationalization, Internationalization Readiness

INTRODUCTION

Internationalization has been one of the trends in the education industry in the past few years brought about by the educational paradigm shift due to globalization especially in higher education. While innovation correlates opportunities, some may be reluctant to the changes it might bring which may affect their way of life.

A task force of NAFSA members appointed in 2008 created a definition of internationalization for NAFSA to use to guide its work. After reviewing the resources that have previously addressed the concept of internationalization, the task force proposed a working definition for NAFSA's purposes: "Internationalization is the conscious effort to integrate and infuse international, intercultural, and global dimensions into the ethos and outcomes of postsecondary education. To be fully successful, it must involve active and responsible engagement of the academic community in global networks and partnerships" (Nafsa.org, 2011). The definition depicts the vagueness of internationalization program, and certainly, its impact is somehow comprehensive to a certain institution including the community where it belongs or the country where it is located.

Internationalization of higher education is the top stage of international relations among universities. It is no longer regarded as a goal in itself, but as a means to improve the quality of education. The knowledge translation and acquisition, mobilization of talent in support of global research and enchantment of the curriculum with international content are considered to be the benefits of internationalization of higher education. Though internationalization holds many positives to higher education, there are grave risks associated with this multifaceted and growing phenomenon including commercial profit, academic colonization, and difficulty in ensuring quality education. The current review has implications for educational policymakers to provide positive benefits to the higher education institutions and the countries concerned (Jibeen & Khan, 2015).

Hayle (2008) listed four benefits of internationalization to either students and/or university in itself as follows: (1) a broadened knowledge and understanding of other nations, cultures, and global issues; (2) networking and the development of social and emotional skills; (3) the generation of revenue; and (4) contributing to the reproduction of Western knowledge. Overall, these themes collectively speak to the institution's internationalization goals, and a measure of commitment to more than one internationalization goal, with less than a half of the student participants reporting that developing global competence was the main benefit derived.

Overall, the Philippines compare favorably with ASEAN peer countries. However, an area of weakness is the relative lack of the openness to international students and academics. The process for student visa applications is complex and similarly, international academics face significant difficulties should they wish to practice their profession in the Philippines (Killingley & Llieva, 2018).

Philippines has a comprehensive transnational education (TNE) strategy, which sets out the terms of engagement between domestic and international higher education institutions (HEIs). From an overseas HEI perspective, however, the limitations on operating through a local partner institution, which must have at least 60 percent ownership of the venture, represent a significant setback. HEIs with strong global brands, many of which will be keen to retain ownership and direct control over the quality of the education being provided. Philippines' ability to retain and attract talent is less strong than its peers (Killingley and Llieva, 2018).

The prospects of internationalizing higher education in the Philippines were contextualized within the present education system that is experiencing problems related to efficiency, quality, equity in access, and other external factors. Given this context, it was suggested that participation in international education programs might be limited to students from high-income families, and to institutions with strong financial resources that can be channeled to development programs that will enable them to meet the requirements of these international activities. There is a strong likelihood that international programs might lead to the intensification of the existing weaknesses in Philippine higher education (Bernardo, 2002).

In Pangasinan State University (PSU), the initiative for internationalization is embedded in its strategic goals particularly on SG no. 5, "Responsive to Globalization and Diversity"(Psu.edu.ph, 2018). If globalization is the end goal, then internationalization is a task that has to be completed in order for the end goal to be achieved (Norvet, 2016). Since PSU – Open University Systems (OUS) is the academic unit of PSU that offers online distance learning which is closely connected to internationalization, it's a promising avenue for its commencement. Distance learning is now an integral part of mass higher education systems in emerging countries and could be an essential tool for internationalizing their systems. It is estimated that at least 21 million students from emerging countries have studied through distance higher education in recent years and this number is growing very quickly (Ergin & Morche, 2018).

Consequently, it is the opportune time to determine internationalization perspective of Pangasinan State University – Open University Systems in terms of readiness, understanding, opportunities, and challenges as perceived by the faculty members before its implementation to uncover valuable facts that may be employed as bases for strategic planning.

Statement of the Problem

This study is determined internationalization perspective of Pangasinan State University – Open University Systems. Specifically, the study was conducted to answer the following questions: (a) What is the level of readiness of PSU-OUS in internationalization as perceived by faculty members? (b) What is the level of understanding of PSU-OUS faculty members in Internationalization? (c) What is the extent of opportunities of PSU-OUS in Internationalization as perceived by faculty members? and (d) What is the extent of the seriousness of the potential Internationalization challenges of PSU-OUS as perceived by faculty members?

RESEARCH METHODOLOGY

The descriptive method of research was used in the study. The descriptive research describes the existing conditions to be investigated. Descriptive research design is a valid method for researching specific subjects and as a precursor to more quantitative studies. While there are some valid concerns about the statistical validity, as long as the limitations are understood by the researcher, this type of study is an invaluable scientific tool (Shuttleworth, 2008).

There are 20 formidable faculty members of PSU-OUS accros all academic programs served as respondents in the study. The academic programs where these professors teach includes Doctor of Education (Ed.D.) major in Educational Management, Master of Arts in Education (MAEd.) major in Educational Management and Instructional Leadership, Master in Development Management major in Public Management and Master of Science in Fisheries. In determining the respondents, total population sampling technique was used. Total population sampling is a type of purposive sampling technique where you choose to examine the entire population (i.e., the total population) that have a particular set of characteristics ("Total population sampling," 2012). The respondents are the faculty members of PSU-OUS across all programs, namely: Doctor of Education major in Educational Management, Master of Arts in Education major in Educational Management and Instructional Leadership, Master of Science in Fisheries and Master in Development Management.

Quantitative data collection method is used in the study particularly web-based questionnaire thru google forms. The questionnaire is divided in four parts. The first part focused on level of readiness of PSU-OUS in internationalization, the second part in on the level of understanding to internationalization, the third part is on extent of opportunities in internationalization, and the last part dealt with level of seriousness of challenges in internationalization. Quantitative data collection methods are based on random sampling and structured data collection instruments. Findings of quantitative studies are usually easy to present, summarize, compare and generalize (Research Methodology, 2018). The indicators from the questionnaire were adapted from the manuscript of Dr. Elmer B. De Leon. Social media such as Facebook and E-mail were utilized in gathering the data.

RESULTS AND DISCUSSION

What Is The Level Of Readiness Of Psu-Ous In Internationalization As Perceived By Faculty Members?

Table 1. shows the level of readiness of faculty members of PSU-OUS in internationalization.

Table 1. Level of Readiness of PSU-OUS in Internationalization as Perceived by Faculty Members

Indicators	Mean	Description
1. Mobility and Exchanges for Students and Teachers	3.65	Very Much Ready
2. International and Intercultural Understanding/Networking	3.60	Very Much Ready
3. Curriculum and Instruction	3.60	Very Much Ready
4. Research Collaboration	3.45	Moderately Ready
5. Academic Standards and Quality	3.15	Moderately Ready
6. Cooperation and Development Assistance	2.85	Moderately ready
7. International Students Recruitment	2.50	Slightly Ready
8. Facilities and Support System	2.20	Slightly Ready
9. Diversity of Income Generation	2.00	Slightly Ready
Total	**3.00**	**Moderately Ready**

Indicators were adapted from Dr. Elmer B. De Leon

Overall, the level of readiness of PSU-OUS in internationalization as perceived by faculty members is moderate with an overall mean value of 3.00. Quite a similar result from the study of Agosto and Sanchez (2017) revealed as to K-12 curriculum, all the respondent schools were very much ready for internationalization while on teachers' qualification and student services, the schools were moderately ready but, less ready for physical plant and facilities.

What is the Level of Understanding of PSU-OUS Faculty Members in Internationalization?

Table 2 depicts the level of understanding of the faculty members of PSU-OUS in internationalization.

Overall, the level of understanding of PSU-OUS in internationalization as perceived by faculty members is moderate with an overall mean value of 3.30.

In particular, the faculty members have high extent of understanding on the following indicators as follows: Internalization promotes activities such as curriculum, student/faculty exchange, technical assistance, and international students; it refers to a series of international activities like academic mobility for students and learners, international linkages, partnerships, projects, academic programs and research initiatives; it focuses on issues on student admission procedures, form of instruction, teaching staff, curriculum development and quality assurance; internationalization activities should be carefully planned, well-resourced and have the involvement and support of all key stakeholders; and the development of curricula and programs is a means towards developing appropriate competencies of students to be successful national and international citizens with mean values of 4.00, 3.90, 3.80, 3.80, and 3.60 respectively.

In addition, the faculty members have moderate extent of understanding on the following indicators, namely: internationalization emphasizes the development of skills, knowledge, attitudes, and values in students, faculty and staff; it leads to inclusion of an international dimension in order to enhance quality of teaching and learning and to achieve the desired competencies; it stresses integration or infusion of international/intercultural dimension into teaching, research and service through a wide range of activities, policies and procedures; It emphasizes creating a culture or climate that values and supports international/intercultural perspectives and initiatives; it will ensure the nation's economic competitiveness; it is about relating to the diversity of cultures that exist within countries, communities, and institutions; reasons for internationalization include interest in international security, maintenance of economic competitiveness, and fostering of human understanding across nations; it encompasses the policies and practices undertaken by academic systems and institutions to improve the quality of education; and it is closely linked with financial reduction, the rise of academic entrepreneurialism and genuine philosophical commitment to cross-cultural perspectives in the advancement and dissemination of knowledge with mean values of 3.50, 3.40, 3.35, 3.30, 3.25, 2.90, 2.85, 2.85 and 2.55 respectively.

Table 2. *Level of Understanding of PSU-OUS Faculty Members in Internationalization*

Indicators	Mean	Description
1. Internalization promotes activities such as curriculum, student/faculty exchange, technical assistance, and international students.	4.00	High Extent of Understanding
2. It refers to a series of international activities like academic mobility for students and learners, international linkages, partnerships, projects, academic programs and research initiatives.	3.90	High Extent of Understanding
3. It focuses on issues of student admission procedures, form of instruction, teaching staff, curriculum development and quality assurance.	3.80	High Extent of Understanding
4. Internationalization activities should be carefully planned, well-resourced and have the involvement and support of all key stakeholders.	3.80	High Extent of Understanding
5. The development of curricula and programs is a means towards developing appropriate competencies of students to be successful national and international citizens.	3.60	High Extent of Understanding
6. It emphasizes the development of skills, knowledge, attitudes and values in students, faculty and staff.	3.50	Moderate Extent of Understanding
7. It leads to the inclusion of an international dimension in order to enhance the quality of teaching and learning and to achieve the desired competencies.	3.40	Moderate Extent of Understanding
8. It stresses integration or infusion of international/intercultural dimension into teaching, research, and service through a wide range of activities, policies and procedures.	3.35	Moderate Extent of Understanding
9. It emphasizes creating a culture or climate that values and supports international/intercultural perspectives and initiatives.	3.30	Moderate Extent of Understanding
10. It will ensure the nation's economic competitiveness.	3.25	Moderate Extent of Understanding
11. It is about relating to the diversity of cultures that exist within countries, communities and institutions.	2.90	Moderate Extent of Understanding
12. Reasons for internationalization include interest in international security, maintenance of economic competitiveness, and the fostering of human understanding across nations.	2.85	Moderate Extent of Understanding
13. It encompasses the policies and practices undertaken by academic systems and institutions to improve the quality of education.	2.85	Moderate Extent of Understanding
14. It is closely linked with financial reduction, the rise of academic entrepreneurialism and genuine philosophical commitment to cross-cultural perspectives in the advancement and dissemination of knowledge.	2.55	Moderate Extent of Understanding
15. It is crucial that governments and individual institutions formulate goals and strategies that should be quantified in order to measure performance.	2.50	Little Extent of Understanding
Total	**3.30**	**Moderate Extent of Understanding**

Indicators were adapted from Dr. Elmer B. De Leon

On the other hand, the faculty members have a little extent of understanding in an indicator, it is crucial that governments and individual institutions formulate goals and strategies that should be quantified in order to measure performance with a mean value of 2.50.

In a study made or conducted by Wilhborg (2010), he found out that teachers were found to experience and understood internationalization in different ways, which could be related to two perspectives within their working context; an organizational didactic or an educational didactic. The findings imply the importance of reinforcing an understanding of internationalization in connection with a didactical theoretical awareness.

What is the Extent of Opportunities of PSU-OUS in Internationalization as Perceived by Faculty ?

Table 3 displays the extent of opportunities of PSU-OUS in internationalization as perceived by faculty members.

Overall, the extent of opportunities of PSU-OUS in internationalization as perceived by faculty members is high with a mean of 3.72.

In particular, the faculty members perceived high extent of opportunities as far as internationalization is concern on the following indicators, to wit: internationalizing curricula through international studies; globally competitive faculty and students; student and staff mobility; transnational distance education; global competitiveness and critical thinking; global job opportunities and experience for students; research collaborations; educational innovation opportunities; intercultural integration and mutual agreement; international networks; international quality assurance; and faculty and student international scholarship opportunities with mean values of 4.00, 4.00, 3.90, 3.90, 3.90, 3.85, 3.80, 3.80, 3.70, 3.60, 3.60, and 3.55 respectively.

Table 3. Extent of Opportunities of PSU-OUS in Internationalization as Perceived by Faculty Members

Indicators	Mean	Description
1. Internationalizing curricula through international studies	4.00	High Extent of Opportunity
2. Globally competitive faculty and students	4.00	High Extent of Opportunity
3. Student and staff mobility	3.90	High Extent of Opportunity
4. Transnational distance education	3.90	High Extent of Opportunity
5. Global competitiveness and critical thinking	3.90	High Extent of Opportunity
6. Global job opportunities and experience for students	3.85	High Extent of Opportunity
7. Research collaborations	3.80	High Extent of Opportunity
8. Educational innovation opportunities	3.80	High Extent of Opportunity
9. Intercultural integration and mutual agreement	3.70	High Extent of Opportunity
10. International networks	3.60	High Extent of Opportunity
11. International quality assurance	3.60	High Extent of Opportunity
12. Faculty and student international scholarship opportunities	3.55	High Extent of Opportunity
13. Twinning and articulation programs	3.40	Moderate Extent of Oppor
14. National and international distinction	3.40	Moderate Extent of Oppor
15. Strong student learning outcomes	3.35	Moderate Extent of Oppor
Total	**3.72**	**High Extent of Opportunity**

Indicators were adapted from Dr. Elmer B. De Leon

On the other hand, the faculty members perceived a moderate extent of opportunities in the following indicators, namely: twinning and articulation programs; national and international distinction; and strong student learning outcomes with mean values of 3.40, 3.40, and 3.35 respectively.

In a journal article written by Knight (2007), she stated that the process of internationalization affords many benefits to higher education based on the results of the 2005 International Association of Universities (IAU) Survey wherein there is overwhelming agreement (96 percent of responding institutions from 95 countries) that internationalization brings benefits to higher education. She further mentioned that the two most important benefits identified by higher education institutions are more internationally oriented staff/students and improved academic quality. The three least-important benefits according to these same institutions are national and international citizenship, revenue generation, and brain gain.

Sankat (2015) also enumerated some highlights of internationalization to universities such as fostering human development through understanding and respect across nations, expanding and sustaining avenues for economic competitiveness, promoting academic entrepreneurialism, and evidence suggests that many citizens are employed by foreign-owned firms – this is likely to be an increasing trend.

What is the Perceived Level of Seriousness of Challenges in Internationalization of PSU-OUS?

Table 4 exposes the level of seriousness of the challenges of internationalization as perceived by the faculty members of PSU-OUS.

Overall, the faculty members perceived less serious on the challenges of internationalization with an overall mean of 2.18.

In particular, the faculty members perceived very serious on the challenges of internationalization as follows: the high cost of investing in building and infrastructure; lack of efficient quality assurance mechanism; and lack of stakeholders' and staff orientation with mean values of 3.70, 3.60, and 3.55 respectively. On the other hand, the faculty members perceived moderately serious on the following challenges, such as: lack of available technology resources; lack of cost efficiency due to insufficient demand for internationalized program and collaboration opportunities; limited time for preparation and planning; lack of stakeholders' understanding and acceptance; and lack of management support system with mean values of 3.30, 3.20, 2.65, 2.55 and 2.55 respectively.

Table 4. Perceived Level of Seriousness of Challenges in Internationalization of PSU-OUS

Indicators	Mean	Description
1. High cost of investing in building and infrastructure	3.70	Very Serious
2. Lack of efficient quality assurance mechanism	3.60	Very Serious
3. Lack of stakeholders' and staff orientation	3.55	Very Serious
4. Lack of available technology resources	3.30	Moderately Serious
5. Lack of cost efficiency due to insufficient demand for internationalized program and collaboration opportunities	3.20	Moderately Serious
6. Limited time for preparation and planning	2.65	Moderately Serious
7. Lack of stakeholders' understanding and acceptance	2.55	Moderately Serious
8. Lack of management support system	2.55	Moderately Serious
9. Student and the global community expectations	2.20	Less Serious
10. Decline of quality education due to marketization focus	2.20	Less Serious
11. Lack of pedagogic competence	2.20	Less Serious
12. International competition for students and staff	2.05	Less Serious
13. Racism and ethnocentrism	1.40	Not At All Serious
14. Lack of respect for local culture and environment	1.40	Not At All Serious
15. Students' cultural conflict and untoward attitude	1.35	Not At All Serious
16. Inability to communicate in English	1.30	Not At All Serious
17. Possible brain drain due to constant mobility	1.30	Not At All Serious
18. Students' inability to manage cultural differences	1.10	Not At All Serious
19. Influx of immigrants for permanent residency in the country	1.00	Not At All Serious
20. Lack of Faculty and staff technical skills and expertise	1.00	Not At All Serious
Total	2.18	Less Serious

Indicators were adapted from Dr. Elmer B. De Leon

In addition, the faculty members perceived less serious on the challenges of internationalization in the following indicators, to wit: student and the global community expectations; decline of quality education due to marketization focus; lack of pedagogic competence; and international competition for students and staff with mean values of 3.30, 3.20, 2.65 and 2.05 respectively. In different circumstances, the faculty members perceived the following international challenges as not serious at all, such as: racism and ethnocentrism; lack of respect for local culture and environment; students' cultural conflict and untoward attitude; inability to communicate in English; possible brain drain due to constant mobility; students' inability to manage cultural differences; influx of immigrants for permanent residency in the country; lack of faculty and staff technical skills and expertise with mean values of 1.40, 1.40, 1.35, 1.30, 1.30, 1.10, 1.00 and 1.00 respectively.

In a study conducted by Braskamp (2009), he pointed out four issues for internationalization in higher education that includes the language of internationalization, appropriate and effective interventions, assessment and evaluation, and appropriate and effective interventions.

CONCLUSION

From the preceding findings, the following conclusions are drawn.

PSU-OUS is modestly ready for internationalization particularly on research collaboration, academic standards and quality and cooperation and development assistance.

The institution has a reasonable understanding about internationalization. To name a few, the institution believes that institution emphasizes the development of skills, knowledge, attitudes and values in students, faculty and staff. Institution also believes the internationalization leads to the inclusion of an international dimension in order to enhance the quality of teaching and learning and to achieve the desired competencies. Further, internationalization stresses integration or infusion of international/intercultural dimension into teaching, research, and service through a wide range of activities, policies and procedures.

The institution has high extent of internationalization opportunities evident on internationalizing curricula through international studies, globally competitive faculty and students, student and staff mobility, transnational distance education, global competitiveness and critical thinking, to name a few.

Internationalization challenges are less serious in the institution specifically on student and the global community expectations, decline of quality education due to marketization focus, lack of pedagogic competence, and international competition for students and staff.

RECOMMENDATIONS

Based on the above-mentioned findings and conclusion, the following recommendations are hereby presented. Faculty members should enhance their readiness for internationalization particularly on international student's recruitment, facilities and support system, and diversity of income generation. They should also develop their understanding on internationalization; for instance, on issues that governments and individual institutions formulate goals and strategies that should be quantified in order to measure performance. In addition, faculty members should sustain their perceived high extent of internationalization opportunities. Further, they should sustain their optimistic view that potential problems or challenges of internationalization are less serious.

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IMPACT OF PODCASTING ON PRONUNCIATION SKILLS OF PRE-SERVICE EFL TEACHERS

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FRESHMEN'S ABSTRACT

This explorative qualitative study investigates EFL freshmen's perception of the impact of creating pronunciation podcasts on their pronunciation skills. The study was conducted with the participation of 80 freshmen, enrolled in a Teaching English as a Foreign Language teacher education program at a Turkish state university. Data were collected through semi-structured interviews, investigator notes, records of dashboard activities, analytics and performance tracking records of the LMS, and podcasts created by the participants as well as the recordings of the peer feedbacks on the discussion board. Analysis of the data was done through content analysis technique, presenting the thematized findings through analytical generalizations. Results have shown that the participants have positive views of creating pronunciation podcasts and that podcasting freed them to a great extent from the spatio-temporal limitations of the classroom, allowing them to study and practice pronunciation at their own convenience. The findings are discussed with reference to pronunciation, recommendations for EFL freshmen are made, and implications are offered.

Keywords: Pronunciation, podcasting, EFL freshmen

INTRODUCTION

Pronunciation which was one of the most commonly neglected aspects of language pedagogy newly gained a revival of interest because of its reprioritized role in speech perception and recognition. In parallel with this revitalization, pronunciation teaching approaches in English as a foreign language (EFL) and/or English as a second language (ESL) have modified their stance by encouraging language learners to study and practice pronunciation outside the classroom walls. Fortunately, language learners now have ample resources to practice pronunciation thanks to the rapid growth of internet-based technologies. Podcasting, one of the promising tools, enables learners to express themselves by addressing an authentic audience purposefully in a real-life environment. Numerous studies demonstrate that listening to podcasts enriches language skills, particularly pronunciation and listening skills. However, a review of the available literature shows that the impact of podcasts and podcasting on pronunciation teaching in teacher education has not been sufficiently examined. Hence, in this paper, we investigated the influence of podcasting on learners' perceptions in a web-enhanced pronunciation classroom.

In the history of English language teaching, it has been well-documented that pronunciation instruction has faced extreme fluctuations in interest. Depending on the trends, pronunciation teaching has drifted from one theoretical extreme to another. In the heydays of the Audiolingualism, pronunciation was considered paramount (Celce-Murcia, Brinton, Goodwin & Griner, 2010; Jones, 1997). Shortly afterwards, its importance was greatly reduced (Kelly, 1969 cited in Celce-Murcia et al., 2010), and it became the orphan

of second or foreign language teaching (Derwing & Munro, 2005). These extreme swings led pronunciation teaching to be either overly emphasized or utterly ignored, depending on the way the pendulum swung.

As a result of this stance towards pronunciation teaching, there came a period when language teachers opted to see pronunciation as the least useful of the language skills, sacrificing pronunciation teaching, and therefore spending class time on other areas of the language (Elliott, 1995). This tendency to neglect pronunciation in the classroom spread rapidly among language policy makers and learners all around the world, adding weight to the already widely-held conception that pronunciation was the least important aspect of language learning and teaching.

This disregard started to change with pronunciation instruction research which began to appear in the early 2000's (Derwing, 2018). Though training in pronunciation teaching in ESL/EFL certificate programs manifested, studies (Breitkreutz, Derwing & Rossiter, 2001; Buss, 2016; Foote, Holtby & Derwing, 2011) revealed that pronunciation instruction was not given enough importance in such certificate programs. Moreover, the classroom applications fell short of closely following and realizing the practices suggested in the literature. This gross negligence also caused pronunciation teaching to become, for many teachers, an anxiety-ridden experience because they struggled with feelings of inefficacy in teaching pronunciation (see Foote et al., 2011; Huensch, 2018). Numerous studies have drawn attention to the inadequate pronunciation instruction teachers had received and the concerns teachers had because they did not know how to meet their students' pronunciation needs (see Breitkreutz et al., 2001; Burgess & Spencer, 2000; Burns, 2006; Foote et al., 2011; Henderson et al., 2012; Huensch, 2018; MacDonald, 2002). The findings of these studies have contributed to the increase in interest pronunciation teaching has gained over the years, helping pronunciation teaching reclaiming popularity in second or foreign language instruction circles (Derwing, 2018).

Despite these contradictory propositions on pronunciation and its instruction, the perceived confusion with regard to the role and place of pronunciation in language teaching, and the spatio-temporal constraints, some scholars and language teachers have sought ways to provide learners with efficient means to practice pronunciation inside and outside the classroom (Lord, 2008). With the advent of technology, learners are now able to hear their pronunciation mistakes, assess their intelligibility and recognize their production of specific sounds and patterns of prosody (Hardison, 2004; Hismanoglu, 2010; Martin, 2004; Pennington, 1989; Ramirez-Verdugo, 2006, Seferoglu, 2005). Though the novelty of using audio materials in education seems to have been wearing off, recently "podcasting… has brought a newfound excitement to the classroom" (Ducate & Lomicka, 2009, p. 68).

A podcast is an audio file that anyone can create ubiquitously using mobile devices, a computer, a microphone, and a software program (Ducate & Lomicka, 2009; Faramarzi & Bagheri, 2015). The simplicity of creating, editing, and publishing, as well as the portability, ease of access, flexibility and ease of use (pausing, rewinding, repeating), dynamism, and interactivity are some of the features that make podcasts desirable personalized learning tools in teaching pronunciation (Abbdedaim, 2013; Facer & Abdous, 2010; Gromik, 2008; McGarr, 2009; Meng, 2005; Rosell-Aguilar, 2007, 2013; Stanley, 2006). Besides offering self-regulated learning, podcasts let students feel a sense of self-worth by enabling them to create and publish something for an authentic audience (Stanley, 2006). It is this creative dimension of podcasting that is interrelated with constructivism, which is based on the premise that learners should construct knowledge through active observation, exploration, processing and interpretation (Rosell-Aguilar, 2007). From a pedagogical perspective, podcasting enables students to produce "comprehensible output" (Swain, 1985), an essential feature for language learning (Swain & Lapkin, 1995). As students create a podcast, they listen to themselves and edit their output, and often repeat these two steps until they figure out the desired form of their utterance, which forms the basis of Swain's (1985) comprehensible output hypothesis.

Despite ample use of podcasts in education, podcasting has yet to develop in foreign language learning and teaching. Some studies in the literature demonstrated that listening to podcasts enriches speaking and listening skills. Among the available studies on the use of podcasts in education, studies by Alm (2013), Carvalho and Aguiar (2009), Diem (2005), Faramarzi and Bagheri (2015) Godwin-Jones (2005), Gorjian, Hayati and Pourkhonic (2013), Gromik (2008), Hegelheimer (2006), Lord (2008), O'Bryan and Hegelheimer (2007), Robin (2007), Rosell-Aguilar (2013), Tanner & Landon (2009), Young (2007) come to the fore.

Though scarce, there is some research in Turkey that falls within the scope of podcasting in learning English as a foreign language. Bakla (2018) looked into listening to podcasts and students' perceptions and found that podcasts provided his participants with meaningful input and his participants enjoyed listening to podcasts. Similarly, Basaran and Cabaroglu (2014) investigated the influence of listening to language learning podcasts on freshmen's English self-efficacy beliefs in listening, speaking, reading, and writing. The results of their quasi experimental study showed that listening to podcasts significantly influenced the participants' perception of their listening comprehension speaking and reading skills. However, it did not have a positive impact on their perceptions of reading and understanding advanced level stories. Similarly, in a study on the impact of podcasts on Turkish EFL learners' oral performance, anxiety in speaking, perceptions of podcast usage, and the relationship between speaking anxiety and oral performance, Harika and Kocoglu (2016) revealed a meaningful relationship between podcasts and oral performance, and podcasts and anxiety levels in students. They have also shown that the students who used podcasts had positive views of podcasts: students believed that podcasts helped them lower their anxiety, increase their confidence, improve their oral performance and pronunciation, and expand their vocabulary. In yet another study on pre-service English language teachers' perception of the use of podcast, Guler and Ozkan (2018) found that the participants had a positive view of podcasts in general and intend to use the podcasts in their future teaching careers. A more recent qualitative and quantitative study by Sendag, Gedik, Caner, and Toker (2017) investigated the effects of mobile-extensive-podcast listening activities on listening, speaking, critical thinking skills and critical thinking dispositions as well as listening strategy development of pre-service English teachers. Interestingly enough, they found no meaningful relationship. That is, mobile intensive-podcast-listening had no significant impact on improving the participants' listening, speaking, critical thinking skills, and listening strategies. As is seen, these studies, which focused on the relationship between listening to podcasts and its impact on participants' listening skills and their perceptions, produced conflicting results. On top of that, none has focused on the impact of creating podcasts on improving English pronunciation skills. Motivated by this need, the present study aims to investigate EFL freshmen's perceptions of podcasting and its impact on their pronunciation skills. With these general goals in mind, the present study aims to answer the following research questions:

1. What are EFL freshmen's perceptions of the impact of cretaing pronunciation podcasts on their pronunciation skills?
2. To what extent does podcasting have an impact on the pronunciation skills of EFL freshmen?

METHOD

Research Design

The present study adopted a qualitative design grounded in a hermeneutic approach in order to gain a thorough understanding of the research problem, explain the situation, and understand how listening to and creating podcasts impact pronunciation skills and participants' perceptions (Baxter & Jack, 2008). As the review of the available literature has shown, the issue had not been studied extensively using a qualitative approach in Turkey. As case study research design is an in-depth practical investigation of a current event or a phenomenon in the actual context (Yin, 2009), and it "facilitates exploration of a phenomenon within its context using a variety of data sources" (Baxter & Jack, 2008, p. 544), a holistic single-case study design serves the purposes of the this study well. Thus, we used a single case exploratory study, adopting Yin's (2009) universally accepted six-stage case study process: plan, design, prepare, collect, analyze and share.

Participants

This study was conducted with the participation of 80 EFL freshmen, who enrolled in an obligatory "Listening and Pronunciation I" course at a Turkish state university in the 2017-2018 academic year. These freshmen are students who are trained to be teachers of English. The participants had no prior listening instruction or pronunciation instruction except for occasional repetition of decontextualized words in passing. One of their obligatory courses as freshmen is a two-hour "Listening and Pronunciation I" course, which covers a variety of issues: segmental and suprasegmental features of English phonology, speech organs, IPA symbols,

macro and micro listening skills, and strategies aiming to develop listening comprehension skills in English. Data were collected from all of these 80 freshmen, who carried out the same tasks in and outside the class. However, only 20 of these freshmen who completed all the tasks intact and were available at all the times were interviewed.

The Context

The initial endeavor of the project started with the development of the web-based component of the course. A freely available and easy-to-use learning management system (LMS) was selected as the online course delivery platform for the course. The LMS was preferred due to its interface, which is visually familiar to users such as popular social networking websites. This LMS allows instructors to post assignments, grade and annotate submissions, give online tests, conduct discussions, send updates, share resources, and even utilize third-party apps seamlessly from any mobile or internet accessed device. The LMS also allows users to provide feedback to any uploaded work, podcasts in our case, on the site.

The Procedure

Before the project began, the participants were given detailed information about the project and were trained on how to use the LMS effectively and how to create podcasts. During the 14-week-long project, all of the participants produced 12 podcasts outside the class. These 12 podcasts included three podcasts on segmental features of English (i.e., production of vowels and consonants in word-initial, word-mid, and word-final); six podcasts on supra-segmental features of English (i.e., stress; word stress, phrase stress, sentence stress; intonation; aspects of connected speech; linking, elision, and assimilation), and three podcasts on extemporaneous speech. The participants created their podcasts using their mobile phones and/or computers and uploaded them to the online courseware that accompanied the course.

Table 1: Topics covered during the instructional time

Week	*Subject*	*Week*	*Subject*
1	Speech organs	8	Connected Speech (Assimilation)
2	IPA symbols	9	Stress (syllable)
3	Consonants	10	Stress (word, phrase, sentence)
4	Consonants	11	Stress (word, phrase, sentence)
5	Vowels	12	Stress (word, phrase, sentence)
6	Monophthongs, diphthongs and tripthongs	13	Intonation
7	Connected Speech (Liaison and elision)	14	Intonation

Within the scheduled syllabus of this course, several issues related to pronunciation in English were covered in face-to-face class hours over a period of fourteen weeks. Following the training of the participants in the use of the web-component of the course, the first two weeks of the project were spent familiarizing the participants with speech organs and IPA symbols. During the last 12 weeks, the participants produced a four to six-minute-long podcast every week on segmental and suprasegmental features of English, topics covered in the class, and they created their own pronunciation podcasts on the assigned segmental and supra-segmental features of English, which were available in their books and in audio files. They were encouraged to listen to, repeat and record the assigned language features as many times as they wished and to upload their final productions outside of the class to the online component of the course that was secured for the project. The final three podcasts were spared for extemporaneous speech on topics of their own choice.

Data Collection Tools and Process

Various data gathering instruments were employed to reach reliable data. Although the foremost data gathering instrument of the present study is the transcripts of semi-structured interviews, other instruments were used to triangulate the findings of the this study, such as investigator notes, dashboard activity records, podcasts created by the participants, as well as peer feedback given on the discussion board. Mainly three questions were asked: (1) What is your opinion of the pronunciation podcast creation project before and after the project? (2) What do you think about the pronunciation podcast creation project? (3) Did creating pronunciation podcast have an influence—positive or negative—on your pronunciation skills? The investigator notes consisted of the notes the first writer, who was also the teacher of the course, took during the project. Dashboard activity records included the feedback the participants gave to one another and comments they made about one another's recordings during the project. Both the investigator notes and the dashboard activity records were considered and made use of during data analysis to clarify and cross-check the data gathered in the semi-structured interviews.

Data Analysis

Since the key objectives of qualitative analysis is to identify conceptual similarities/differences and to discover types, classes, sequences, processes, patterns or wholes (Jorgensen, 1989), the data analysis of the present study consisted of examining, categorizing, tabulating and recombining evidence to draw empirically based conclusions (Yin, 2009). Bearing these objectives in mind, the recordings were transcribed verbatim and transferred to a word document, which were then shown to the interviewees for confirmation. The data set was then subjected to classical content analysis, which counts themes or codes to detect/identify the most common or recurrent concepts. The initial step in content analysis started with reading the interview transcripts, observational notes, and other relevant documents obtained from the analytics and performance tracking records of the LMS. After gathering the preliminary notes used to formulate the initial categories, themes and relationships, the obtained data were "pre-coded" (Layder, 1998) by researchers manually and independently by highlighting or underlining significant participant quotes. Then, some preliminary words or tentative ideas for codes were recorded through a holistic coding concept. The second coding cycle was held through the combination of nvivo coding and pattern coding; thus, the terms and phrases used by the participants were examined in detail to figure out the patterned variation in the gathered data. Finally, the coded data were categorized and recombined to draw empirically based conclusions through analytical generalizations. The identified codes then led to various sub-categories and categories. The researchers reviewed the categories again to identify and remove any overlapping ones and finalized the "coding and retrieving process" (Patton, 2002). The data were analyzed through cross-case analysis, involving an in-depth exploration of similarities and differences across the data sources with a view to supporting empirical generalizability and theoretical predictions. The researchers analyzed and coded the data independently of each other after a training and norming session of coding 10% of the data. The comparison of coding yielded 87% agreement according to inter-rater reliability formula of Miles and Huberman (1994). A third rater, a Turkish linguist who is specialized in content analysis and familiar with the categories was consulted for the discrepancies. The three coders analyzed those discrepancies and reached full agreement. The third coder's participation in the coding process helped complete the process without any bias. Finally, the emerging themes and sub-themes were compared and discrepancies were discussed to reach a consensus. After the negotiations, the consistency between the researchers was .82 using the Miles and Huberman's (1994) reliability formula, which is within the acceptable range. The coders came up with two categories: Positive and negative. The positive category includes linguistic (L), pedagogical (Ped.), psychological (P), and technological (T) sub-categories, whereas the negative category contained only two sub-categories: computer illiteracy (CI) and quality of internet connection.

RESULTS

As regards the perceived impact of podcasting, the results indicated that the participants had positive views of podcasting and that the majority of them (85%) agreed that podcasting helped them improve their pronunciation skills and develop positive views towards podcasting. In order to explore the attitudes of the participants in detail, we first inquired about the participants' expectations of podcasting prior to and after the implementation. Based on the content analysis of the interview questions, it was found that the responses varied: some were satisfied with the podcasting, some were doubtful of its efficacy, and some were dissatisfied with it.

In terms of participants' initial expectations, the analysis revealed that roughly 15% of the participants had had moderately positive attitudes prior to podcasting. Moreover, we found that only 10% of the participants had had relatively positive expectations of it and hoped to gain better pronunciation skills. For instance, one of the participants expressed his/her enthusiasm:

> *At the beginning of the term, I was excited about recording my own voice and expected it to improve my pronunciation a bit (Participant 6).*

On the opposite end of the cline were those participants who had higher expectations (5%) and had expected to dwell on intensive pronunciation exercises as well as experience a more interactive process with the teacher. The initial expectation of one of the participants was as follows:

> *I was hoping it would help me improve my pronunciation. I thought that we would get face to face feedback, and we would be tutored in the class to correct our mistakes (P 4).*

It should be noted that the demographic data about the participants who had higher expectations revealed that they all had had prior experience on similar web-enhanced learning tools during their intensive English language education at English preparatory school in the university.

The analysis of the data also revealed that in between these two extremes were the majority of the participants (85%), who had complicated feelings, ranging from doubt to skepticism to fear of the unknown. For instance, one of those participants who initially thought that the procedure would be complicated stated:

> *At the beginning of the term, I thought that podcasting would be complicated, and it would bore us (P 15).*

Similarly another participant expressed his skepticism of it saying:

> *At the beginning of the term, I thought that it would be difficult to use this LMS because I've never used such a thing. I thought something would be sophisticated, and therefore I felt confused at first (P 1).*

Likewise, another participant who thought that it would be a burden said:

> *At the beginning of the term, I had my own suspicions regarding podcasting because I thought that it would take a lot of time; therefore, I thought I would not like it (P 10).*

To further compare the participants' expectations at the beginning and end of the study, they were asked to what extent their expectations came true at the end. The analysis of the data illustrated that while the participants who had positive attitudes (10%) maintained their stance towards podcasting, only one of the 5% of the participants who had negative feelings about and expectations of it changed his/her position in a positive way. The expectations of the other 4% remained negative. For instance, the participant who expressed that his/her attitude did not change said;

> *My opinion about podcasting still hasn't changed. I still find it sophisticated and a bit challenging (P15).*

The greatest change was observed in the position and stance of those who had neither positive nor negative expectations. The data of the first round explicated that the attitudes of a great number of the participants (85%) were identified as undecided, skeptical, suspicious, anxious, and worried about podcasting. However, at the end, we saw that expectations of the 80% of this group had changed in a positive way. Concerning this change, one of the participants stated:

> *At the beginning, I had worries about it if it was necessary to use this app. However, I thought about positive sides, and I changed my mind (P 10).*

Another participant verbalized the same stance saying:

> *Yes, my opinion has changed, because at the beginning, as I expressed before, I thought that I would face some problems in uploading my homework and was a bit nervous. But as the time passed, I thought that this experience would have positive impact on us when we begin teaching. Actually I might use such apps in my own teaching as well (P 6).*

The in-depth analysis of the data brought some sub-themes that could be named as purely linguistic gains, technology-related issues, pedagogical, social, and psychological gains and other benefits (see table 2).

Table 2. Themes and sub-themes

	positive (%)		negative (%)	
Themes	linguistic (L)	80	computer illiteracy (CI)	10
	pedagogical (Ped.)	85	quality of internet connection (QIC)	15
	psychological (P)	85		
	technological (T)	30		

Positive views on creating pronunciation podcasts

As seen in table Positive views includes linguistic, pedagogical, psychological, and technological. As for the linguistic gains, almost all of the participants declared that they made great improvements in their pronunciation skills, which was reflected in the increase in their final exam scores as well. The main reason behind the increase was that the process helped them relax in producing something in front of an audience. Although the data unveiled that 80% of the participants stressed that podcasting helped them improve their pronunciation, 10% of them stated that it did not do so. Additionally, it was found that the other 10% of them were still unsure about the positive influence of it on their pronunciation skills. Each and every one of those who acknowledged the positive impact of it on their pronunciation skills underlined the importance of having multiple opportunities as they listened to the audios and recorded their own podcasts. This opportunity helped them pedagogically and psychologically. More than 85 % of the participants who had positive views about podcasting underlined that the unlimited opportunity of recording and listeing to their own pronunciation production eased their stress of speking in front of an audience. In this aspect, one the participant expressed his/her opinion:

> *I think podcasting did not have any negative sides but many positive sides. First of all, we all improved our pronunciation, because we tried until we succeed it (P19).*

Likewise, another participant expressed:

> *I clearly see that podcasting contributed to my pronunciation because I was able to hear my own pronunciation. Thus, I had the chance to evaluate myself and improve my pronunciation (P17).*

Talking about the same positive aspect of podcasting, some participants drew attention to yet another aspect of it; that is, the flexibility and freedom in the tryouts of podcasting before submitting the final version of their podcasts. For instance, one of the participants expressed his/her thoughts as:

> *I think one of the important aspects of podcasting is saving time. We were able to submit the podcasts whenever we wanted to, but the greatest opportunity we had is to try it as many times as we desire (P 13).*

Yet another noteworthy aspect of podcasting was related to finding it worthy of recommendation. The analysis of the data revealed that all of the participants, even the 10% who underlined that the project did not contribute to their pronunciation at all, stated that they would definitely recommend podcasting to teachers, EFl freshmen and prospective students who would like to gain progress in the target language pronunciation. For instance, one of the participants stated:

> *I would definitely recommend using such apps both to students and teachers as it enables them to reach the content and peers whenever needed (P 7).*

Like the participant above, the following participant underlined its usefulness despite its flaws saying:

Yes, certainly I would. Regardless of the problems I had while using the LMS, I think all of the activities were useful. It's a good way to collect all the homework in one place (P 6).

In contrast to this great majority, 10% of the participants stated that podcasting did not help them improve their pronunciation skills at all. One of the participants said crediting his/her previous pronunciation skills stating:

> *It is impossible for me to say podcasting help me improve my pronunciation. It is not a matter of question. Because, what we did in this course about pronunciation is almost similar to those what I did without any such productions (p 5).*

It should be noted here that a distinctive feature of this group is that all of them had similar prior experiences in their intensive English language education at English Preparatory School.

Additionally, it was found that there were some participants (10%) who were still unsure of the contribution of podcasting. One of those participants who credited the difficulty of fossilized pronunciation errors stated:

I hope it has. Although I am not sure about that. Most of the things we do in class and as homework are familiar to me. I have been using English actively for almost 10 years now, so if there are words that I pronounce incorrectly, it is really difficult for me to change their pronunciation. Old habits die hard (P 2).

In another sub-theme, which is related to technological issues, we saw that 30% of those who found the project useful underlined that they developed their computer-literacy skills during the process. For instance, one of the participants underlined:

> *Podcasting helped me learn to use the technology efficiently. I did not know anything about this sort of technology and web-enhanced thing before (P16).*

Another widely expressed sub-theme is having the opportunity to listen to their own voice and productions. One of the participants expressed his/her thoughts as:

> *I think the positive side would be that we can hear ourselves and see the way we pronounce the words before sending them, which helps our pronunciation to become better. I don't see any negative sides (P18).*

Negative views on creating pronunciation podcasts

When it comes to the cons of podcasting, we saw that the negative attitudes centered around two main issues: computer literacy (10%) and lack of quality of internet access (15%). As can be seen, the former is directly related to the participants and their computer skills, whereas the latter lies outside the control them. The following excerpts reflect their attitudes on the issue:

> *Negative side of podcasting was the fact that I was not able to upload my recording from my phone. I had to send my files from my phone to a PC, and only then I was able to do that, which means that the only way to submit my homework when I had access to a PC (P 4).*
>
> *The only negative side that I can think of is the poor Internet connection, I know it is related to the internet access, but when Internet connection is weak, we cannot make contact and upload our homework on time (P 11).*

Another recurrent sub-theme was related to the spatio-temporal limitations of the classroom. That is, we learned to what extent podcasting freed participants from the spatio-temporal limitations of the classroom. We found that one of the most frequently mentioned benefits of creating podcasts was related to spatio-temporal limitations of the classroom. For instance, one of them said:

> *If I am to talk about the pros of podcasting, everybody was able to easily submit their assigned podcasts at anytime and anywhere they wanted to. We easily delivered our assignments (P 6).*

DISCUSSION

The results have demonstrated that the participants had positive view about podcasting and had linguistic, pedagogical, social, and psychological gains from podcasting. For instance, most of the participants stated that the project helped them improve their pronunciation skills by allowing them to practice pronunciation at their convenience. The great majority of the participants underlined that their pre-podcasting expectations

regarding improving pronunciation were fully met. This observation supports findings of some previous research on the same issue (e.g., Ducate & Lomicka, 2009; Gorjian et al., 2013; Lord, 2008; Tanner & Landon, 2009). For instance, Lord's (2008) study showed that her participants developed positive attitudes towards pronunciation and found it useful. The same issue was voiced by Ducate and Lomicka's (2009) participants, underlining that podcasting helped them develop positive attitudes towards pronunciation.

Another contribution of the study is pedagogical. As the one course our participants had had until then, they stated that they would take it as a model for teaching pronunciation and dealing with issues of pronunciation when they start teaching English. This realization supports Guler and Ozkan's (2018) finding that underlines their participants' positive views of podcasts and their intention to integrate podcasting into their teaching.

Yet another area of contribution from this study involves social skills. For the first time in their lives, almost all of the participants produced podcasts and received feedback from others. Even though the speaking practice was virtual, this process helped them overcome their fear of speaking in front of an audience.

Another way in which the study contributed positively is psychological in that it discovered participants' excitement and enthusiasm. The participants were intensely excited because they would participate in something completely new to them: they would record their own voices and listen to them. The contentment of accomplishing and creating something on their own seemed to enhance their feelings of self-worth and esteem. This sentiment is in accord with that of Rosell-Aguilar (2007), who maintains that podcasting is profoundly interrelated with constructivism in which learners construct knowledge through active exploration, observation, processing and interpretation. This observation supports findings of some previous research on the same issue. For instance, Lord's (2008) study showed that her participants developed positive attitudes towards pronunciation and found it useful. The same sentiment was voiced by the participants of Ducate and Lomicka (2009), underlining that podcasting helped them develop positive attitudes towards pronunciation and earned their appreciation.

In sum, this study has broadened our horizons regarding the use of web-enhanced mobile assisted language learning tools and devices in creating pronunciation podcasts. It has demonstrated that creating pronunciation podcasts outside the classroom can help use time much more efficiently. This study has implications for English language teachers and Listening and Pronunciation teachers. The findings of the study have revealed that English language teachers (ELT) teachers will have more freedom as to how they spend their time in and outside of the classroom by creating pronunciation podcasts outside the classroom. Likewise, listening and pronunciation teachers will have considerable leeway to spend their time in the classroom. They can spend more of their time on other important aspects and issues of their course.

CONCLUSION

The results of our study are encouraging, not only because they support findings from previous research, indicating that there is room for learners to improve their pronunciation skills through web-enhanced learning tools, but also the possible role podcasting can play in language learning endeavors. This observation is quite important given the tendency of language teachers to view pronunciation as the least useful of the basic language skills and to sacrifice pronunciation teaching for other areas of the language (Elliott, 1995). Teachers' inclinations to ignore pronunciation compounds the already problematic issue in many countries, where teachers and learners have to grapple with spatio-temporal limitations of the classroom in listening and pronunciation courses in ELT programs. Last but not least, the results of our study led us to conclude that podcasting freed learners to a great extent from the spatio-temporal limitations of the classroom, allowing them to study and practice pronunciation at their own convenience, and benefitting them linguistically, pedagogically, socially, and psychologically. Given these benefits, ELT teachers' consciousness on creating pronunciation podcasts should be raised. Also, Listening and Pronunciation course teachers could be encouraged to integrate web-based practices such as podcasting into their courses. Policy makers and materials developers could be informed about the benefits of creating pronunciation podcasts.

The overall promising findings of the study should be interpreted cautiously in the light of several limitations. The first one pertains to the nature of the study. In such a study, the influence of podcasting on the intelligibility and accentedness of the participants' pronunciation might be investigated. Another limitation of the study is related to time spent on the project. As it will be appreciated, a 14-week-long project may not be long enough. The final limitation of the study is related to providing instructor feedback on podcasts. Further studies may examine the influence of face-to-face instructor feedback. In spite of these limitations, in listening to the participants' voices on creating podcasts through this study, we saw the urgent need for devoting extra time on pronunciation and devising web-enhanced language learning tools to be used in an outside of the classroom.

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TRANSACTIONAL DISTANCE AND STUDENT SATISFACTION IN A POSTGRADUATE DISTANCE LEARNING PROGRAM

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ABSTRACT

The present study examines the three dimensions of the transactional distance theory of Moore and their correlation with student satisfaction, through a quantitative survey with data collected from 115 postgraduate students of the Hellenic Open University (H.O.U). The results indicate that students perceived low levels of teacher-student transactional distance and slightly higher, but still low, levels of student-student and student-content transactional distance. Moreover, they seem to be satisfied by their distant learning studies. Male students perceived lower levels of teacher-student and student-content transactional distance than female ones, while students with previous experience in distance learning perceived lower levels of student-student transactional distance than those without such experience. Statistically significant correlations exist between the three dimensions of transactional distance and satisfaction, with the strongest, negative correlation, observed between satisfaction and student-content transactional distance. Finally, statistically significant and, moderate to low, positive correlations were observed between the three types of transactional distance, indicating their interlinkages.

Keywords: Distance learning, transactional distance, interaction, teacher, student, satisfaction educational material content.

INTRODUCTION

The main characteristic of distance learning is that the learning process takes place without the physical presence of the teacher and the student in the same room (Cohen, Manion & Morrison, 2007). Thus, there is a geographical distance between the teacher and the student. The first attempt to establish a comprehensive theory of distance learning began in 1972, leading to the theory of transactional distance (Moore, 1989, 1993). With this theory, Moore establishes the concept of distance in education in a social context and not in the usual physical interpretation (Saba, 2003). Moore emphasizes that in distance learning there is a gap, a distance between the teacher and the student (Moore, 1989). This distance, the transactional distance, is not only about the geographical distance that separates the teacher from the student. It refers to the non-interaction, or to a peculiar form of interaction, between teacher and student due to their geographical separation. Therefore, as transactional distance one could define the psychological and communicative space between a teacher and a student, or otherwise the distance between the teacher's input and the student's actual perception in an educational program (Moore, 1989).

The theory of transactional distance in an educational program refers to a set of variables that can be grouped into three main categories: Dialogue, Structure, and Autonomy of the student (Moore, 1993). According to Giossos, Koutsouba, Lionarakis and Skavantzos (2009), transactional distance is the result of teaching as an initial action, while the dialogue, the autonomy and the structure of the curriculum describe the mechanisms by which it is produced. Additionally, transactional distance is perceived differently by each person depending on his/her experiences, cultural background and the educational level (i.e. undergraduate, postgraduate, etc.). Therefore, there is no general transactional distance, but a perceived transactional distance (Giossos, Mavroidis & Koutsouba, 2016). Transactional distance is, in general, inversely proportional to the development of dialogue between teachers and students and proportional to the structure of the course and the students' autonomy (Moore, 1993). Moore (1993), in his theory, notes that transactional distance can also occur in face-to-face, traditional education and depends on the characteristics of those who learn and those who teach.

According to Moore (1989) there are three types of interaction, and therefore three types of transactional distance: (a) the transactional distance between students and teachers, which refers to the psychological, communicative and collaborative distance between them, (b) the transactional distance between the students, which refers to the psychological distance that the students "feel" among them, and (c) the transactional distance between students and content of the program, which indicates whether it satisfies the needs and expectations of the students. Hillman, Willis and Gunawardena (1994) added a fourth component to the model, the interaction between student and interface, due to the addition of high technology communications systems to mediate the communication process, corresponding to a fourth type of transactional distance, which refers to the extent to which the distribution system of the content/material is friendly and accessible to the user. The present work examines the first three types of transactional distance described by Moore, and their relation with student satisfaction in a postgraduate distance learning program.

THEORETICAL FRAMEWORK

The Concept of Dialogue

Dialogue is developed between teachers and students through an interaction or set of interactions which have a positive balance in the student's understanding process (Moore, 1993). Dialogue is influenced by the philosophy on the creators of a distance learning program, the design and philosophy of the program itself, the level of studies, the personality of the teachers and of the students, the subject matter/content of the program and environmental factors (Moore, 1993). Dialogue corresponds to the amount of control exercised by the student (Rovai, 2002). Increased dialogue results to an increased tendency to reduce transactional distance and to increase the sense that the student belongs to a community (Rovai, 2002). Dialogue is not a simple communication between the teacher and the student. It is a kind of cooperation between the two sides and is related to the understanding of the teacher, which aims at solving the problems of the student (Giossos, Koutsouba, Lionarakis & Skavantzos, 2009). Moore (1993) highlights the qualitative characteristics of dialogue more than its quantitative characteristics.

The Concept of Structure

Structure expresses the rigidity or the flexibility of the educational objectives, the teaching methods and the ways of evaluating a program (Moore, 1993). It is a qualitative variable and depends on the means of communication, the philosophy and personality of the teachers, as well as on the particular characteristics of the students (Moore, 1993).

Dialogue is affected by the structure of a program. For example, a program with a high level of structure - such as a TV show or an asynchronous video - does not offer opportunities to develop dialogue, since almost everything is predetermined, from the delivery of the course to the (lack of) interference and feedback by the learners. As a result, transactional distance increases with increased structure. On the contrary, through a videoconference where students can freely express themselves and the teacher's responses may vary depending on the dialogue developed, even for the same teaching unit/course, transactional distance is reduced (Moore, 1993). The parameters that decisively influence the structure of a distance learning program are: a) the way

in which content is presented, b) the motivation of the students through targeted interventions, c) the motivation of the students towards analysis and criticism, d) the provision of personalized guidance, e) the practical application of the learning content and the evaluation of the acquired knowledge through tasks, and f) the extent to which students are enabled to create new knowledge by offering feedback to the program (Moore, 1993).

The Concept of Autonomy

Learner autonomy refers to the degree to which the student in a learning process - and in cooperation with the teacher - defines the objectives, the learning experiences and the decisions on the evaluation of a program. The educational system usually does not promote autonomy since it is often dominated by the students' dependence on the teacher (Moore, 1993). The student, due to distance from the teacher, should – to a significant extent – take the responsibility of his/her learning path. In distance learning programs, students with a high degree of autonomy seek for less dialogue and structure, while students with a low degree of autonomy seek for more (Moore, 1993).

Satisfaction

Satisfaction from an educational program is usually defined as the pleasure that the student gets from the results that he/she has achieved, from the forms of communication used, from the acceptance and understanding of the other, and especially from the level of the self-esteem he/she acquires (Vakoufari, Angelaki & Mavroidis, 2014). The theory of transactional distance puts great emphasis on the continuous and effective contact of teachers and students, which also results in an increased satisfaction of the student. These two-way relationships involve dialogue, exchange of views, teamwork, and take place in an appropriate and specific learning environment. In an effective learning environment, the chances of students to overcome the obstacles increase, resulting in achieving the desired goals, which bring along the feeling of satisfaction (Vakoufari, Angelaki & Mavroidis, 2014).

In the distance learning environment, the role and performance of the teacher plays an important role in the satisfaction of the student. The way the teacher guides the students in the learning process, together with the quality of the course, which is closely linked with its design and construction, are important factors for a satisfactory and effective learning experience. These features, which are particularly important for students, are significant elements of the quality of their educational experience and, therefore, an important predictor of their satisfaction (Joo, Lim & Kim, 2013).

Krsmanovic, Djuric and Dmitrovic (2012) report the following main parameters related to the student's satisfaction:

- Functionality and update of the information on an online platform
- Completeness, clarity and quality of educational material
- Rate of provision of information to students
- Understanding the required tasks by the students
- Flexibility in forms of communication with the teachers and their availability
- Successful and effective communication between teachers and students
- Relationship between effort made and academic performance.

LITERATURE REVIEW

A number of recent studies examined the different dimensions and parameters of the transactional distance theory and on how they affect student satisfaction in distance learning or blended programmes. Ekwunife - Orakwue & Teng (2014) examined the impact of transactional distance dialogic interactions on student learning outcomes in online and blended environments. Their research concluded that student-content interaction has the greatest impact on learning outcomes compared to other forms of interaction, almost twice as much as student-teacher interaction and student – student interaction. While "dialogue" seems to

contribute to the student satisfaction, it doesn't seem to be the same as to the academic performance. The level of "dialogue" is not affected by the age, while women are more likely to engage in communication than men.

Mbwesa's (2014) research correlates students' perceived satisfaction with transactional distance. This research has shown that student-student, teacher -student and student-content interaction are indicators of the perceived student satisfaction. The teacher-student interaction has the greatest impact on the transactional distance, making it necessary for students to be encouraged by the teacher as well as to support them in understanding the material.

Sher's (2009) research study evaluates the relationship of student-teacher interaction and student-student interaction, in relation to learning outcome and satisfaction in purely distance learning programs. This study concludes that both types of interaction play a critical role in learning outcome as well as in student satisfaction from the learning process. In addition, some students were more familiar with the program's online platform. However, this didn't affect the learning outcomes and the satisfaction of the students' sample as a whole.

The research of Stein, Wanstreet, Calvin, Overtoom, & Wheaton (2005), illustrates students' cognitive satisfaction with the knowledge they acquire as a function of the structure of the distance learning program, the interaction and the existing know-how in relation to Information and Communication Technologies, within learning environments that are either supported or dependent solely on the internet. The results of their research show that cognitive satisfaction is directly related to satisfaction with the structure of the programs and with the satisfaction from the interaction, which is mainly initiated by the teachers. On the contrary, the format in which the teaching material is distributed does not appear to have an impact on satisfaction.

The research of Kassandrinou, Angelaki, & Mavroidis (2014) examines the presence of transactional distance among students and its impact on the learning process in a mixed learning environment, that of the Hellenic Open University (HOU). The findings indicate that the transactional distance among students exists and is more geographical and partly emotional, as communication is limited. At the same time, transactional distance is influenced by factors such as the students' mentality, the teacher's encouragement to students to communicate with one another and the relatively limited opportunities offered by the HOU for interaction among students. In addition, the role of the teacher is crucial in facilitating communication among students.

The research of Ustati & Hassan (2013) examines the interaction between teacher and learner through an online platform in a blended learning program in Malaysia, where there are face-to-face meetings once per month. The results of this study show that learners have access to up-to-date teaching materials through the platform, but at the same time they receive sufficient feedback from the teacher, although they would also like to have some form of modern communication. Also, it appears that the learners would like to develop more interaction with one another.

Miyazoe & Anderson's (2010) research analyzes and compares the interaction of the student with the teacher, the fellow students and the content of four programs in a mixed learning environment. The results show that the teacher-learner interaction takes on higher priority in the in-person Counseling Group Sessions (CGS), while the student-content interaction takes priority in the online part of the program, affecting therefore more the satisfaction of students. At the same time, interaction with peers is increased in asynchronous online communication.

The study of Paul, Swart, Zhang and MacLeod (2015) examined transactional distance as a barrier to students' engagement with learning in the online environment, updating Zhang's scale of transactional distance. Their results indicated that all sub-constructs of the transactional distance theory, i.e. the transactional distance between student and teacher, student and student, and student and content, were significant predictors of student satisfaction in an online environment, with the student-teacher transactional distance being the stronger predictor.

Best and Conceicao (2017) explored the impact of transactional distance dialogic interactions on student satisfaction in an international blended learning master's degree program. The participants reported experiencing transactional distance for learner-learner and learner-teacher dialogic interaction elements and

dissatisfaction in the online components of the program, but reported a sense of community and satisfaction for the face-to-face (in-person) elements of the program. Transactional distance for the dimension of learner-content dialogic interaction was the highest observed and was attributed to the multi-institutional nature of the program. Students reported general satisfaction for the program overall.

According to Weidlich and Bastiaens (2018), regression models show that transactional distance is the most important predictor of satisfaction for an online learning population. They also note that according to their study, student-teacher and student-content transactional distance are significant predictors of student satisfaction, while - surprisingly according to the authors - student-student transactional distance shows no significant relationship with satisfaction. They also noted that the predictive capabilities of the sub-constructs amount to a much lower R^2 in their study, compared to the study of Paul *et al*. (2015) in which R^2 was 0.586. They attributed this difference partly to the fact that in their study only student-teacher and student-content transactional distance were significant predictors of student satisfaction.

Overall, the literature review shows that all forms of interaction linked to the transactional distance theory are important for the satisfaction that students receive form a distant or blended learning program. At the same time, the relationship between each type of interaction and student satisfaction is complex and variant. For example, depending on the type of course and specificities of the population, student-content or teacher-student interaction may be more important predictors of student satisfaction. Such type of information is very useful for the design of distance learning programs, of their learning material and of the training programs of tutors.

METHODOLOGICAL FRAMEWORK OF THE SURVEY

Purpose and Research Questions

As shown by the theoretical framework and the literature review, the theory of transactional distance is central for distance education and blended programs. The different types of interaction inherent to distance education programs are key for designing these programs effectively in order to optimize the learning outcomes and increase the satisfaction of students. This is especially important for the HOU, which is a relatively new university offering exclusively distance learning courses, and were relevant research studies are needed in order to better understand and improve the learning process.

Following the above, the purpose of this study is to investigate the three dimensions of transactional distance (student - teacher, student - student, student - content) and how they affect student satisfaction in the distance learning environment of a postgraduate course of the Hellenic Open University.

In this context, the research questions are:

- How do the students perceive each of the three dimensions of transactional distance, as well as the satisfaction from their studies?
- How are the above variables affected by student demographics (gender, age, professional status, academic level, previous experience in distance learning)?
- How each of the three dimensions of transactional distance is related to the other two dimensions and to student satisfaction?

Educational Context

Consisting of four separate Schools, namely Humanities, Science and Technology, Social Sciences and Applied Arts, the HOU is the unique Hellenic public educational institution offering exclusively distance learning courses to students throughout Greece as well as abroad since 1998. Undergraduate and postgraduate HOU courses are offered in Greek and are addressed to both Greek and non-Greek adult students, provided that the latter master the Greek language in an advanced level. Further information about the studies in HOU can be found in Kassadrinou, Angelaki, and Mavroidis (2014) and in Anagnostopoulou, Mavroidis, Giossos and Koutsouba (2015).

HOU students following the Postgraduate Program on "Education Sciences" at the academic year 2016-7, when the current research was conducted, had to hand in four written assignments throughout the 10-month academic year, for each course module they enrolled in and sit exams at the end of it. Furthermore, each course module included five face-to-face Counseling Group Sessions (CGS). Participation in CGS is not compulsory. Students should plan their own study during each course module, while they are continuously supported by their tutor. To obtain their Master's Degree, students had to successfully complete four course modules and to submit a postgraduate dissertation.

It should be noted that the use of online tools in HOU has been increasing in recent years. Such tools include a web-based instructional environment (portal), where there is a dedicated website to each course module. The portal simplifies organizational procedures and provides forums for asynchronous tutor-student as well as student-student interaction.

The students upload their written assignments through the portal, and the tutor provides his/her feedback on the assignment to each individual student through the same system. Furthermore, the tutor provides information on the course and on the timelines through the portal to his group of students. Finally, students can pose questions to their tutor, either directly through email or through the portal. In the latter case, the post is seen by all the students in the group, who can also react and a discussion then opens. The most common subject of the posts and discussions is the written assignments and the questions relevant to them. The use of the forums by the students and tutors has been quite limited in the beginning, yet it is gradually increasing.

Research Strategy

A quantitative research approach was used, to extract cause-effect relationships under the prism of the interaction of variables (Bird, Hammersley, Gomm & Woods, 1999). Correlation research was selected to examine the relation between the parameters.

Participants

A purposive sample of 115 postgraduate students was selected. The sample consisted of postgraduate students from six different course groups of the Postgraduate Program of Studies "Education Sciences" of the Hellenic Open University, during the academic year 2016 - 2017.

Survey Tool

In order to collect the data a questionnaire was used, consisting of three main sections. The first section included questions related to the demographic characteristics of the respondents, namely gender, age, occupational status, level of studies and previous experience in distance learning.

The second section included questions on the three dimensions of transactional distance experienced by the students. More specifically, there were eight questions related to the student - teacher transactional distance, eight questions related to the student - student transactional distance and eight questions related to the student-content transactional distance. All questions were closed and a five-point Likert scale was used (1. I fully disagree, 2. I partly disagree, 3. I am not sure, 4. I partly agree, 5. I fully agree).

Finally, the third section addressed the perceived satisfaction of students from their participation in the distance learning environment. It consisted of eight closed type questions and a five-point Likert scale was also used (1. none, 2. little, 3. moderate, 4. much, 5. very much).

The questionnaire was based on scales developed in previous studies, one for transactional distance and one for the satisfaction of students in distance learning programs. For transactional distance the scale of Mbwesa (2014) was used, with its questions adjusted to the framework of the Hellenic Open University. From Mbwesa's (2014) questionnaire two questions were removed for each axis of the transactional distance, since the content of these questions was not relevant to the organizational framework and the administrative and academic functioning of the Hellenic Open University. This does not affect the

internal coherence of the questionnaire, since the Cronbach's Alpha in the Mbwesa (2014) survey/study showed that all sub-scale coefficients were above 0.7, while the Crombach Alpha was also measured in the present study. For measuring the satisfaction of students in distance learning programs, the scale of Arbaugh (2000) was used, as adapted for the framework of the Hellenic Open University by Vakoufari, Angelaki and Mavroidis (2014).

The data collection process took place during the third Counseling Group Session, in February 2017. The students were informed in detail about the purpose of the study. Participation in the study was voluntary and anonymous. Finally, participants were informed that they could have access to the results of the study if they so wished. For the analysis of data the statistical program SPSS 24 was used.

Validity and Reliability

The validity and reliability of the tool/scales has originally been tested in the previous surveys (Mbwesa, 2014; Vakoufari et al., 2014). The reliability test for the inner coherence of the subclasses was assessed by calculating the Cronbach's Alpha coefficient. All the coefficients of the questionnaire subsets, as calculated from these surveys, were above 0.7. The lowest value was observed for the sub-scale measuring the transactional distance between the student and the educational content, which was ⍰ = 0.672. This value is acceptable for behavioral studies (Mbwesa, 2014). In the present research the Cronbach's Alpha coefficients were also calculated and the results are shown in Table 1.

Table 1. Reliability factors for the questionnaire and its sub-scales

Grouped variables	Number of questions	Coefficient a
All scales	32	0.895
Transactional distance teacher- student	8	0.849
Transactional distance student - student	8	0.911
Transactional distance student - content	8	0.693
Satisfaction from distance learning studies	8	0.902

Overall, the reliability is quite high. The lowest value is observed for the scale measuring the transactional distance between the student and the content, which was ⍰ = 0.693, a value of approximately 0.7, that remains acceptable for behavioral studies (Mbwesa, 2014).

RESULTS

Demographic Information

The results of the survey showed that 27 participants (23.5%) were men, while 88 (76.5%) were women. It also showed that 45 participants (39%) were aged from thirty-one to forty years old, 41 (35.7%) were aged from forty-one to fifty years old, 18 (15.7%) were less than or equal to thirty years old and 11 (9.6%) older than fifty years old. Regarding their professional status, the results showed that 99 (86.1%) were full-time employees, 10 (8.7%) were unemployed and 6 (5.2%) were employed part-time. Also, 80 (69.6%) participants were university graduates, 31 (27%) already held a postgraduate degree, 3 (2.6%) were graduates of Technological Educational Institutes, while one participant 1 (0.8%) held a PhD. Finally, 84 participants (73%) responded that they had no previous experience on distance learning. The demographic information is shown in Table 2.

Table 2. Demographic Information

Demographic Information	v	%
SEX		
Men	27	23.5
Women	88	76.5
AGE		
30 <	18	15.7
30-40	45	39.0
41-50	41	35.7
50 >	11	9.6
EMPLOYMENT STATUS		
Unemployed	10	8.7
Part-time employees	99	86.1
Full-time employees	6	5.2
EDUCATIONAL LEVEL		
University graduates	80	69.6
Postgraduate degree	31	27.0
Technological Educational Institutes	3	2.6
PhD	1	0.8
EXPERIENCE ON DISTANCE LEARNING		
Previous experience on distance learning	31	27.0
No previous experience on distance learning	84	73.0

Descriptive Analysis Results

Descriptive statistics, such as mean score and standard deviation, were used since the variables under examination were ordinal. Table 2 presents the mean value and standard deviation of the transactional distance between the teacher and the student, the student - student transactional distance, the transactional distance between the student and the content, and the satisfaction from the distance learning program. It should be noted that the questionnaire was structured so that higher values of parameters correspond to higher levels of interaction and, therefore, lower levels of transactional distance.

Table 3. Mean values and standard deviation of the variables

Variable	Average	Standard deviation
Teacher- student transactional distance	3.82	0.97
Student - student transactional distance	3.32	1.15
Student - content transactional distance	3.31	1.08
Satisfaction with distance learning	3.62	1.11

Demographic Differences

In order to select whether to use parametric or non-parametric tests, the values of the warp and the bending of the dependent variables were examined. All variables were found to have a normal distribution, and therefore for the analysis of inductive statistics, parametric criteria were used, such as t – test and ANOVA (Cohen, 1988). The analysis of gender, age, occupational status, academic level and experience in distance learning that follows focuses only on those results where statistically significant differences were observed.

In order to investigate the possible differences in relation to gender, a t - test was performed. The analysis showed a statistically significant difference in the teacher - student transactional distance in relation to gender (Cohen's d index equal to 0.39), with lower levels of teacher – student transactional distance observed for men. Also, the analysis showed a statistically significant difference of the transactional distance between the student and the content, in relation to the gender (Cohen's d index equal to 0.52), with lower levels of student – content transactional distance observed for men.

Table 4. Results of t - test in relation to gender differences

	Men		Women				
	M	SD	M	SD	t	p	Cohen's d
Teacher – student	3.99	0.46	3.75	0.73	2.02	0.04	0.39
Student – student	3.16	0.73	3.37	0.96	-1.21	0.23	
Student – content	3.53	0.47	3.25	0.64	2.17	0.03	0.52
Satisfaction	3.84	0.76	3.55	0.88	1.52	0.13	

Note: p< 0.05

In order to investigate the possible differences in relation to previous experience in distance learning, a t - test for independent samples was performed. The analysis showed that the transactional distance among students has a statistically significant difference in relation to the experience in distance learning (Cohen's d index equal to 0.28), with lower levels of student – student transactional distance observed for students with previous experience in distance learning.

Table 5. Results of t - test in relation to differences in experience in distance learning

	With experience		Without experience				
	M	SD	M	SD	t	p	Cohen's d
Teacher – student	3.84	0.66	3.75	0.74	0.619	0.537	
Student – student	3.48	0.85	2.88	0.93	3.23	0.002	0.28
Student – content	3.28	0.64	3.4	0.54	-1.009	0.315	
Satisfaction	3.84	0.82	3.55	0.95	0.505	0.614	

Note: p< 0.05

Correlation Analysis

The Spearman's rho criterion was used to examine the correlation between the examined variables, since the variables were of an ordinal scale (Cohen, 1988). The results presented in Table 5, suggest the existence of statistically significant correlations among variables. It should be noted that the questions were set in such a way that higher parameter values correspond to increased levels of interaction and therefore decreased levels of transactional distance. In particular, a small but statistically significant positive correlation exists between (a) the student-student interaction and satisfaction (and therefore a negative correlation between the student – student transactional distance and satisfaction), $r = 0.101$, $p < 0.01$, and (b) the student-student transactional distance and the student-content transactional distance, $r = 0.168$, $p < 0.05$. Also, statistically significant, moderate, positive correlations exist between (a) the teacher-student interaction and satisfaction (and therefore a negative correlation between the teacher – student transactional distance and satisfaction), $r = 0.335$, $p < 0.01$, (b) the teacher-student transactional distance and the student-student transactional distance, $r = 0.3$, $p < 0.01$, and (c) the teacher-student transactional distance and the student-content transactional distance, $r = 0.323$, $p < 0.01$.

Finally, statistically significant, strong, positive, correlation occurs between the interaction between the student and the content of the distance learning program and satisfaction (and therefore a negative correlation between the student – content transactional distance and satisfaction), $r = 0.618$, $p < 0.01$.

Table 6. Correlation between the examined parameters

Spearman's rho		Teacher-student	Student-student	Student-Content	Satisfaction
Teacher-student	Correlation Coefficient	1.0	0.3**	0.323**	0.335**
	Sig. (1-tailed)	-	0.001	0.00	0.00
	N	115	115	115	115
Student-student	Correlation Coefficient	0.3**	1.0	0.168*	0.101
	Sig. (1-tailed)	0.01	-	0.036	0.141
	N	115	115	115	115
Student-content	Correlation Coefficient	0.323**	0.168*	1.0	0.618**
	Sig. (1-tailed)	0.00	0.036	-	0.00
	N	115	115	115	115
Satisfaction	Correlation Coefficient	0.335**	0.101	0.618**	1.0
	Sig. (1-tailed)	0.00	0.141	0.00	-
	N	115	115	115	115

*** Correlation is significant at the 0.01 level (1-tailed).*
** Correlation is significant at the 0.05 level (1-tailed).*

DISCUSSION

The findings of the descriptive statistical analysis suggest that students have a positive perception of their communication and collaboration with the teacher and of the support provided by the latter. This indicates that they perceive that the transactional distance between teachers and students remains low. The studies of Ekwunife - Orakwue and Teng (2014), Falloon (2011) and Mbwesa (2014), also indicated low levels of teacher-student transactional distance in distance learning programs. It shows that well-designed programs result to an increased satisfaction of students from their interaction with the teacher and the development of dialogue in an online / distance learning environment. The differences observed between these studies and that of Ustati and Hassan (2013) may be attributed to the different research approaches and the very small sample used by Ustati and Hassan (2013) - who used a qualitative approach, with a very limited number of two informants - and possibly, to the different curricula and design of the courses/ institutions.

In relation to student-student interaction, the results also indicate low levels of transactional distance, which is attributable to the communication, the cooperation and the mutual support among students. However, student-student interaction is not as effective as student-teacher interaction. The above findings are consistent with the results of other studies, which show a relatively high level of interaction, and therefore a relatively low level of transactional distance among students (Ekwunife - Orakwue & Teng, 2014; Falloon, 2011; Mbwesa, 2014; Miyazoe & Anderson, 2010; Sher, 2009; Stein, Wanstreet, Calvin, Overtoom & Wheaton, 2005). At the same time, there is also a general agreement with the qualitative studies of Kassandrinou, Angelaki and Mavroidis (2014) and Ustati and Hassan (2013), which suggest that the level of student-student interaction is lower than that of student-tutor interaction. Indeed, as suggested in the study of Kassandrinou et al. (2014), which was performed in the same educational environment as the present study, the limited face-to-face interaction and the lack of group assignments lead to an increased student-student transactional distance (in relation to teacher-student transactional distance). This is enhanced by the fact that the postgraduate students were accustomed to traditional face-to-face courses during their undergraduate studies, where they interacted more easily with their fellow students.

In relation to the transactional distance between the students and the content of the distance education program, the results show that students believe that the content of the distance education program meets their needs, with the student-content transactional distance being at a similar level as the student-student transactional distance. These results are in agreement with the results of similar studies, such as those of Miyazoe and Anderson (2010), Mbwesa (2014) and Stein et al. (2005), which suggest similar levels of student interaction with the educational content. The results of Ustati and Hassan (2013) suggest lower levels of student-content interaction, this being attributed to technical issues of the online platform used, and possibly to the low number of informants.

In relation to student satisfaction, the results show that students are quite satisfied from their distance learning studies, which is a positive finding, especially noting that their previous educational experiences are mainly from conventional education. The high levels of perceived satisfaction are in agreement with findings from studies conducted in other educational environments, such as those of Sher (2009) and Stein et al. (2005), and also consistent with the findings from other studies in HOU, such as the study of Anagnostopoulou, Mavroidis, Giossos and Koutsouba (2015).

Regarding the effects of the demographic characteristics of the sample, a statistically significant, quite high, difference was observed regarding the levels of transactional distance between the students and the content of the distance program in relation to gender. Furthermore, a statistically significant, moderate, difference was observed regarding the level of transactional distance between the students and the teacher in relation to gender. The above is in line with the results of Ekwunife – Orakwue and Teng (2014), who observed that the gender dimension plays an important role in distance learning. It appears that women perceive a larger transactional distance between themselves and the content of the educational material and a relatively larger transactional distance between themselves and the teacher. The higher transactional distance perceived by female students, especially in relation to the educational content, may be attributed to their increased need for personal contact and preference for face-to-face meetings as well as to their increased stress in relation to information and communication technologies (Moss, 2004; Muller, 2008; Zembylas, 2008), since students in distance education work most of the time alone with the educational material. Finally, a statistically significant difference in relation to gender is not observed for the parameter of student satisfaction, which is in agreement with the findings of Anagnostopoulou et al. (2015) and Sher (2009).

The results also suggest that there was a statistically significant difference in the level of student-student transactional distance in relation to their previous experience in distance learning. Students who have previous experience in distance learning perceive a lower level of transactional distance between students, since they are more accustomed to the distance education context and realize the importance of their interaction with peers, which they are not afraid to pursue to a higher degree. Sher (2009) notes that students who have prior experience with the distance / online learning context could feel more comfortable as compared to those who have no such experience.

The examination of the correlation between the examined parameters revealed that the correlation between the student-teacher transactional distance and the student satisfaction from the educational program was statistically significant and moderate, with the satisfaction increasing as transactional distance decreases. This correlation indicates the importance that students place in the interaction with their tutor in a distance learning environment, and therefore the importance of the tutor's role for student satisfaction. Similar findings were observed in the studies of Ekwunife - Orakwue and Teng (2014), Mbwesa (2014), Stein et al. (2005), as well as of Sher (2009) who indirectly addressed satisfaction through the learning outcomes.

Furthermore, the results of this study also showed a statistically significant, but very low, correlation between the student-student transactional distance and satisfaction, with the satisfaction increasing as transactional distance decreases. Ekwunife - Orakwue & Teng (2014), Mbwesa (2014), Sher (2009) and Stein et al. (2005), also found a positive relation between the student-student interaction and satisfaction. In their case, this relation was stronger than in the present study, possibly due to the different types of programmes examined and to the larger previous experience of their respondents with distance education programs. Finally, the correlation between the student-content transactional distance and satisfaction was statistically significant and strong, with the satisfaction increasing as transactional distance decreases. This indicates that the interaction of the student with the educational material is an important predictor of his/her satisfaction from the studies, as also indicated by Ekwunife - Orakwue and Teng (2014), Mbwesa (2014) and Stein et al. (2005), reconfirming the central role of the educational material in distance education.

In relation to the correlation between the three dimensions of transactional distance, the results showed that (a) the correlation between the student-teacher transactional distance and the student-student transactional distance was statistically significant and moderately positive, (b) the correlation between the student-teacher transactional distance and the student-content transactional distance was statistically significant and moderately positive, and (c) the correlation between the student-student transactional distance and the student-content transactional distance was statistically significant and positive, but low. These findings, which are consistent with those of Mbwesa (2014) and Stein et al. (2005), show that the three main dimensions of transactional distance are related and that the interaction of the students with their teacher, their peers and the educational content are interlinked. The three types of interaction need to be pursued in an integrated manner to lead to a successful distance education program.

CONCLUSIONS

The purpose of this study was to investigate the levels of transactional distance perceived by postgraduate students of the Hellenic Open University and their correlation with the degree of students' satisfaction from their distance learning studies. The first research question was how students perceive each of the three dimensions of transactional distance according to Moore (student - teacher, student - student, student - content), as well as the satisfaction from their studies. The analysis of the research results revealed that learners appreciate to a greater extent the communication, collaboration and support with/from their teachers, and to a lesser extent the interaction with their peers and with the content of the distance program, while they seem in general satisfied with their distance learning studies.

The second research question referred to whether these variables are affected by student demographics (gender, age, occupational status, academic level, previous experience in distance learning). The results showed that men have a more positive opinion than women regarding whether the content of the distance program covers their distance learning needs, and therefore they experience a lower level of student -content transactional distance than women. It also appears that men have a more positive attitude in relation to the communication, support and collaboration with the teacher and therefore they perceive lower levels of student - teacher transactional distance than women. Finally, students who have previous experience in distance learning have a more positive opinion about the communication, support and cooperation with their peers and therefore experience lower levels of student-student transactional distance, compared to students with less experience in distance learning.

Finally, the correlation between the examined variables showed that statistically significant correlations exist between satisfaction and the three dimensions of transactional distance, with the strongest, negative correlation, observed with the student-content transactional distance and the weakest, negative, correlation with the student-student transactional distance (with the correlation between satisfaction and teacher-student transactional distance positioned in between). This confirms the importance that the educational material has for distance learning, with the role of the tutor also being of significance. Furthermore, it indicates the need for the tutors and the educational organization/institution to explore ways to promote student-student interaction so that it has a more prominent role in the distance education program. Regarding the correlation between the different dimensions of transactional distance, the results showed statistically significant and, moderate to low positive correlations between all types of transactional distance, indicating the interlinkages existing between the three dimensions of transactional distance according to Moore.

It should be noted that the study has certain limitations: it was conducted in the framework of HOU, and the generalization of the findings regarding other distance learning environments needs caution. Furthermore, the study focused on a limited number of postgraduate students selected via purposive sampling. In this respect a larger sample, chosen with random sampling, representing the total HOU student body would enable further examination of the relation between the dimensions of transactional distance and student satisfaction.

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INSIGHTS FROM THE IMPLEMENTATION OF A FLIPPED CLASSROOM APPROACH WITH THE USE OF A COMMERCIAL LEARNING MANAGEMENT SYSTEM

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ABSTRACT

As an option to help cope with challenges such as differing student needs, lack of student interest, and limited contact hours, the commercial learning management system (LMS) Blackboard was used to support a flipped classroom approach in a first-year English as a foreign language course at a large Thai public university. The aims of the study were to determine students' perceptions of the course and how it affected their second language writing anxiety, in order to improve later versions of the course. Data were collected over the course of two non-consecutive measures from 272 participants in the first semester and 141 in the second. Data on students' perceptions and anxiety were collected using a questionnaire and the Second Language Writing Anxiety Inventory (Cheng, 2004). After quantitative and qualitative analysis, results showed that participants' second language writing anxiety was not significantly affected by the modified course. Their perceptions of the course appeared to be impacted by technological difficulties that occurred. The results seem to indicate that frustration with technology should be of greater concern when attempting to utilize an LMS or similar platform.

Keywords: Learning management system, education, technology, EFL

INTRODUCTION

In Thailand, English serves as a tool to "[link] Thailand culturally, intellectually and commercially with other ASEAN countries and the rest of the world" (Baker, 2012, p. 18). Yet, despite this important status, the teaching and learning of English among Thai students is problematic. The challenges facing numerous Thai learners of English as a foreign language (EFL) are exemplified by the difficulties seen in the general introductory English courses offered to first-year students of Chulalongkorn University, Thailand's oldest institution of higher education.

Currently, all of the first-year students of Chulalongkorn University (except those in the Faculty of Arts) are required to take two general introductory English courses, Experiential English I and Experiential English II, offered by the Chulalongkorn University Language Institute. These courses have been designed to provide

students with the language skills necessary to function in more advanced English courses at the university. Although the Experiential English courses provide many transferable skills, such as critical thinking skills, collaboration skills, and research skills, and place an emphasis on students' language development, they have several drawbacks. One is that students have only a single three-hour class every week; for many students, this may be the only exposure they have to English throughout the week. Additionally, regardless of their initial ability in English, all students are taught using the same basic material and administered the same examinations. All of these factors may disadvantage students at both ends of the ability spectrum.

Moreover, a major component of the examinations the students are required to sit, as well as the courses themselves, is writing, which may add an extra layer of difficulty because writing is a complex skill, necessitating the interplay of receptive, expressive, and reflective skills, and the achievement of an acceptable level of writing is an arduous task (Deane, 2011). For students of the Experiential English courses, there is an added level of challenge: as they are learners of English as a foreign language (EFL), they are being asked to engage with a writing system that has marked differences from the one they are familiar with, and this can be highly challenging and even anxiety-provoking (Mat Daud, Mat Daud and Abu Kassim, 2005; Weigle, 2002). The literature has shown negative correlations between the anxiety aroused by being asked to write in a second or foreign language (known as second language writing anxiety) and various academic outcomes, including lower standardized writing test scores (Jahin, 2012).

As the major purpose of both Experiential English courses is to prepare students for further, more specific English courses throughout their university career, it would seem highly pertinent to ensure they are indeed establishing a strong linguistic foundation upon which students may pursue future academic endeavors. At present, the limitations outlined previously may hinder the achievement of this goal. In seeking to address the shortcomings of the Experiential English courses—its limited contact time, its use of non-differentiated materials and examinations, the potential for anxiety resulting from an emphasis on writing—it was decided to implement a flipped classroom approach, aided by the commercial learning management system Blackboard. This particular learning management system, or LMS, was selected chiefly due to practicality (as Chulalongkorn University pays the licensing fee for its use throughout the institution), but it also happens to be an oft-used LMS in higher education settings and leading international proprietary LMS (Carvalho, Areal, and Silva, 2011; Zanjani et al., 2017).

Interventions of a similar nature—technology-aided flipped classrooms—have been attempted in other contexts (Elmaadaway, 2018; Cheng et al., 2017), but little has been done in the Thai EFL context. As such, little concrete information exists on the effects of attempting such an endeavor with Thai EFL learners. Thus, in conducting this research, the researchers aimed to determine if such a course would indeed help to alleviate the aforementioned problems, with the understanding that such a broad objective may lend itself only to a research study of an exploratory nature. As the primary role of the researchers is educators, however, it was felt that any insights gained would be valuable at a pedagogical level. This particular study is part of a larger project examining the effects of utilizing an LMS to implement a flipped classroom approach at Chulalongkorn University, looking at issues such as teachers' perceptions and links with student academic achievement and. However, this article will focus on students' perceptions of the use of a course employing a flipped classroom approach via a commercial learning management system, and how the course impacted their levels of second language writing anxiety, so as to inform later iterations of the course.

LITERATURE REVIEW

The Flipped Classroom Approach

The flipped classroom approach refers to an alternative model of instruction where the timing of what are traditionally seen as classroom activities are swapped with what are usually seen as activities that occur outside the boundaries of a classroom (Cheng et al., 2017). According to Elmaadaway (2017), a flipped classroom is "an appropriate alternative to conventional, unidirectional forms of knowledge acquisition" (p. 480). Novel content is delivered to students via reading texts or short videos outside of the classroom. Time in the classroom is then spent further developing this knowledge through a variety of methods, such as interacting with the teacher and peers or taking part in discussions or debates (Brame, 2013). Essentially, a flipped classroom approach allows class time to be used to expand ideas and complete more sophisticated

language- and thinking-intensive tasks, as it pushes much of the core input for students into their own time. This allows for flexible and convenient learning (Squillante, Wise, and Hartey, 2014).

There are a number of theoretical underpinnings for flipped classrooms. One of the key ones is constructivism, which refers to learning theories, based on the work of scholars like Vygotsky and Piaget, that support the need for shaping comprehension and knowledge of the world by participating in experiences and engaging in reflection on them to create mental models of information (Bishop & Verleger, 2013; Cheng, Ritzhaupt, & Antonenko, 2018; Eppard & Rochdi, 2017). In a flipped classroom, each learner is expected to dynamically engage with the material, the teacher, and his/her peers, rather than being fed information, with the end result being an individual construction of knowledge (Cheng, Ritzhaupt, & Antonenko, 2018; Eppard & Rochdi, 2017). Thus, vital components of the flipped classroom are active learning and student-centeredness (Ahmad, 2016).

Theoretical support for flipping classrooms can also be found in the concept of Mastery Learning, based on the work of Bloom. A key tenet of mastery learning is offering students multiple opportunities to achieve learning objectives and demonstrate their knowledge. The pacing of the learning process is left up to individual learners and correction is given where needed (Eppard & Rochdi, 2017; Lane-Kelso, 2015). In a flipped classroom approach, course material is made available to students prior to class time, so they may view and engage with it on their own time and at their own speed. In the classroom, they must utilize that knowledge to participate in exercises that support deep learning and critical thinking in regards to the content (Moraros et al., 2015).

Research of student perceptions of flipped classrooms has found generally positive views of its use (Bishop and Verleger, 2013). One study by Butt (2014) on the use of a flipped classroom approach in a final-year actuarial course at an Australian university found a large number of students deemed it beneficial to their academic pursuits and supported its use in the future. A majority of the graduate-level epidemiology students researched by Moraros et al. (2015) deemed the effectiveness of a flipped classroom to be quite high, with wholly 100% of the international students who participated in the research rating the approach as either very effective or somewhat effective. In addition to positive perceptions of its use, flipped classrooms have also been found to positively impact learning outcomes, such as the significantly improved writing proficiency of the Japanese participants in Leis, Cooke, and Tohei's (2015) research.

A key aspect of a flipped classroom is the delivery of new course material beyond the confines of class time. According to Bishop and Verleger (2013), however, it should not be understood that the mere assignment of reading texts outside of class, followed by participation in classroom-based discussions, constitutes a flipped classroom. Instead, they define a flipped classroom as "an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom" (Bishop and Verleger, 2013, para. 13). Learning management systems have been one option for providing the latter.

Learning Management Systems

In simple terms, a learning management system or an LMS is "an online portal that connects lecturers and students" (Squillante, Wise, and Hartey, 2014, p. 5). Using an LMS like Blackboard to deliver course material allows it to not only be easily accessible online at any time and any place, but also enables both instructors and students to engage in continual monitoring, feedback exchange, and assessment (Bradford, Porciello, Balkon, and Backus, 2007).

Different LMSs have different features that facilitate the teaching and learning process. Blackboard, for example, allows the online sharing of course materials, online assignment submission, and asynchronous discussion (Heirdsfield et al., 2011). The free open source LMS Moodle offers many of these same features, as well as online quiz capabilities (Carvalho, Areal, and Silva, 2011)

The literature reveals varied uses of LMSs. For instance, Moodle was integrated into a class meant to familiarize ninth grade students with online learning (List and Bryant, 2009). In a Thai EFL context, Sanprasert (2010) investigated how an LMS can be used to foster learner autonomy in a blended learning environment. Results showed that different aspects of autonomy were supported by the utilization of an LMS. The use of a learning

management system to implement a flipped classroom can be seen in the study conducted by Moraros et al. (2015), where the learning management system Blackboard was used as a repository for pre-recorded instructor videos that were to be viewed prior to class. Making videos, animations, references of organ system histology, and an online bank of histology items available via Blackboard to students of traditional Chinese medicine was also part of a flipped classroom detailed by Cheng et al. (2017).

Second Language Writing Anxiety

Cheng (2004) theorizes that second language writing anxiety is multidimensional, comprising physical manifestations of anxiety (such as perspiring), mental distress (such as concerns regarding writing tasks), and avoidance behaviors (such as procrastinating when asked to complete a writing task). Having feelings of distress when asked to engage in writing in a second or foreign language seems to be associated with various negative writing-related outcomes, including poor writing performance, low writing quality, and avoidance of courses and careers where advanced writing is required (Kara, 2013). In general, the research has found that writing anxiety has a debilitating impact on student writing performance (Rezaei and Jafari, 2014). Why this is is still a question of debate among researchers, although several studies point out the fact that writing is most often a solitary endeavor, undertaken in relative isolation (Atay and Kurt, 2006). The highly individualized nature of writing may leave weaker writers floundering without any means of seeking guidance or assistance (Jahin, 2012). For EFL writers, additional difficulties may arise from a perceived lack of enough English for clear expression, as seen with the Turkish subjects investigated by Kara (2013).

However, the use of technology seems to have a positive effect on writing anxiety, with Chuo (2007), for instance, noting a significant decrease in the anxiety levels of learners of a writing course that incorporated WebQuests, a type of inquiry-driven learning that integrates online resources. Kassem (2017) discovered the use of a wiki significantly reduced the writing anxiety levels of Saudi Arabian students enrolled in a business writing course. Even when no apparent effect is seen on writing anxiety, the incorporation of technology does still seem to positively affect the overall writing experience. While Pae's (2007) research of 15 university level Korean students who participated in a wiki-aided English writing course found that the majority of participants' anxiety levels dropped, the difference between pre- and post-course anxiety levels was not significant. What the participants revealed, however, was that they found the use of a wiki to be a fun, beneficial way to practice writing.

METHODOLOGY

Method

This study was a mixed methods study, and involved both quantitative and qualitative data. The decision to use mixed methods was because it "makes room for both the exploratory inductive process that begins with empirical evidence of the particular and proceeds to a level of abstracting/theorizing/generalizing and the confirmatory deductive process of hypothesis testing of theories" (Rocco et al., 2003, p. 22). As a study of this nature had yet to be conducted in this particular context, the researchers wanted to evaluate the outcomes from a number of angles and a mixed methods approach seemed to fulfill this aim.

There were three broad phases to the study. The key activities for each phase, such as the design of a course using the flipped classroom approach and quantitative and qualitative analysis of the data, are summarized in the following table.

Table 1. Outline of the research phases and key activities undertaken during each phase

Phase	Key Activities
1	• Flipped classroom course design • Preparation for implementation
2	• Flipped classroom course implementation • Data collection
3	• Data analysis

DESIGN AND PREPARATION

In the first phase of research, which preceded data collection, two of the researchers designed lessons that utilized the flipped classroom approach based on the core syllabus of Experiential English II. In designing the course, the researchers considered Bishop and Verleger's (2013) warning against restricting flipped classroom activities to asynchronous video lectures, close-ended problems, and quizzes testing discrete items. Such activities, while useful and necessary to an extent, run counter to elements that constructivism and mastery learning set forth as important to learning, elements such as meaningful interaction (Cheng, Ritzhaupt, & Antonenko, 2018; Eppard & Rochdi, 2017). Therefore, the researchers attempted to create a balance between different types of activities, including, for example, online quizzes, open-ended questions related to external YouTube videos, and an assignment for students to create a page on the social network site Facebook related to class content.

Aside from the theoretical concepts associated with constructivism and mastery learning, a guiding, more practical, principle adopted in lesson planning was to not to make the content of course seem wholly different from what students would have been exposed to in the traditional setting, as that was felt to be unfair and might have proved anxiety-provoking for the research participants who would undoubtedly compare their own experiences to those of their peers taking the same course. That is, while the delivery of the content and the way students were asked to work with it was different from that of other students taking the Experiential English II course, the *actual content* was kept as similar as possible.

Once the new lessons had been planned, assignment materials and corresponding instructions were uploaded to the LMS used in the study, which was Blackboard. An example of an assignment can be seen in Figure 1.

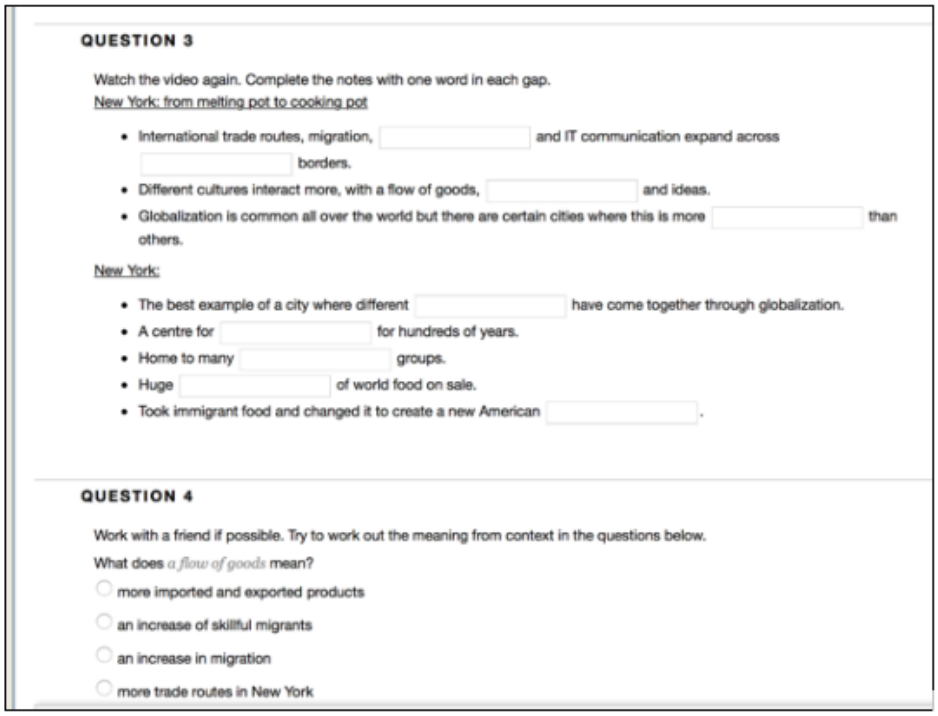

Figure 1. An example of an LMS-based assignment

Initially, the researchers had also hoped to incorporate gamification principles as a means to motivate students to access English more frequently than they had under the present structure of the course. The format of the version of the Blackboard learning management system that was being utilized, particularly its cosmetic aspects, did not lend itself readily to gamification on a wide scale, at least not to the extent it was visualized by the researchers. Consultation with the instructors who joined the project before the launch of the course, furthermore, also yielded great reluctance to utilize gamification. As such, it was decided the game-based learning platform *Kahoot!* would be incorporated into the structure of the course, but it would only be used in the classroom and only on a volunteer basis.

Once the course materials were uploaded to Blackboard, the researchers publicized the study to instructors of the course. Interested instructors took part in a short single-day training session offered by one of the researchers in order to familiarize themselves with the lessons and the Blackboard learning management system. This occurred before the start of the course.

Participants

Due to time and personnel constraints, it was decided to carry out the research only with students of Experiential English II (although it should be noted that Experiential English I and II share the same difficulties outlined previously). Thus, the population of the study was all first-year students of Chulalongkorn University taking the Experiential English II course offered by the Chulalongkorn University Language Institute. This was approximately 5,000 students.

As the study was meant to be exploratory in nature, it was decided that the research sample was to be a convenient sample. The research participants were students of the instructors of the course who had interest in taking part in the research, i.e. the instructors were the ones who chose to use the modified course. The participants were students studying in the Experiential English II course during two non-consecutive semesters. The following table summarizes information on the participants of this study.

Table 2. Information on participants of the study

Semester	Total number of participants	Number of classes	Gender
1	272	9	Male: 45.9% (125) Female: 54.0% (147)
2	141	5	Male: 66 Female: 74

As seen in the table, the first semester had a total of 272 participants, who were in nine different classes or sections. Two of these sections were taught by researchers in this study, and the remaining seven were taught by three instructors who chose to be part of the research (one teacher was in charge of four sections, one taught two, and the final taught one). In the second semester, data were collected from five sections of 141 students in total, with two taught by the researchers and the remaining three under the supervision of three instructors who chose to take part in the research. The number of female participants slightly outnumbered males in both semesters.

Data Collection

Data collection took place once the course was implemented. The course ran for a total of 16 weeks, with one week off for the midterm and one week off for the final examinations. Two data collection instruments were utilized to gather information on students' writing anxiety and perceptions of the course.

At the start of the course, all instructors of the Experiential English II course asked their students to complete the Second Language Writing Anxiety Inventory or the SLWAI (Cheng, 2004), available both in its original English and also translated into Thai, for students who were more comfortable with this language, in order to determine a baseline anxiety level for both research participants and their peers. One's score on this 22-item inventory represents one's level of anxiety when asked to write in a second or foreign language. The inventory conceptualizes second or foreign language writing anxiety as a multidimensional construct, the confluence of avoiding situations where one must write, physical symptoms such as numbness, and mental anguish associated with writing in a second or foreign language. A high score means the respondent has a high level of anxiety when engaging in this activity (Atay & Kurt, 2006; Cheng, 2004).

The SLWAI was made available as an online questionnaire. It must be noted that all students were informed that choosing to complete the SLWAI was completely voluntary and they would not be penalized or rewarded for doing so. They were informed that their responses were purely for research purposes and that by participating, they were helping to improve the course.

Each semester utilized a different procedure to ensure the SLWAI respondents' anonymity. In the first semester, respondents were asked to enter their section number, the first letter of their name, and the last four digits of their cell phone number. The idea was that the information would be given a unique marker, but be untraceable to any one individual. While confidentially was indeed maintained, it was discovered that statistical analyses suffered as a result of some respondents entering differing information before and after the course—for example, a respondent entered three digits on the inventory before the course started and four on the one towards the end of the course. Although the three digits were identical to the first three of the four-digit sequence seen in the latter inventory, and the initial letter and section numbers that were input matched, it was impossible to say with certainty if the information was from the same respondent. Due to this uncertainty, vigorous statistical analysis could not be run on the first set of data collected.

In the proceeding data collection period, quasi-anonymity was maintained by having students identify themselves only by their section number and their student identification number. While the latter is a unique sequence of 10 digits assigned to each student, access to personal information associated with the number is highly restricted. Attempting to attach a name to a student identification number, for example, would require going through a number of official channels. The researchers chose to ask for this number, however, in order to facilitate data analysis with minimal damage to the students' privacy.

At the conclusion of the course, the participants and other students taking the course were again asked to complete the SLWAI, as well as answer several open-ended questions regarding the course. The researchers asked the instructors to assure the students again that their responses were for research and course improvement purposes. This short questionnaire was also available online in both Thai and English. The data from the questionnaires were used to supplement the SLWAI data and to reveal information regarding students' perceptions of the course.

The SLWAI scores as well as both the students' responses to the questionnaire were collected for data analysis, with the research participants' data being grouped by referring to their section or class number.

Data Analysis

The data collected over the course of two non-consecutive semesters were subjected to similar forms of analysis. However, due to the issues discussed previously, only descriptive statistical analyses were run with the SLWAI data from the first semester's participants. The data from the SLWAI administered during the second semester were analyzed with an independent samples t-test. The SLWAI data of the research participants in both semesters were also compared to data taken from a random sample of students from the population. The responses to the questionnaires from both semesters underwent conventional content analysis, a form of quantitative data analysis. In this form of content analysis, the data are examined in order to yield categories for further analysis, rather than presupposing categories into which data can be sorted. This form of content analysis is useful for revealing information about a phenomenon (Hsieh & Shannon, 2005).

RESULTS

The results from the data analysis are presented and discussed by semester. It should also be noted that data from the first semester were treated as pilot study data, i.e. serving to elucidate any problems with the data collection procedures or the modified course.

Findings from the First Semester of Data Collection

Following the first semester utilizing the modified Experiential English II course, the researchers examined students' comments on the questionnaires. Based on the data from these, several small changes were made to the content on the Blackboard system in response to research participants' comments. For instance, some announcements and instructions were reworded for clarity, as there were remarks that seemed to indicate students were not able to easily find some of the materials or follow some of the assignments. Links to other websites were checked for accuracy and some content items were rearranged for greater convenience.

As thorough statistical analysis on the SLWAI scores could not be done, it was decided to note the average total score for each group and determine which anxiety level the students, as a whole, fell into. According to Atay and Kurt's (2006) criteria, SLWAI scores may be used to categorize respondents as being at a high anxiety level (an SLWAI score greater than 83), an average anxiety level (an SLWAI score between 58 and 83), or a low anxiety level (an SLWAI score equal to or less than 58). The following table shows findings regarding the anxiety levels of the students, with "BB" referring to the group that was taught using the modified course and "Non-BB" referring to their traditionally taught counterparts.

Table 3. Categorization of mean SLWAI scores of the BB and non-BB group

Group	Mean Score		Categorization
BB	Pre-course SLWAI	64.1	average
	Post-course SLWAI	62.8	average
Non-BB	Pre-course SLWAI	59.6	average
	Post-course SLWAI	63.4	average

As can be seen, both groups started off with mean SLWAI scores that placed them at the average level of anxiety. This did not change at the conclusion of the course. However, it should be noted that a slight drop in the mean SLWAI score occurred in the BB group, while a slight increase was seen in the non-BB group. Though these changes cannot be analyzed statistically, they are still interesting to note. Overall, however, the first semester of data collection did not yield any quantitative results of particular note.

In terms of the qualitative data from the questionnaires, only 20% (n = 39) of respondents elected to answer the open-ended questions, and thus, it was understood that any insights gleaned would likely not be overly representative of the participants. The key insight found upon conducting content analysis on the students responses was suggested avenues for minor changes to the content and delivery of content via Blackboard. The following table shows some sample comments from the respondents (translated from Thai).

Table 4. Sample comments from the first semester respondents

Respondents	Comment
Respondent 8	There should be more interesting media and YouTube videos on the site itself.
Respondent 19	We should be able to download PDFs.
Respondent 22	Some of the materials are not interesting and are hard to find.

It might be noted, however, that within the small amount of responses that were logged, 30.8% of the respondents claimed to enjoy learning using a textbook alone, as opposed to using the textbook augmented by an LMS. One respondent even noted (in English): "Book is always better".

Findings from the Second Semester of Data Collection

It was found that the implementation of a flipped classroom approach via Blackboard did not seem to lead to any quantifiable differences in the second language writing anxiety of the research participants and their peers taking the course without the support of the Blackboard LMS. Statistical analysis using independent samples t-tests determined that the SLWAI scores of BB and non-BB groups were comparable at the start of the course. At the end of the data collection period, the mean writing anxiety level of both groups did show a reduction but when an independent samples t-test was run on the set of scores obtained at the conclusion of the course, no statistically significant difference was found, $t(100) = 1.2$, $p = 0.25$. It would appear then that taking the flipped classroom course delivered via Blackboard did not affect the writing anxiety levels

of the research participants in a discernible way. In the post-course questionnaire, however, some of the respondents made remarks that appeared to refer to their anxiety and how the course affected it. Some of these remarks appeared to point to an positive effect, while some seemed to indicate the course did not have a positive impact on anxiety. A sample of these comments can be seen in the table below.

Table 5. Comments related to anxiety from second semester respondents

Respondents	Comments
Respondent 243	When we take this course, it helps us to destroy the wall of fear of using English.
Respondent 402	This course reduces your fear about English.
Respondent 619	This course made me enjoy and have fun with learning, even though in the first few weeks, I was scared and did not like English.
Respondent 317	Students who do not have writing skills will feel pressure and not want to take this course.
Respondent 591	I want this course to focus on speaking more in order to increase confidence in speaking because some friends still do not feel brave enough to speak English because they are scared of making mistakes.

The first three remarks suggest taking the course may have alleviated these respondents' negative feelings towards the English language and the learning of it. The two last comments, however, appear to point to the course provoking feelings of anxiety. Interestingly, even though one of the aims of the modified course was to reduce writing anxiety by introducing the flipped classroom approach and bringing in the LMS so students could pace their own learning and have constant access to assistance, the second to last comment appears to imply that this goal was not reached. Some students were still concerned when they were asked to engage in writing. The small number of comments that mentioned anxiety or related emotions, however, does not allow a conclusive supposition regarding the impact of the modified course on the participants' writing anxiety.

It must be noted that several difficulties were encountered while undertaking data collection in the second semester, and these no doubt affected the responses that were gathered from the research participants. The first and most impactful issue was the problematic nature of the learning management system used in the investigation. Around the time of data collection, there was an administrative decision for the entire Blackboard learning management system to be upgraded from version 2014 to 2017. There were several problems associated with this upgrade, including some missing information and access issues on the part of both instructors and students. These and other technical issues were the subject of some irritation among the participants of the study. A number pointed out various problems they encountered while using the learning management system. The following are some sample comments regarding difficulties involved with the use of the Blackboard LMS. These are taken from the short post-course open-ended questionnaire and translated to English from Thai. The most baldly explicit condemnation is seen in the last comment.

Table 6. Sample comments regarding difficulties from second semester respondents

Respondents	Comment
Respondent 267	The Blackboard program which is not stable makes it complicated to use.
Respondent 402	Homework cannot be done on an iPad on Blackboard.
Respondent 407	Blackboard should work better; for example, it should allow scrolling up and down on an iPad
Respondent 417	The teacher's various announcements on Blackboard are hard to keep up with.
Respondent 568	Don't use Blackboard. The system is bad.

As can be seen from all of the sample remarks, the technical difficulties attached to the LMS made its use unappealing and frustrating for a number of participants. It was noted that the use of an LMS like Blackboard in tandem with a physical textbook was a preferred mode of study for only 41.6% of the post-course questionnaire respondents, or 300 students from the total 721 that responded to the questionnaire. More in-depth analysis revealed notable results. For example, of the 22 questionnaire respondents from one section that had utilized Blackboard, more than a third (36.4%) revealed they would prefer to learn using *only* the textbook. One respondent went so far as to offer the following criticism of the system, presented here unedited in its original English:

Respondent 496: *Should not include blackboard which is very confusing and technologically complicated to use while studying in the class. I personally think that should have invested time in person to practice intensively about various english skills that needed in national examination field.*

It seems clear this particular respondent did not perceive the positive aspects of the LMS (e.g. ability to work at one's own pace outside of a physical classroom setting) to outweigh the technological drawbacks.

DISCUSSION

The overarching aim of this research was to determine how students perceived the use of a course employing a flipped classroom approach via a commercial learning management system, and how their second language writing anxiety were affected by it. As noted at the beginning of the article, this research is highly exploratory in nature, with a great emphasis on examining the views the students had of the modified course so as to improve later iterations of it. Various studies on the use of the flipped classroom approach have found that it benefits students in manifold ways, such as positively affecting their learning achievement, self-regulation, and self-efficacy (Lai & Hwang, 2016). In this study, the researchers were interested in seeing if the change in how the content of the course was delivered and worked with positively affected students' second language writing anxiety, a concern for this group due to the great importance placed on writing by the course. Overall, no statistically significant differences between the research sample and their counterparts were found in terms of their anxiety levels. As such, the course utilizing a flipped classroom approach aided by an LMS did not seem to impact students' writing anxiety in a discernible manner. It should be noted, though, that while no statistically significant difference was seen between participants learning with the LMS-aided flipped classroom and their counterparts, the mean writing anxiety levels of both groups did drop. This could be taken to mean that the modified course did not lead to a greater degree of anxiety than the regular course. Since anxiety has been linked to negative academic outcomes (Jahin, 2012), the fact that changing the delivery of the course led to a similar outcome in regards to writing anxiety as the traditional course may be seen as slightly promising, as one could implement the modified course with minimal concern for it increasing students' anxiety. Further research may attempt to determine what factors could lead to a significant reduction in writing anxiety when implementing a flipped classroom approach via an LMS. For example, does the ability to engage more with material in class play any part in anxiety reduction, as this has been noted by other researchers as a benefit of the flipped classroom approach (Butt, 2014)?

One of the major limitations of this study was its relatively small sample size, particularly during the second semester of data collection. As noted, participation in the research was on a purely voluntary basis. The research's goals and set-up were publicized to all instructors of the course before the beginning of classes, and although there appeared to be a strong amount of initial interest, ultimately, only a few instructors joined the study, and consequently, only a relatively small number of students were exposed to the modified iteration of the Experiential English II course. Another difficulty in addition to the issue of the relatively small number of participants was the fact that some of the participating instructors seemed to have abandoned the use of Blackboard once the course was underway. That is, some of the earlier assignments and materials were utilized while the later ones were not. What impact this abandonment had on the research results could not be clearly determined and future studies may touch upon how to minimize participant dropout. In future research, it may also be pertinent to determine from the start which participants are, using the terminology of McNally et al. (2017), "flip endorsers" or people with favorable attitudes towards the flipped classroom approach and which are "flip resisters", those who are less likely to favor the flipped classroom approach. The latter group can then be addressed using appropriate measures.

An interesting matter that arose from this research was how technical issues seem to affect perceptions of a course that is delivered via a technological channel; in this case, the commercial learning management system Blackboard. In examining the participants' comments, it was made abundantly clear that technical issues seem to play a strong role in how a technology-aided course is perceived. It might not even be an exaggeration to say that the benefits of the course, as noted in the comments from the research participants, appeared to have been overshadowed in part by the persistent technical issues. Indeed, this is a phenomenon that has been discussed in the literature. Elmaadaway (2017) cautioned that complications could arise in a flipped classroom approach where students are required to watch videos and complete work in an online environment, as these activities might be adversely affected by factors such as Internet connectivity or device functionality. Nah, White, and Sussex (2008) concluded that negative comments regarding a cell phone-accessible site for the practice of listening skills resulted from participants experiencing technical problems while attempting to complete assignments. Hara and Kling (1999) noted in their study of an online graduate course that their participants expressed irritation with some technological aspects of taking a web-based course, such as the inability to download or access materials. The researchers concluded "the substantial frustrations reported by our informants...were not incidental and could actually impede their learning" (para. 1). Contrarily, a technological channel that is perceived in a favorable light could lead to favorable outcomes, such as the personal communication application LINE, used in Chen Hsieh, Wu, and Marek's (2016) research, leading EFL learners to feel their speaking proficiency was improved, their interactions were more effective, and their writing was enhanced.

As can be seen from the comments taken from the questionnaires, the students investigated in this study felt frustration with the technology they were asked to use, pinpointing such problems as the unstable nature of the Blackboard system and certain features being unavailable. While the inability to access the LMS due to the upgrade was unforeseen and unfortunate, other issues may have resulted from the choice of LMS. Analysis of users' views of Blackboard by Zanjani et al. (2017) revealed one of its major drawbacks is its lack of a user-friendly interface. Although assignment instructions were made available in what were deemed highly visible parts of the interface, some students may have required additional guidance in navigating it. Additional guidance may have also been necessary because it has been noted Thai students may not be used to operating on their own in an active learning context, such as one created by using a flipped classroom approach (Suranakkharin, 2017; Thaichay & Sitthitikul, 2016). Suranakkharin (2017), in a study of using the flipped classroom approach to help Thai EFL learners master English collocations, discussed the importance of having a facilitator in the success of flipped classroom instruction and subsequent student perceptions. Future research might focus on the provision of better technological and overall support, and how it impacts participants' perceptions.

CONCLUSION

Overall, it would seem that when choosing to incorporate technology into the teaching and learning process, great care must be taken to offer consistent technical support and prepare alternative plans in scenarios where the technological option is simply not viable. This is one of the major insights gained from this research and further research should explore how to minimize these technical issues so as to help students fully benefit from a course that utilizes a technological component. Whether the technical issues they experienced affected the students' writing anxiety level or other factors was not investigated in this research, but may also be a fascinating avenue of study to pursue.

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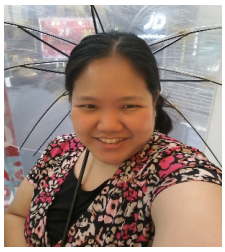

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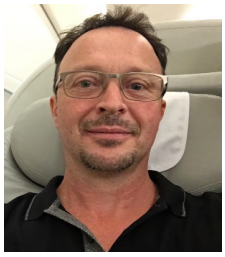

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IMPACT OF THE WEB APPLICATION FOR THE EDUCATIONAL PROCESS ON THE COMPOUND INTEREST CONSIDERING DATA SCIENCE

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ABSTRACT

This quantitative research analyzes the impact of the Web Application for the Educational Process on Compound Interest (WAEPCI) considering the machine learning and data science. The sample is composed of 46 students who studied the Financial Mathematics course in a Mexican university during the 2017 school year. WAEPCI presents the calculation of the Compound Interest and Compound Amount over a period of four years through the data simulation. The results of the machine learning (linear regression) indicate that WAEPCI positively influences the assimilation of knowledge and development of mathematical skills on the Compound Interest and Compound Amount. Data science establishes 4 predictive models on the use of WAEPCI in the educational process by means of the decision tree technique. The construction of web applications facilitates the active role of students, improves the assimilation of knowledge and allows the development of skills. Finally, WAEPCI improves the teaching-learning conditions on Financial Mathematics through the data simulation.

Keywords: Technology, higher education, web application, machine learning, data science.

INTRODUCTION

Technology is transforming the planning and organization of school activities through the construction and use of virtual spaces for learning and teaching (Gezgin, 2019; Mishra & Iyer, 2015; Yeoman & Ashmore, 2018). In particular, Information and Communication Technologies (ICT) are modifying the behavior of teachers and students during the educational process (Blaine, 2019; Lee, Yeung & Cheung, 2019; Mei & May, 2018).

Educational institutions must update pedagogical strategies through digital tools in order to meet the needs and demands of students (Carvalho & Yeoman, 2018; Rooney & Nystrom, 2018; Zeivots & Schuck, 2018). The use of technology such as videos, audiovisual contents and digital tools allows achieving the active role of students during the learning process (Le & Pinkwart, 2015).

Young teachers are more frequently using technological tools in the educational process because these individuals have developed digital skills (Ayale-Perez & Joo-Nagata, 2019). For example, Facebook improved communication and participation among students through the dissemination of school activities (Salas-Rueda & Salas-Rueda, 2019).

In fact, the incorporation of web applications in the classroom positively influences the teaching-learning process (Jack & Higgins, 2019; Scardamalia & Bereiter, 2014). Due to technological advances, teachers have the possibility to use a wide variety of educational applications on the Internet (Hughes & Dobbins, 2015; Marcel, 2019; Spector, 2014). For example, interactive multimedia systems and mobile applications favor the active role of students during the learning process (Bdiwi, Runz, Faiz, & Cherif, 2019).

One of the educational challenges in the 21st century is the creation of virtual spaces to improve teaching-learning conditions (Bidarra & Rusman, 2017; Doney, 2019). Therefore, this quantitative research proposes the construction of WAEPCI to improve teaching-learning conditions on financial mathematics.

The research questions are:

- What is the impact of WAEPCI on the assimilation of knowledge and development of mathematical skills on Compound Interest and Compound Amount?
- What are the predictive models on the use of WAEPCI in the teaching-learning process?

WEB APPLICATIONS IN THE EDUCATIONAL FIELD

The educational institutions are modifying the curricula in order to develop the competences of students through the technological tools (Herodotou, Heiser, & Rienties, 2017; Marshalsey & Sclater, 2018). In particular, universities face the challenge of improving the teaching-learning conditions through the construction of new virtual spaces (Marcel, 2019; Wang & Wang, 2017).

Web applications positively influence the participation of students during the educational process and encourage new ways to achieve the learning (Blaine, 2019; Zeivots & Schuck, 2018). In particular, Bdiwi, Runz, Faiz and Cherif (2019) propose to improve the educational process through the use of sensors, smart devices, web applications and Internet services.

The digital tools facilitate the planning and realization of educational activities centered on students (Mei & May, 2018). In fact, Internet is changing the functions and roles of teachers through the sending and receiving of information on the network (Ramadan, 2016).

Use and Construction of Web Applications

The design and construction of web applications is changing the way of carrying out the school activities (Mei & May, 2018). In particular, Salas-Rueda, Salas-Rueda, Salas-Rueda and Vargas-Perez (2019) designed a web application to facilitate the assimilation of knowledge during the educational process of statistics. Likewise, Noguchi, Kogure, Konishi and Itoh (2015) built an intelligent tutoring system called Intelligent Practice Supporting System (IPSS) with the purpose of improving the teaching-learning conditions in chemistry courses through the personalization of the contents.

The use of web applications in the educational field increases the motivation of students during the performance of the school activities (Zeivots & Schuck, 2018). For example, Salas-Rueda and Salas-Silis (2018) used the Logic.ly simulator in the classroom in order to facilitate the educational process on mathematics and increase motivation of the students.

Several authors (e.g., Gauthier & Jenkinson, 2018; Ke, 2014; Yeh, Chang & Chen, 2019) have built web applications to facilitate the teaching-learning process. Yeh, Chang and Chen (2019) built a digital game to improve educational conditions through interaction, rewards and feedbacks. In the field of biology, Gauthier and Jenkinson (2018) designed and implemented a web application to improve the assimilation of knowledge and development of skills about molecular environments.

Daradoumis, Marques-Puig, Arguedas and Calvet-Liñan (2019) designed a web tool to improve the performance of students in the field of information technology through the personalization of content. Also, Ke (2014) built an application to facilitate the teaching-learning process about mathematics at the basic educational level.

Finally, technology is modifying the activities carried out in formal and informal education contexts (Chorana, Lakhdari, Cherroun, & Oulad-Naoui, 2015). For example, the creation of web applications facilitates the assimilation of knowledge, allows the development of skills and increases the motivation of students during the learning process (Gauthier & Jenkinson, 2018; Yeh, Chang, & Chen, 2019).

METHOD

This quantitative research aims to analyze the impact of WAEPCI in the teaching-learning process about Financial Mathematics through the machine learning and data science. WAEPCI presents the calculation of the Compound Interest and Compound Amount over a period of four years by means of the data simulation.

Participants

The sample consists of 46 students who studied the Financial Mathematics course in a Mexican university during the 2017 school year. The participants, 26 women and 20 men, attended the careers of Administration (n=20, 43.48%), Marketing (n= 10, 21.74%) and Commerce (n=16, 34.78%).

Procedure

The procedure began with the design and construction of WAEPCI through the PHP programming language. Figure 1 shows the data requested by WAEPCI (Capital and Interest rate).

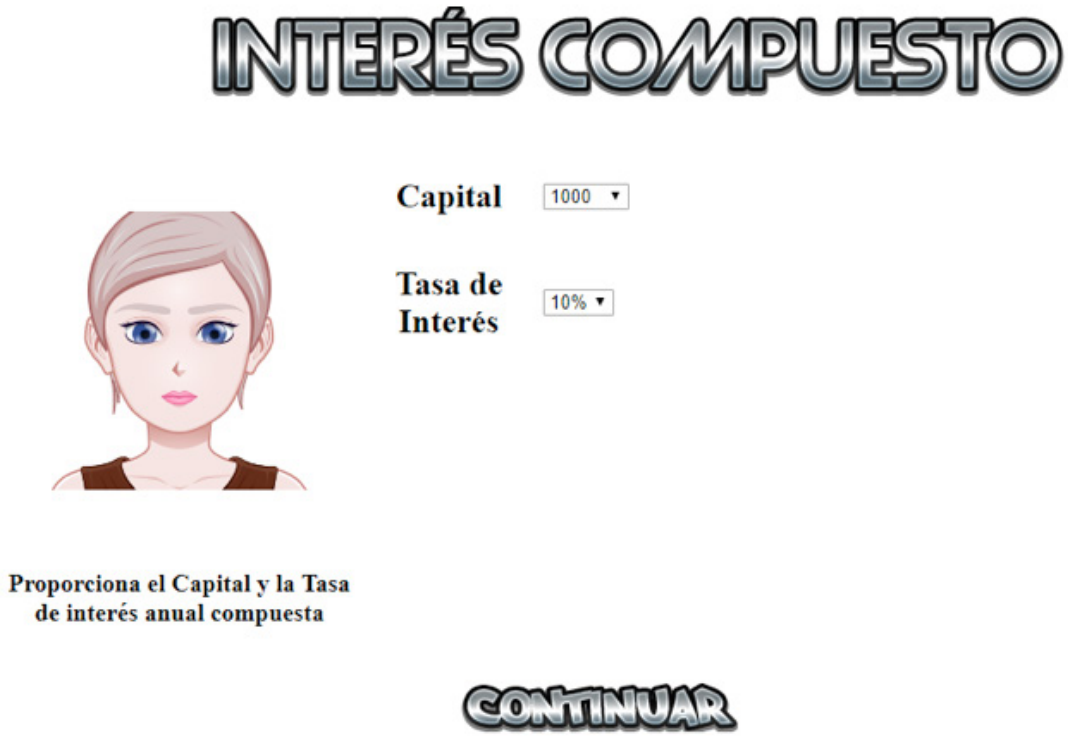

Figure 1. Homepage of WAEPCI

WAEPCI is available at the following web address: http://sistemasusables.com/matfin/sistema1/inicio.html

Figure 2 shows the data simulation of the Compound Interest and Compound Amount in WAEPCI for the year 1.

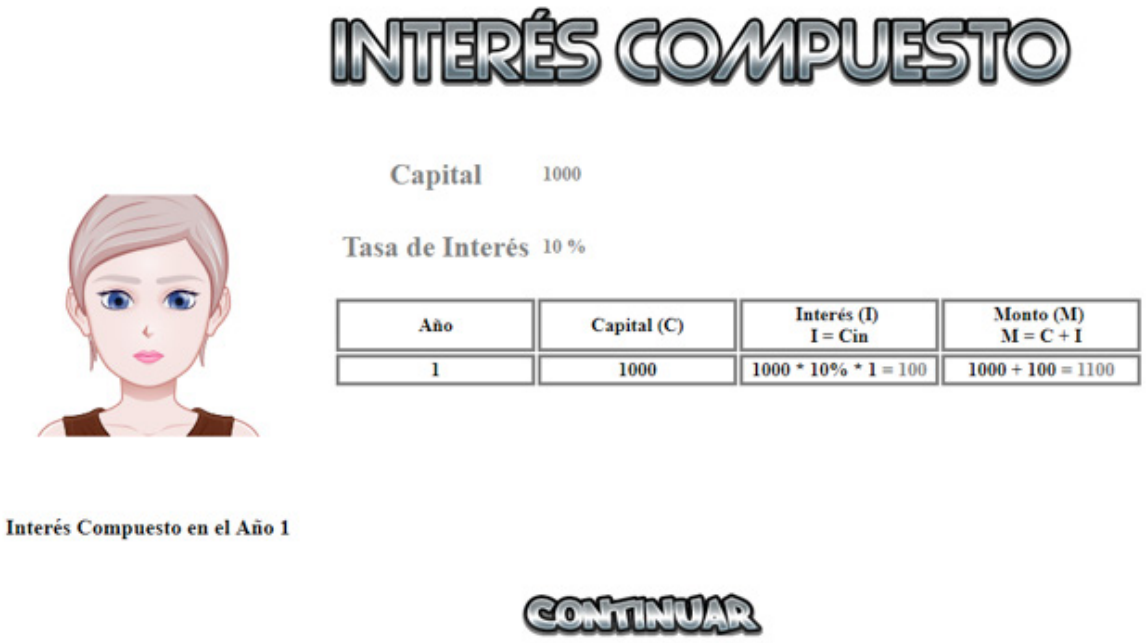

Figure 2. Compound Interest and Compound Amount in WAEPCI for the year 1

WAEPCI presents the calculation of the Compound Interest and Compound Amount for the year 2.

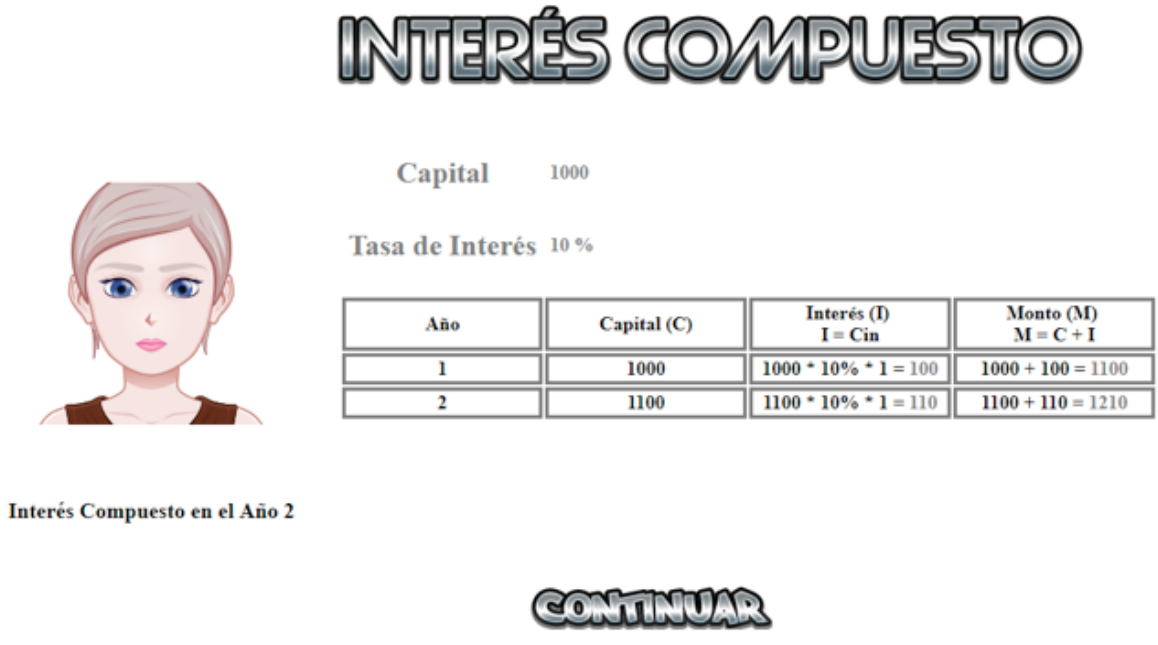

Figure 3. Compound Interest and Compound Amount in WAEPCI for the year 2

WAEPCI presents the data simulation on the Compound Interest and Compound Amount for the year 3 (See Figure 4).

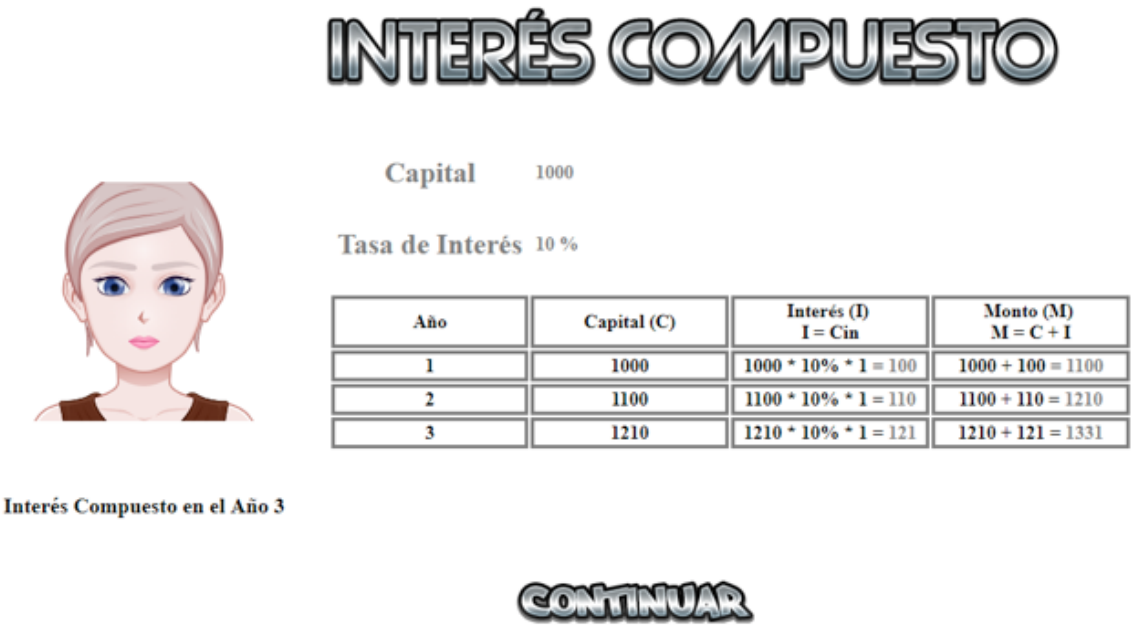

Figure 4. Compound Interest and Compound Amount in WAEPCI for the year 3

Finally, Figure 5 shows the calculation of the Compound Interest and Compound Amount in WAEPCI for the year 4.

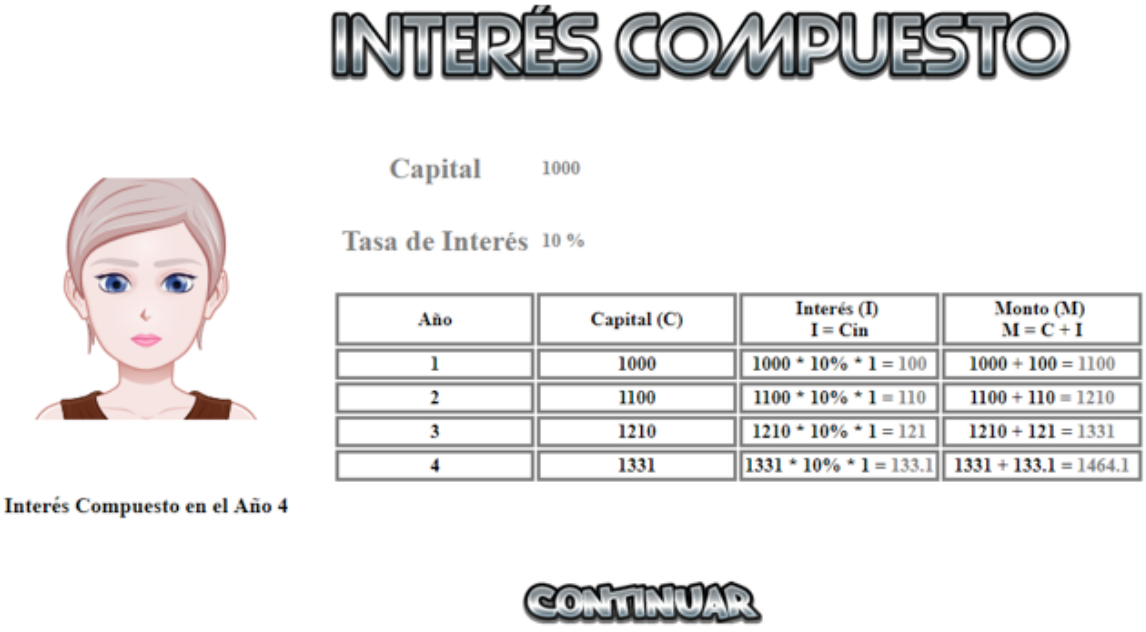

Figure 5. Compound Interest and Compound Amount in WAEPCI for the year 4

Figure 6 shows the technological acceptance model used in this quantitative research.

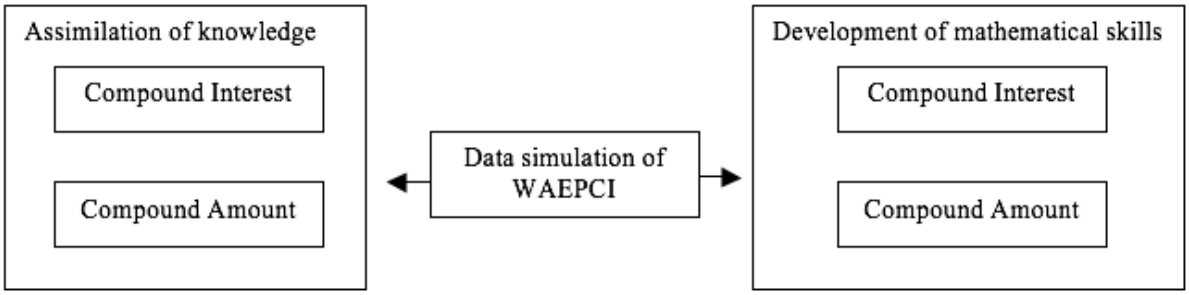

Figure 6. Technological acceptance model of WAEPCI

The research hypotheses about the impact of WAEPCI in the teaching-learning process are:

- Hypothesis 1 (H1): Data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Interest
- Hypothesis 2 (H2): Data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Amount
- Hypothesis 3 (H3): Data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Interest
- Hypothesis 4 (H4): Data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Amount

Information about the career, age, sex of the students, data simulation of WAEPCI and the teaching-learning process is used during the construction of the predictive models (decision tree technique).

The predictive models on the use of WAEPCI in the teaching-learning process are:

- Predictive model 1 on WAEPCI and assimilation of knowledge (Compound Interest)
- Predictive model 2 on WAEPCI and assimilation of knowledge (Compound Amount)
- Predictive model 3 on WAEPCI and development of mathematical skills (Compound Interest)
- Predictive model 4 on WAEPCI and development of mathematical skills (Compound Amount)

Data Analysis

The Rapidminer tool allows the calculation of the machine learning (linear regression) and construction of the predictive models by means of the decision tree technique (data science). Machine learning uses the training section to calculate the linear regressions and evaluate the hypotheses of this research, that is, 50% (n = 23 students), 60% (n = 27 students) and 70% (n = 32 students) of the sample allow knowing the impact of WAEPCI in the teaching-learning process. On the other hand, the evaluation section with 50% (n = 23 students), 40% (n = 19 students) and 30% (n = 14 students) of the sample allows identifying the accuracy of these linear regressions by means of the calculation on the squared error. (See Figure 7).

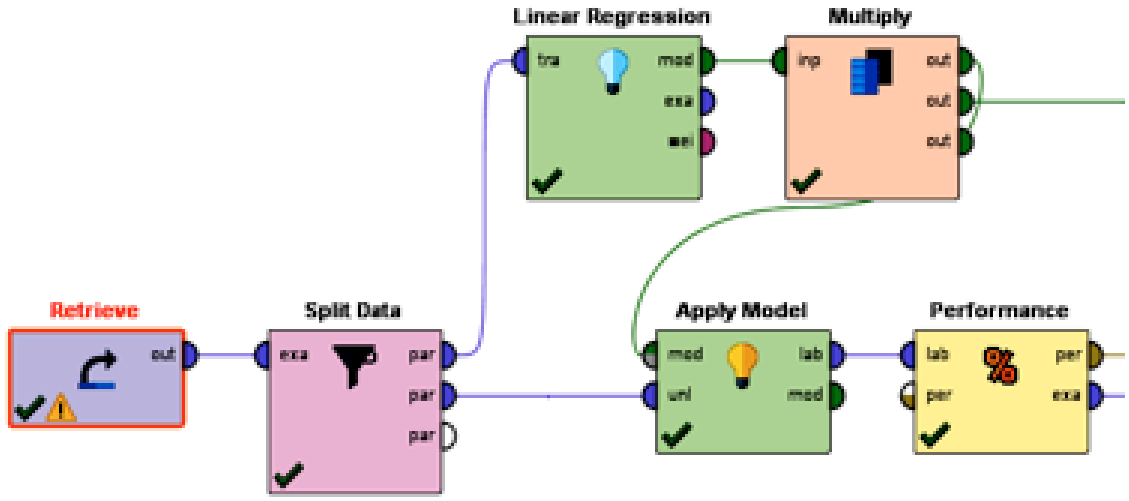

Figure 7. Machine learning in the Rapidminer tool

Figure 8 shows the use of the Rapidminer tool for the construction of predictive models by means of the decision tree technique.

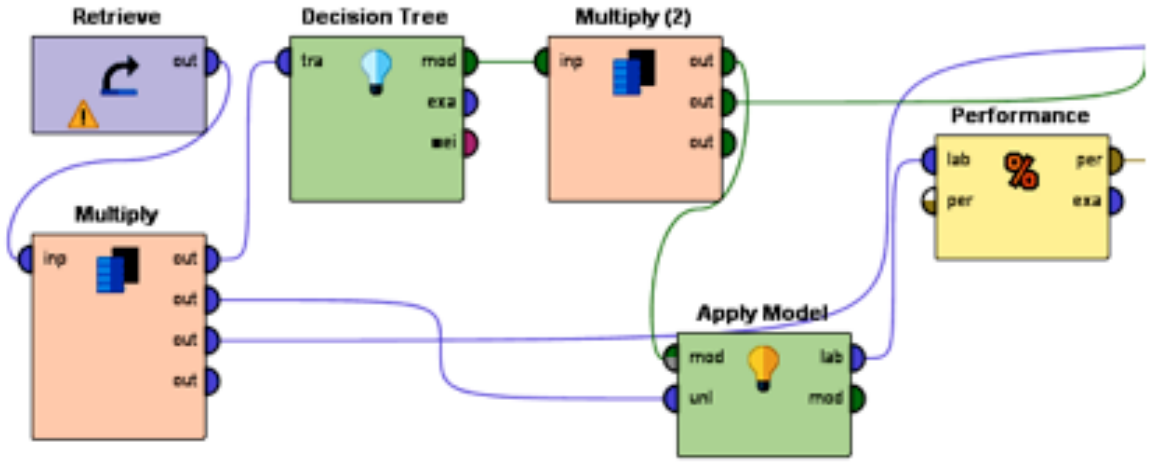

Figure 8. Predictive models in the Rapidminer tool

Data Collection

Table 1 shows the measurement instrument used for the collection of data about the use of WAEPCI in the teaching-learning process.

Table 1. Questionnaire

Variable	Dimension	Question	Answer	n	%
Profile of student	Career	1. Indicate your career			
			Administration	20	43.48%
			Commerce	16	34.78%
			Marketing	10	21.74%
	Sex	2. Indicate your sex			
			Man	20	43.48%
			Woman	26	56.52%
	Age	3. Indicate your age			
			18 years	4	8.70%
			19 years	20	43.48%
			20 years	14	30.43%
			21 years	4	8.70%
			22 years	4	8.70%
			23 years	0	0.00%
			24 years	0	0.00%
WAEPCI	Data simulation	4. Data simulation of WAEPCI is			
			Excellent (1)	30	65.22%
			Good (2)	14	30.43%
			Bad (3)	2	4.35%
Assimilation of knowledge	Compound Interest	5. The use of WAEPCI influences the assimilation of knowledge about the Compound Interest	Too much (1)	29	63.04%
			Much (2)	13	28.26%
			Little (3)	4	8.70%
	Compound Amount	6. The use of WAEPCI influences the assimilation of knowledge about the Compound Amount.	Too much (1)	30	65.22%
			Much (2)	12	26.09%
			Little (3)	4	8.70%
Development of mathematical skills	Compound Interest	7. The use of the WAEPCI influences the development of mathematical skills about the Compound Interest	Too much (1)	38	82.61%
			Much (2)	6	13.04%
			Little (3)	2	4.35%
	Compound Amount	8. The use of WAEPCI influences the development of mathematical skills about the Compound Amount	Too much (1)	31	67.39%
			Much (2)	13	28.26%
			Little (3)	2	4.35%

The data collection was done at the end of the Compound interest unit in the 2017 school year. Also, Cronbach's alpha for the Assimilation of knowledge (0.628) and Development of mathematical skills (0.824) are greater than the value of 0.620.

RESULTS

Data simulation of WAEPCI positively influences the assimilation of knowledge and development of mathematical skills about the Compound Interest and Compound Amount (See Table 2).

Table 2. Results of the machine learning (linear regression)

Hypothesis	Training	Linear regression	Conclusion	Squared error
H1: WAEPCI → Assimilation of knowledge about the Compound Interest	50%	y = 0.886x + 0.250	Accepted: 0.886	0.132
	60%	y = 0.909x + 0.197	Accepted: 0.909	0.163
	70%	y = 0.930x + 0.160	Accepted: 0.930	0.207
H2: WAEPCI → Assimilation of knowledge about the Compound Amount	50%	y = 0.721x + 0.312	Accepted: 0.721	0.215
	60%	y = 0.744x + 0.283	Accepted: 0.744	0.265
	70%	y = 0.743x + 0.360	Accepted: 0.743	0.165
H3: WAEPCI → Development of mathematical skills about the Compound Interest	50%	y = 0.647x + 0.375	Accepted: 0.647	0.179
	60%	y = 0.559x + 0.506	Accepted: 0.559	0.148
	70%	y = 0.677x + 0.360	Accepted: 0.677	0.183
H4: WAEPCI → Development of mathematical skills about the Compound Amount	50%	y = 0.664x + 0.437	Accepted: 0.664	0.209
	60%	y = 0.629x + 0.444	Accepted: 0.629	0.240
	70%	y = 0.693x + 0.400	Accepted: 0.693	0.220

Assimilation of Knowledge

The use of WAEPCI influences too much (n=29, 63.04%), much (n=13, 28.26%) and little (n=4, 8.70%) the assimilation of knowledge about the Compound Interest (See Table 1). Also, the results of machine learning (linear regression) with 50% (0.886), 60% (0.909) and 70% (0.930) of training indicate that hypothesis 1 is accepted (See Table 2). Therefore, data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Interest.

Figure 9 shows the predictive model 1 on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a man and has an age > 19.5 years then the use of WAEPCI influences much the assimilation of knowledge about the Compound Interest.

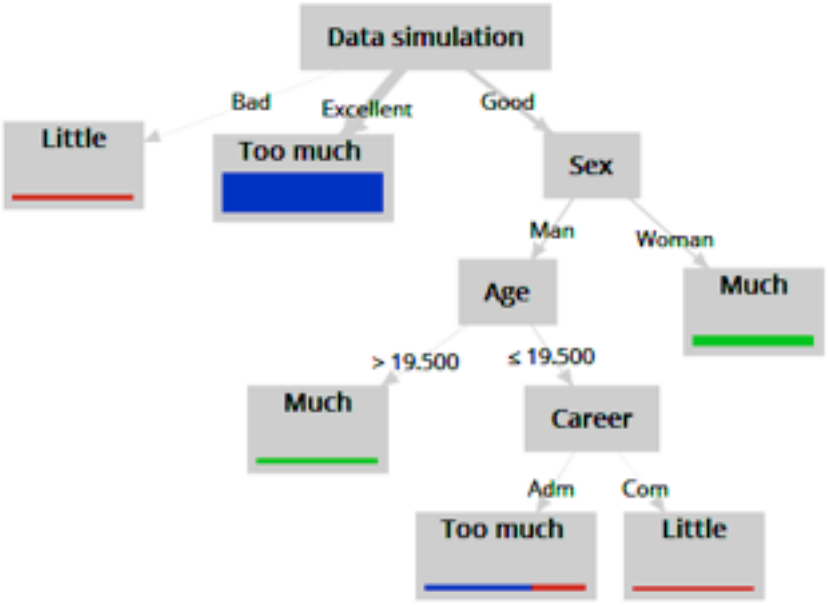

Figure 9. Predictive model 1 on the use of WAEPCI

The predictive model 1 has the accuracy of 97.83% and presents 6 conditions on the use of WAEPCI (See Table 3). For example, if the student considers that data simulation of WAEPCI is good and is a woman then the use of WAEPCI influences much the assimilation of knowledge about the Compound Interest.

Table 3. Conditions of the predictive model 1

No.	Data simulation of WAEPCI	Career	Sex	Age	Assimilation of knowledge (Compound interest)
1	Good	-	Man	> 19.5 years	Much
2	Good	Administration	Man	≤ 19.5 years	Too much
3	Good	Commerce	Man	≤ 19.5 years	Little
4	Good	-	Woman	-	Much
5	Excellent	-	-	-	Too much
6	Bad	-	-	-	Little

The use of WAEPCI influences too much (n=30, 65.22%), much (n=12, 26.09%) and little (n=4, 8.70%) the assimilation of knowledge about the Compound Amount (See Table 1). Also, the results of machine learning with 50% (0.721), 60% (0.744) and 70% (0.743) of training indicate that hypothesis 2 is accepted (See Table 2). Therefore, data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Amount. Figure 10 shows the predictive model 2 on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a woman and takes career of the Administration then the use of WAEPCI influences too much the assimilation of knowledge about the Compound Amount.

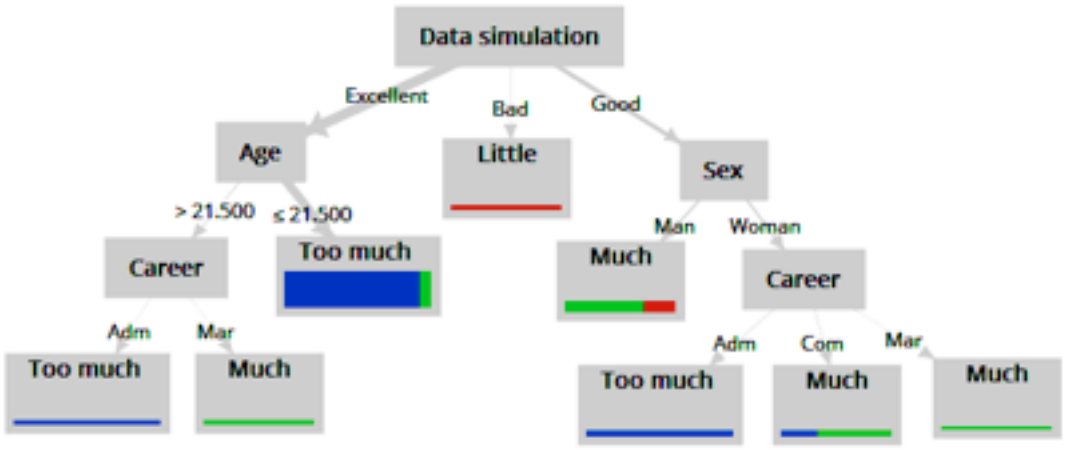

Figure 10. Predictive model 2 on the use of WAEPCI

The predictive model 2 has the accuracy of 89.13% and presents 8 conditions on the use of WAEPCI (See Table 4). For example, if the student considers that data simulation of WAEPCI is good and is a man then the use of WAEPCI influences much the assimilation of knowledge about the Compound Amount.

Table 4. Conditions of the predictive model 2

No.	Data simulation of WAEPCI	Career	Sex	Age	Assimilation of knowledge (Compound Amount)
1	Good	-	Man	-	Much
2	Good	Administration	Woman	-	Too much
3	Good	Commerce	Woman	-	Much
4	Good	Marketing	Woman	-	Much
5	Bad	-	-	-	Little
6	Excellent	Administration	-	> 21.5 years	Too much
7	Excellent	Marketing	-	> 21.5 years	Much
8	Excellent	-	-	≤ 21.5 years	Too much

Development of Mathematical Skills

The use of the WAEPCI influences too much (n=38, 82.61%), much (n=6, 13.04%) and little (n=2, 4.35%) the development of mathematical skills about the Compound Interest (See Table 1). Also, the results of machine learning with 50% (0.647), 60% (0.559) and 70% (0.677) of training indicate that hypothesis 3 is accepted (See Table 2). Therefore, data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Interest.

Figure 11 shows the predictive model 3 on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a woman and takes the career of Commerce then the use of the WAEPCI influences too much the development of mathematical skills about the Compound Interest.

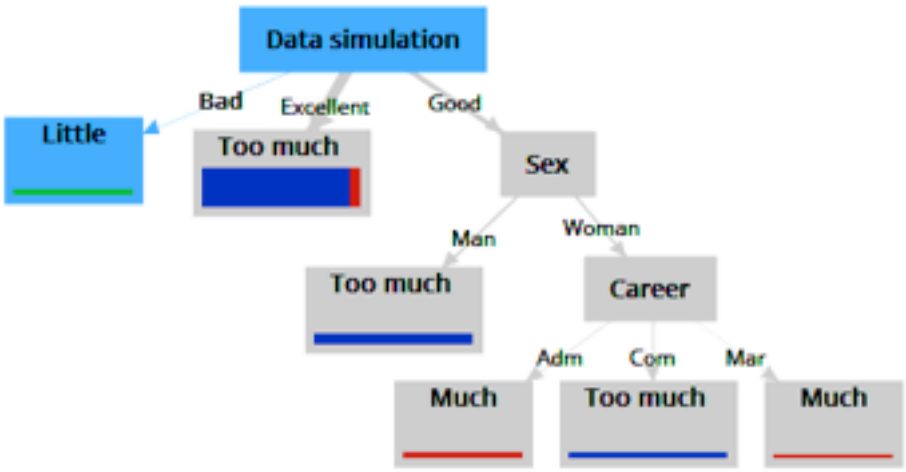

Figure 11. Predictive model 3 on the use of WAEPCI

The predictive model 3 has the accuracy of 95.65% and presents 6 conditions on the use of WAEPCI (See Table 5). For example, if the student considers that data simulation of WAEPCI is good and is man then the use of the WAEPCI influences too much the development of mathematical skills about the Compound Interest.

Table 5. Conditions of the predictive model 3

No.	Data simulation of WAEPCI	Career	Sex	Age	Development of mathematical skills about Compound Interest
1	Good	-	Man	-	Too much
2	Good	Administration	Woman	-	Much
3	Good	Commerce	Woman	-	Too much
4	Good	Marketing	Woman	-	Much
5	Excellent	-	-	-	Too much
6	Bad	-	-	-	Little

The use of WAEPCI influences too much (n=31, 67.39%), much (n=13, 28.26%) and little (n=2, 4.35%) the development of mathematical skills about the Compound Amount (See Table 1). Also, the results of machine learning with 50% (0.664), 60% (0.629) and 70% (0.693) of training indicate that hypothesis 4 is accepted (See Table 2). Therefore, data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Amount.

Figure 12 shows the predictive model 4 on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a man and takes the career of Commerce then the use of WAEPCI influences too much the development of mathematical skills about the Compound Amount.

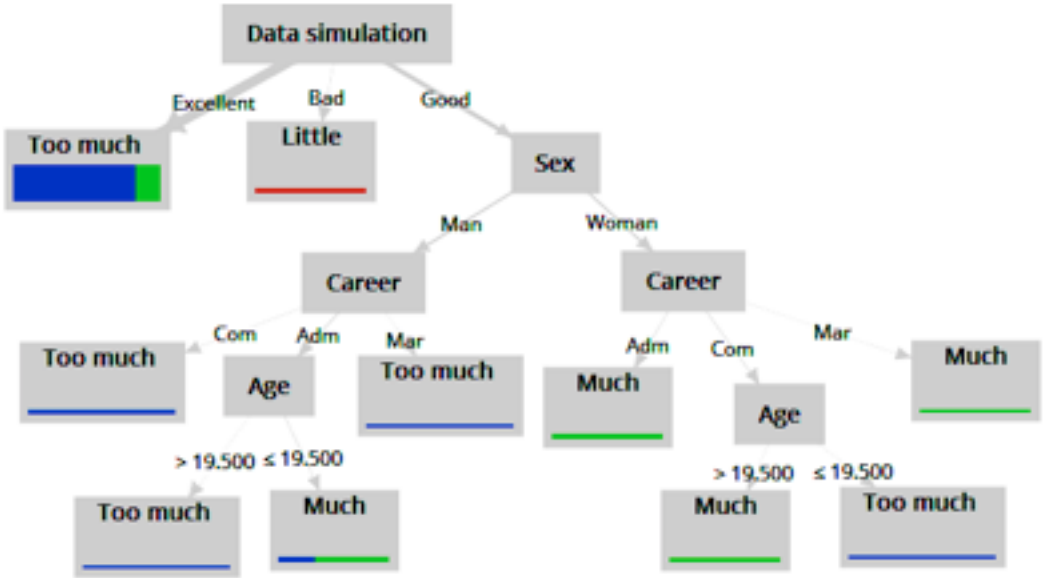

Figure 12. Predictive model 4 on the use of WAEPCI

The predictive model 4 has the accuracy of 86.96% and presents 10 conditions on the use of WAEPCI (See Table 6). For example, if the student considers that data simulation of WAEPCI is good, is a man and takes the career of Marketing then the use of WAEPCI influences too much the development of mathematical skills about the Compound Amount.

Table 6. Conditions of the predictive model 4

No.	Data simulation of WAEPCI	Career	Sex	Age	Development of mathematical skills about the Compound Amount
1	Good	Commerce	Man	-	Too much
2	Good	Administration	Man	> 19.5 years	Too much
3	Good	Administration	Man	≤ 19.5 years	Much
4	Good	Marketing	Man	-	Too much
5	Good	Administration	Woman	-	Much
6	Good	Commerce	Woman	> 19.5 years	Much
7	Good	Commerce	Woman	≤ 19.5 years	Too much
8	Good	Marketing	Woman	-	Much
9	Excellent	-	-	-	Too much
10	Bad	-	-	-	Little

DISCUSSION

The design, construction, use and implementation of web applications allow updating school activities inside and outside the classroom (Alderete, 2017; Barclay, Donalds, & Osei-Bryson, 2018; Jong, Sotiriou, & Gillet, 2014). For example, WAEPCI presents the calculation of the Compound Interest and Compound Amount over a period of four years by means of the data simulation.

Assimilation of Knowledge

The results of the machine learning for the Hypothesis 1 are greater than the value of 0.886. Therefore, data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Interest.

Also, the predictive model 1 presents 6 conditions on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a man and has an age > 19.5 years then the use of WAEPCI influences much the assimilation of knowledge about the Compound Interest.

On the other hand, the results of the machine learning for the Hypothesis 2 are greater than the value of 0.720. Therefore, data simulation of WAEPCI positively influences the assimilation of knowledge about the Compound Amount.

Also, the predictive model 2 presents 8 conditions on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a woman and takes career of the Administration then the use of WAEPCI influences too much the assimilation of knowledge about the Compound Amount. In fact, data simulation of WAEPCI has more influence on the assimilation of knowledge about the Compound Interest.

Development of Mathematical Skills

Several authors (e.g., Radovic, Maric, & Passey, 2019; Willis, Lynch, Fradale, & Yeigh, 2019) explain that technological tools facilitate the development of skills in the educational field. The results of the machine learning for the Hypothesis 3 are greater than the value of 0.558. Therefore, data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Interest.

Also, the predictive model 3 presents 6 conditions on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a woman and takes the career of Commerce then the use of the WAEPCI influences too much the development of mathematical skills about the Compound Interest.

On the other hand, the results of the machine learning for the Hypothesis 4 are greater than the value of 0.628. Therefore, data simulation of WAEPCI positively influences the development of mathematical skills about the Compound Amount.

Also, the predictive model 4 presents 10 conditions on the use of WAEPCI in the teaching-learning process. For example, if the student considers that data simulation of WAEPCI is good, is a man and takes the career of Commerce then the use of WAEPCI influences too much the development of mathematical skills about the Compound Amount. In fact, data simulation of WAEPCI has more influence on the development of mathematical skills about the Compound Amount.

Finally, technology is modifying the planning and organization of school activities in the 21st century (Kalolo, 2019; Mishra & Iyer, 2015; Terziyan, Golovianko, & Shevchenko, 2015). In particular, WAEPCI is a web application that facilitates the educational process on financial mathematics by means of the data simulation.

CONCLUSION

WAEPCI facilitates the assimilation of knowledge and development of mathematical skills on Compound Interest and Compound Amount. The results of machine learning with 50%, 60% and 70% of training indicate that WAEPCI positively influences the educational process on financial mathematics.

Data science identified 4 predictive models on the use of WAEPCI in the teaching-learning process through the decision tree technique. The accuracy of these predictive models presents an accuracy higher than 86.90%.

This research recommends the construction of web applications to achieve the active role of students through the data simulation. Also, teachers can incorporate technological tools in and out the classroom in order to develop the competencies of students.

The limitations of this research are the size of the sample and use of WAEPCI in the topics of Compound Interest and Compound Amount. Therefore, future research can build web applications that facilitate the educational process on annuities, amortizations and depreciation. Likewise, teachers can use digital games and web applications in the educational field with the purpose of creating new virtual spaces for learning.

The implications of this research are related to the use of technology in school activities to improve teaching-learning conditions. For example, WAEPCI is a web application that facilitates the assimilation of knowledge and allows the development of mathematical skills on financial mathematics.

Finally, educational institutions can modify the functions and activities of teachers and students through technological tools and media of communication. In particular, WAEPCI transforms the teaching-learning process on financial mathematics through the data simulation on the Compound Interest and Compound Amount.

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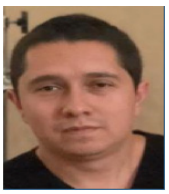

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TOYS FOR THE BOYS, TOOLS FOR THE GIRLS? GENDER AND MEDIA USAGE PATTERNS IN HIGHER EDUCATION

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ABSTRACT

Since the introduction of digital media the fear of women being left out of the virtual world is expressed in various contexts. With the aim to establish if these gender differences still exist and, if they do, what form they take this paper investigates the use of digital media by male and female higher education students. 1,327 students enrolled at German higher education institutions completed an online questionnaire concerning the digital devices that they own or have access to, and their usage of media and e-learning tools and services for their learning. Using multivariate analysis, the study indicates that male students show higher acceptance values for more general web tools higher than female students, but when it comes to e-learning related tools women show higher acceptance values for a lot more different tools and services than men. The findings indicate that differences in media usage patterns between male and female students are not a question of having access, but of the attitude toward and the reasons for using digital media, and that the mentioned fear of women being left out did not come true.

Keywords: Gender differences, Media usage behaviour, Digital technology, Digital media, Higher education

INTRODUCTION

Digital media are omnipresent in almost every aspect of society and decisively shape the everyday life of information and knowledge societies. Politicians, as well as educators, demand that students at every educational level become proficient in digital media, as digital literacy is considered an indispensable condition for participating in (continuing) education, professional development and communication (BMWi, BMI & BMVI, 2014; Stalder, 2016; Adams Becker et al., 2017).

Today, student access to the necessary technologies is taken for granted. There has been a rapid proliferation of mobile devices and Internet connectivity throughout Western industrialized societies (bpb, 2016), and university campuses are usually well equipped with freely accessible information and communication technologies, including wireless LAN in student rooms in dormitories (Lehmann, 1999; Glenn & D'Agostino, 2008; Roberge & Gagnon, 2014; Jisc & EDUCAUSE, 2015). The importance of technology is high for Open and Distance Learning in general and for e-learning in particular (Bates, 1995; DeVolder 1996; Conole 2014). Computers and the Internet are used in universities for administrative purposes (e.g. registration, updating information, submitting assignments and receiving feedback), for teaching (e.g. streaming lectures, providing supplementary study material, experiments and tests), for research (e.g. searching library catalogues, Internet searches, online surveys), and for communication and collaboration (e.g. chats, guided discussions, study groups, video-conferences). Zawacki-Richter (2012) states that e-learning established itself within German higher education institutions from the beginning of the 21st century, with e-learning implemented in addition to traditional teaching and learning formats. But, due to the high density of campus-based universities, distance education still plays a minor role in the German-speaking area (Zawacki-Richter, 2012).

To ensure a meaningful application of digital media it is not enough to gear the development toward the technically feasible, but rather to challenge their pedagogical implementation into formal teaching

and learning processes (Zawacki-Richter, 2015). The knowledge of media usage patterns and perceived usefulness by higher education students is vital, in order to inform the media selection and digital alignment of universities.

Digital media offer more flexible learning opportunities that are independent of time and space, thus expanding access to higher and continuing education (Vollmeyer & Imhof, 2007). With the advent of electronic media and information and communication technologies there was increasing concern about the greater affinity and access of men to technology and the possibility of women being left out of the virtual world (Broos, 2005; Cooper, 2006; Vollmeyer & Imhof, 2007). This trend is also confirmed by a representative study in Germany which concludes that the digital divide between gender and age groups has not been overcome so far and requires great attention (Initiative D21, 2017). Thus, the aim of this paper is to explore the current patterns of student media use and the extent to which gender differences persist and, if they do, what form they take. This can then lead to suggestions for strategic media development to improve the use of digital media at higher education institutions.

GENDER AND DIGITAL MEDIA

Following Bourdieu (1997), gender-specific differences in the media usage of women and men can be explained with a different habitus of women and men. The habitus is determined by social experiences encompassing the socialisation. In the context of media use, social experiences can be influenced by stereotypical gender attributions, for example, that technology and science have traditionally been seen as male domains all but inaccessible to women, especially as developers (Kramarae, 2001). Furthermore, technology is often associated with masculinity and the under-representation or invisibility of women explained within terms of a masculine culture (Wajcman, 1991). Following a traditional gender attribution, men claim technology as their field of knowledge and try to maintain their dominance (Luca, 2010). Complementing the stereotypical gender attribution, students' private lives have to be taken into account. The still existing gendered division of labour, results in women having more domestic and childcare responsibilities than men which means that women, who often also hold a job outside the home, have to meet multiple commitments (von Prummer, 2008). Hence, women have less time for studying in general and getting used to using digital media for studying in particular.

Gender is discussed and shown to be a pivotal principle of order for media usage differences in various contexts for a long period of time, though research into gender issues in e-learning has yielded divergent results concerning the participation of women in e-learning:

On the one hand, gender differences in the use of digital media seem to have all but disappeared, as women and men have equal access to the new media and Internet. In a study of media usage of students at an English distance teaching university, Price (2006) comes to the conclusion that women "may outperform their male counterparts online" and "do not have reduced computer and Internet access compared with men" (p. 357). A survey of business students at four German-speaking (3 German, 1 Swiss) universities by Remmele & Holthaus (2013) finds that e-learning usage patterns of women and men in higher education have become similar. Fallows (2005) states that for the U.S. population women somewhat outnumber men in access to the Internet, but she also points out that access does not equal the amount of time spent and ways in which it is used.

On the other hand, women have been found to have less access and less inclination to utilise digital media, or they use it for different purposes than their more technology-oriented male peers. A survey of the German resident population 14+ years old (Initiative D21, 2017) shows that more men (86 %) than women (77 %) use the Internet. A similar relation applies for the use of the mobile Internet (m 69 %, w 59 %). When it comes to knowledge of digital terminology, men also outperform women by far (Initiative D21, 2017). In a Belgian survey Broos (2005) finds "significant gender differences regarding attitudes toward new communications technology, extent of computer use, and self-perceived computer experience favouring males" (p. 29). Similar to the results of the Initiative D21 survey (2017), men spend more time using a computer, are less anxious about and have a more positive attitude toward digital media than women (Broos, 2005). Moreover, differences in the way of use of social network sites, that are considered to play an active role in peoples' daily lives (Smith & Anderson, 2018; Initiative D21, 2017; Albert et al., 2015), are

observed for male and female students. Park, Kee & Valenzuela (2009) show that "female students […] are more likely to use the Facebook Groups for obtaining information" (p. 731) than male students. Looking at four different usage purposes Mazman & Usluel (2011) showed that Facebook is more often used for 'maintaining existing relationships', 'academic usage' and 'following agenda' by women, while men use it more often for 'making new relationships'.

For new students at higher education institutions in Switzerland, Martin (2012) proves a correlation between gender and software skills in the use of digital media. Women evaluate their software skills significantly lower than men and have a more negative attitude toward digital media (Martin, 2012). For German higher education students Kleimann et al. (2005) also find gender specific differences in the evaluation of the students' skills. Only for emails the same amount of males and females (98 %) consider themselves to possess good skills. In all other dimensions, for example the Internet (m 96 %, w 92 %), word processing (m 88 %, w 81 %) or graphics software (m 29 %, w 16 %), men have a better appreciation of their own skill levels than women (Kleimann et al., 2005). Beyond this, Fallows (2005) finds for the U.S. population that women are less interested in technology, try less hard- and software applications, are less self-confident in their operating skills but care more about the risks of using digital media than men. Furthermore, she states that "men use the web for more kinds of entertainment and recreation than women do" (Fallows, 2005, p. iv). The presented findings are often summed up in the catch-phrase "tools for the girls, toys for the boys" which signals a different attitude with consequences for the equitable design and delivery of e-learning elements (Kirkup, 1992; Cooper, 2006; Kelan, 2007; Wyatt, 2015).

RESEARCH QUESTIONS

Aim of the Study

Considering prior research, it can be assumed that gender differences are not a matter of access but rather a matter of the quality of the use of digital media. This paper presents a secondary analysis of survey data on student media use in German tertiary education in 2015 . The primary focus of this paper is on the persistence of gender differences in access, attitudes and usage of digital media for learning in higher education. A detailed analysis of all possible influence variables is beyond the scope of this article, however given that media usage is a complex and individually structured action influenced by cognitive characteristics, personality and external factors, the variables age and time budget are also considered. Having a limited time budget is an indicator for structural private life differences and follows the assumption that students who have a job and/or childcare responsibilities, which are said to often be women (von Prummer, 2008), are disadvantaged in creating an efficient learning environment.

In this regard, the purpose of this paper is to address the following research questions:

- What kind of digital devices do higher education students own or have access to and how long do they use the Internet?
- What are the differences between female and male higher education students regarding their attitude toward technology usage?
- How does digital media usage behaviour and acceptance of female and male higher education students differ?

METHOD

Instrument and Sample

The online questionnaire used was developed based on the dimensions of Johnsson-Smaragdi (1994) and Bonfadelli's (1993) model of media usage: (1) environment (media and learning environment), (2) socialisation (education and media relevant sociodemographic dimensions), (3) behaviour (media usage and learning behaviour) and (4) personality (education and media relevant dispositions). The items and scales focus on access to media and mobile devices, study-related media usage, students' attitudes toward technology, the use of social networks (for learning), the compatibility of studying and working, as well as demographic variables. In total, 51 media, tools and services were classified according to the media typology

of Grosch and Gidion (2011): printed and digital text media (n = 2), general web tools and services (n = 22) and e-learning tools and services (n = 27) (Zawacki-Richter, 2015; Zawacki-Richter et al., 2015). Table 8 provides an overview of the various media, tools and services. For each of those tools the participants are asked how often they use them for studying (Likert-Scale: 5 = almost every day; 4 = a few times a week; 3 = between once a week and once a month; 2 = less than once a month; 1 = never) and how useful they are for academic purposes (Likert-Scale: 5 = very useful - 1 = not useful at all). Furthermore, participants were asked to indicate how often digital teaching and learning approaches are used at theire university (Likert-Scale: 5 = very often - 1 = not at all). Cases where "I'm not familiar with that" or "I don't know" were chosen, are defined as missing values.

Data Collection

To collect the data, a mailing list of the project leaders and coordinators of the BMBF [German Federal Ministry of Education and Research]-program "Offene Hochschulen" ["Open Universities"] was used. Key contact people distributed the online questionnaire via the homepage and university learning management systems (LMS). Participation was voluntary and self-recruited. On this way a considerable amount of German higher education studens has been contacted.

Sample

Between April and June 2015 1,327 students enrolled at German higher education institutions completed the online questionnaire concerning their media usage behaviour. 62 % of the participants were female, 39 % were male. The average age was 27 years (n = 1,299; SD = 7.9), the total range was between 17 and 69 years of age. Including the current semester, the students had studied 5.5 semesters (n = 1,303; SD = 3.86) on average. With 31 semesters, a 46-year-old man was enrolled for the longest period of time. 69 % of the students were enrolled in on campus programs, 11 % in blended-learning programs, 5 % in fully online programs and 14 % in integrated vocational programs.

Data Analysis

In addition to descriptive analyses and contingency tables a number of 2 (gender) x 2 (age) x 2 (time budget) ANOVAs were conducted to investigate differences in the media usage behaviour. To take the premises of the ANOVA (Huber et al., 2014) into account, a sample of n = 100 was drawn for the calculations. Partial eta-squared (η^2) (small: $.01 \leq \eta^2 < .059$; medium: $.059 \leq \eta^2 < .138$; large: $\eta^2 \geq .138$) and Cramer's V (small: $.1 \leq$ Cramers's V $< .3$; medium: $.3 \leq$ Cramers's V $< .5$; large: Cramers's V $\geq .5$) were used to calculate effect size (Cohen, 1969). For each scale in the study, the Cronbach's Alpha internal consistency coefficients (α) was calculated to access reliability (Streiner, 2003).

According to the research question(s) the focus of the following data analyses is on gender as an explanatory variable for media usage. Given that (study-related) media usage is a multi-dimensional phenomenon, age and time budget are other variables taken into account. For this purpose, the sample is grouped into younger and older students. Huber et al. (2014) suggest the median as a dividing line between younger and older students. Consequently, the group of younger students is younger than 24 years and the group of older students is 24 years and older. The variable time budget divides the sample into students with a normal and a limited time budget. Having a limited time budget means that the students work more than 19 hours a week or have alt least one child. Here it is assumed that students who work more than 19 hours a week or who have an own child or children habe a limited time budget for their studies.

Limitations

The presented survey does not claim to obtain a perfectly randomized sample of the German higher education student population. The selection of the participating higher education institutions was based on the members of the BMBF-program "Offene Hochschulen" and with including the FernUniversitat in

Hagen, a German single-mode distance teaching university, it might be biased toward distance or online learning students. Furthermore, the sample within the participating higher education institutions might not be randomized, because the reference to the questionnaire was published through the learning management system. Thus, more technophilic students might have participated more frequently. However, the mentioned biases apply equally for all survey participants.

The way in which the frequency of use of media, tools and services for studying was conducted has to be critically examined, too. Using a named five-point Likert scale the data has ordinal scale level. For research pragmatic reasons (using an endpoint named scale allows a large margin of interpretation for the participants and also a named scale with equal intervals (hours, days, weeks etc.) is not meaningful enough) the variable frequency of use is considered as metric in the presented study as it is believed that the intervals between the scale values are interpreted homogeneous.

Lastly, it has to be mentioned that the mostly small effect sizes (η^2 and Cramer V) of the statistically significant results indicate that the practical relevance has to be interpreted with caution and critically examined.

FINDINGS

Table 1 shows that the proportion of female and male students differs concerning the type of study program (X^2 (3, n = 1,283) = 17.38, p = .001). Women tend to study more often in online programs than men and men tend to study more often in integrated vocational study programs.

Table 1. Type of study program by gender

	on campus programs	blended learning programs	fully online programs	integrated vocational study programs
female students	69.2 %	11.9 %	6.7 %	12.3 %
male students	69.5 %	10.0 %	2.6 %	17.9 %

On average the students were employed for 12 hours per week (n = 1,286; SD = 13.94). There is no significant difference for the amount of hours for female and male students work per week (t (946.05) = .823, p = .411).

14 % of the respondents had children (n = 1,302). Table 2 shows, that separated by gender the proportion of female students with children is almost twice than that of male students (n^2 (1, n = 1,280) = 14.46, p = .00).

Table 2. "Do you have children?" by gender

	yes	no
female students	16.4 %	83.6 %
male students	8.9 %	91.1 %

34 % (n = 1,280) of the students can be considered as having a limited time budget for their studies. Table 3 shows, that the proportion of students having a limited time budget differs significantly regarding gender (X^2 (1, n = 1,259) = 7.62, p = .006), with more female students having a limited time budget for their studies than male students.

Table 3. Time budget by gender

	limited time budget	normal time budget
female students	37.0 %	63.0 %
male students	29.4 %	70.6 %

Access to Electronic Devices and Digital Media

There is no significant difference between the number of devices female and male students own (t (945.95) = -1.823, p = .069). On average students own five (SD = 1.56) different electronic devices. One-third of each group owns six or more digital devices (see table 4).

Table 4. Number of devices owned by female and male students

female students				male students		
cum. %	%	n	number	n	%	cum. %
0	0	0	0	1	0,2	0.2
0	0	0	1	2	0.4	0.6
4.4	4.4	35	2	24	4.8	5.4
16.5	12.1	97	3	59	11.8	17.3
37.3	20.8	167	4	85	17.1	34.3
61.5	24.2	194	5	116	23.3	57.6
85.3	23.7	190	6	106	21.3	78.9
95.1	9.9	79	7	66	13.3	92.2
99.6	4.5	36	8	23	4.6	96.8
100	0.4	3	9	14	2.8	99.6
	0	0	10	2	0.4	100
	100	801	total	498	100	

Table 5 shows that there is a significant correlation with small effect sizes between gender and ownership of desktop PCs, smartphones and MP3 players. 57 % of male students own a desktop PC, whilst only 32 % of the female students do. The percentage of men owning a smartphone (95 %) is also higher than the percentage of women (88 %). MP3 players are more often owned by female (67 %) than by male (57 %) students. Because of the small effect sizes, the findings shall not be over-interpreted.

Table 5. Device owned by female and male students

ownership	female	male	total	n	χ^2	Cramer's V
desktop PC	31.7 %	57.2 %	41.6 %	1239	87.61, p = .00	.25
printer	76.9 %	74.1 %	75.9 %	1289	1.31, p = .25	
scanner	66.0 %	62.3 %	64.6 %	1268	1.78, p = .18	
notebook / laptop	93.1 %	89.6 %	91.8 %	1288	4.89, p = .03	.06
netbook	15.4 %	17.8 %	16.4 %	1113	1.12, p = .29	
tablet PC	36.1 %	44.2 %	39.2 %	1208	7.85, p = .01	.08
e-book reader	20.4 %	16.4 %	18.8 %	1152	2.90, p = .09	
smartphone with Internet access	88.1 %	94.6 %	90.6 %	1275	15.06, p = .00	.11
self-phone without Internet access	24.8 %	25.9 %	25.2 %	1138	0.18, p = .67	
MP3 player	67.0 %	56.8 %	63.1 %	1225	12.97, p = .00	.10

Overall, 99 % of the surveyed students have Internet access at home, meaning there is full coverage of Internet access for German HE students. Furthermore, there is no correlation between the access of female and male students (X^2 (1, n = 1,268) = .58, p = .45). However, there is a significant difference between the number of hours females and males are using the Internet actively per day. Male students reported being online for 4.84 hours a day, whilst female students are online for 3.78 hours (t (840.1) = -7.1, p = .00).

Uses of Mobile Devices for Learning

Students were also asked how they use their mobile devices (e.g. mobile phone, tablet PC) for learning (see figure 1). On a list of 20 items with yes or no answers, students report the highest degree of usage for doing Internet searches outside the classroom (80 %) and accessing the learning management system (74 %). Only rarely were mobile phones and tablets used for location-based services (6 %), for writing papers and assignments (10 %) and for sending text messages to teachers (13 %).

The differences between female and male respondents range from +8.3 % to -13.9 %. Significantly more female students use their mobile digital device to post texts and pictures (+8.3 %; X^2 (1, n = 1,156) = 7.92, p = .005), to buy books (+7.6 %; X^2 (1, n = 1,156) = 7.7, p = .006), to access social networks (+7.1 %; X^2 (1, n = 1,156) = 6.24, p = .012), to use library services (+7.0 %; X^2 (1, n = 1,156) = 5.43, p = .02), and to take pictures (+6.8 %; X^2 (1, n = 1,156) = 6.01, p = .014). Only listening to music whilst learning (-13.9 %; X^2 (1, n = 1,156) = 25.69, p = .000) and sending text messages to teachers (-3.9; X^2 (1, n = 1,156) = 3.88, p = .049) is used significantly more by male students.

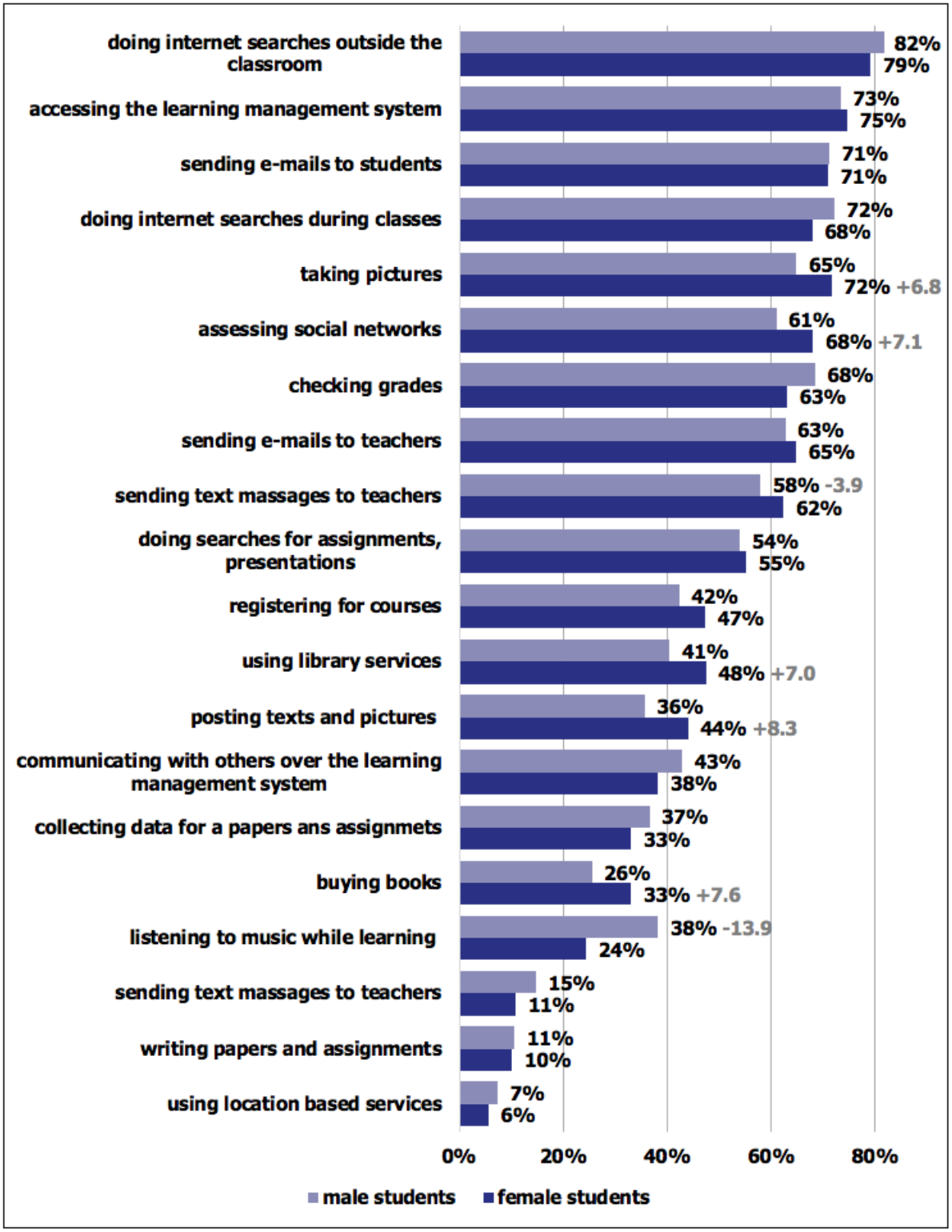

Figure 1. Use of mobile devices for learning by female and male students

Students' Attitudes Toward Technology and Acceptance of Media, Tools and Services

To measure the students' general acceptance of technology, the Technology Usage Inventory (TUI) developed by Kothgassner et al. (2013) was used. "Here user acceptance is defined as the demonstrable willingness within a user group to employ IT [information technology] for the task it is designed to support" (Dillon & Morris, 1996, p. 4). The TUI intends to measure technology-specific and psychological factors that

contribute to the actual use of technology. It consists of the following seven scales: "curiosity", "anxiety", "interest", "usability", "usefulness", "scepticism" and "accessibility". The scale "immersion" was exclude a priori because it only can be conducted for technologies that are designed to cause immersion (e.g. TV, virtual simulations) (Kothgassner et al., 2013). According to Kothgassner et al. (2013) the validity of the scales is also given for other technologies, thus the items were adapted to the research subject "digital media for learning" for the present study. Other than expected, a principal component analysis (with varimax rotation) of all items of the TUI does not suggest to retain seven but five factors (explained variance 63.5 %; KMO = .908; scale reliability between α = .88 and α = .71).

The scale "usefulness" represents whether students consider the use of digital media as useful for learning and whether it supports their daily lives. The scale "interest and curiosity" represents the general interest in (new) technology as well as their curiosity about study-related digital media in particular. The scale "anxiety" represents whether students feel overburdened and anxious to make mistakes while using a variety of technical devices. The scale "scepticism" represents whether students think that digital media are risky, dangerous or disadvantageous for their studies. The scale "accessibility" represents how students perceive the accessibility of media for studying regarding financial aspects and the ease of accessibility. High values always mean a high correspondence with the statement of the scale.

Table 6. Students' general acceptance of technology (TUI) by gender

	gender	*n*	*MV*	*SD*	*T*	*df*	sig.
usefulness	female	790	5.39	1.52	-0.62	1276	.54
	male	488	5.44	1.52			
interest and curiosity	female	797	3.22	1.46	-9.84	1290	.00*
	male	495	4.03	1.39			
anxiety	female	791	2.81	1.67	6.07	1147.1	.00*
	male	495	2.27	1.47			
scepticism	female	792	4.07	1.53	0.02	1280	.98
	male	490	4.06	1.57			
accessibility	female	792	3.77	1.39	-5.97	1282	.00*
	male	492	4.25	1.43			

** $p < .01$ (2-tailed)*

Table 6 shows the differences of female and male students on the described scales. Males have a significantly higher interest and curiosity in (new) technology in general and study-related digital media. They are also more likely to think that digital media for studying is accessible to anyone. In contrast, female students are significantly more anxious to make mistakes while using technology than men.

In addition to the definition of acceptance already introduced, media acceptance can also be understood as a two-dimensional indicator for the quality of media use (Grosch, 2014). According to this understanding, the acceptance values ((Value usage frequency + Value perceived usefulness) / 2) for the 51 media, tools and services, result from the averaged ratings of the frequency of media use at university and the perceived usefulness of (= satisfaction with the) media for academic purposes The differences regarding the acceptance of media tools and services among female compared to male students are depicted in table 7.

Table 7. Acceptance of media tools and services in comparison

Type of medium	Significantly higher acceptance among female students	Significantly higher acceptance among male students
text media	printed texts**	electronic texts (e.g. e-books, PDFs)**
general web tools and services	social networks**	Skype (conference call)*
		Skype (1:1 call)*
		search engines**
		micro blogging (e.g. Twitter)*
		cloud computing**
		wikis**
		etherpads*
		videos (e.g. on YouTube)**
		music (e.g. iTunes)**
		chat / instant messaging**
e-learning tools and services	online library services**	file storage / file sharing (external, e.g. Dropbox)**
	file storage / file sharing (internal)*	spreadsheet software (e.g. Excel, Numbers)**
	e-portfolios**	
	multimedia software of the university**	
	internal university forums / newsgroups**	
	mailing lists for courses**	
	virtual seminars / webinars (synchronous)**	
	bibliographic software (e.g. Zotero)**	
	MOOCs**	
	computer terminals on campus**	
	computer terminals outside of the university (e.g. at home, at work)**	
	word processing software (e.g. Word, Pages)*	
	statistical software (e.g. SPSS)**	
	software for qualitative text analysis (e.g. MaxODA)**	

** p < .05 (2-tailed); ** p < .01 (2-tailed)*

Table 8 lists the acceptance values of media, tools and services according to their ranking. It also shows the mean values separated for female and male students. Female as well as male students accept search engines (MV = 4.66), computers outside of the university (MV = 4.48) and external email accounts (MV = 4.35) the most. Geo tagging (MV = 1.21) and virtual worlds (MV = 1.19) are at the bottom of the list.

Table 8. Ranking according to acceptance of media, tools and services for learning in higher education

Rank		n	MV total	MV females	MV males
1	search engines (W)	1312	4.66	4.63	4.72
2	computer terminals outside of the university (E)	1245	4.48	4.57	4.36
3	email account (external) (W)	1312	4.35	4.36	4.33
4	Internet based learning platform (E)	1271	4.35	4.36	4.33
5	word processing software (E)	1281	4.29	4.32	4.24
6	printed texts (T)	1315	4.12	4.24	3.94
7	university email account (W)	1230	3.83	3.83	3.84
8	electronic texts (T)	1303	3.81	3.73	3.95
9	presentation software (E)	1264	3.79	3.78	3.80
10	spreadsheet software (E)	1225	3.64	3.56	3.79
11	online library services (E)	1242	3.62	3.74	3.42
12	emailing lists for courses (E)	1179	3.49	3.60	3.30
13	chat / instant messaging (W)	1108	3.40	3.28	3.58
14	wikis (W)	1121	3.36	3.12	3.69
15	file storage / file sharing (external) (E)	1143	3.36	3.22	3.57
16	computer terminals on campus (E)	1168	3.27	3.36	3.15
17	social networks (W)	1221	3.21	3.30	3.07
18	file storage / file sharing (internal) (E)	1026	3.17	3.23	3.09
19	videos (W)	1249	3.15	3.01	3.38
20	internal university forums / newsgroups (E)	1020	2.90	2.99	2.74
21	cloud computing (W)	776	2.82	2.55	3.10
22	statistical software (E)	752	2.68	2.79	2.50
23	bibliographic software (E)	578	2.64	2.74	2.47
24	online exams / tests (E)	854	2.62	2.65	2.57
25	forums / newsgroups (W)	1020	2.61	2.58	2.65
26	multimedia software of the university (E)	590	2.61	2.69	2.49
27	graphics software (E)	910	2.50	2.48	2.55
28	music (W)	1110	2.49	2.34	2.69
29	virtual seminars / webinars (synchronous) (E)	574	2.45	2.56	2.28
30	Skype (1:1 call) (W)	1058	2.33	2.28	2.41
31	multimedia learning software online (E)	553	2.33	2.40	2.26
32	e-portfolios (E)	452	2.32	2.43	2.13
33	software for qualitative text analysis (E)	494	2.30	2.44	2.11
34	lecture recordings (E)	715	2.16	2.18	2.13
35	podcasts / vodcasts (E)	715	2.16	2.18	2.13
36	Skype (conference call)	997	2.14	2.09	2.22
37	MOOCs (E)	247	2.12	2.36	1.84
38	presentation sharing (W)	587	2.05	2.08	2.03
39	audio software (E)	720	2.03	2.00	2.05
40	video software (E)	775	2.02	2.04	1.98
41	virtual labs (E)	385	2.00	1.99	1.98
42	business networks (W)	726	1.97	1.94	2.01
43	etherpads (W)	260	1.93	1.77	2.06
44	blogs (W)	902	1.90	1.89	1.89
45	simulations or learning games (E)	523	1.88	1.91	1.85
46	RSS feeds (W)	472	1.75	1.71	1.79
47	micro blogging (W)	950	1.45	1.40	1.51
48	photo communities (W)	738	1.41	1.43	1.39
49	social bookmarking (W)	360	1.40	1.44	1.35
50	geo tagging (W)	399	1.21	1.20	1.22
51	virtual worlds (W)	731	1.19	1.15	1.23

types of media (Grosch & Gidion, 2011): T = text media; W = general web tools and services; E = e-learning tools and services

To broaden this quite detailed examination of each media, tool or service, five sum scales were formed on the basis of principal component analysis of all items of the survey regarding the frequencies, digital teaching and learning approaches and benefits of the use of these multiple tools and services.

The scale "application of e-learning tools" ($\alpha = .90$) was established with 16 items regarding the frequency of use of multiple e-learning tools and services (e.g. virtual seminars, web-based training, multimedia learning software, e-portfolios, podcasts). A 2 (gender) x 2 (age) x 2 (time budget) ANOVA with this scale indicates a significant main effect of the time budget (F (1, 521) = 7.36, p = .007, $\eta^2 = .014$) and significant interactions of age and gender (F (1, 521) = 5.13, $p = .024$, $\eta^2 = .010$) (see figure 2) and age and time budget (F (1, 521) = 4.29, $p = .039$, $\eta^2 = .008$). But, with an effect size of $\eta^2 = .008$ the interaction of age and time budget is practically irrelevant. Students with a limited time budget use e-learning tools more often than students who have no limitations regarding their time for studying. Male students who are younger than 24 years use e-learning tools more often than females, however in contrast to females, their frequency of use slightly decreases with the group of older students. Females who are 24 years and older use e-learning tools more often than when they are younger than 24 years.

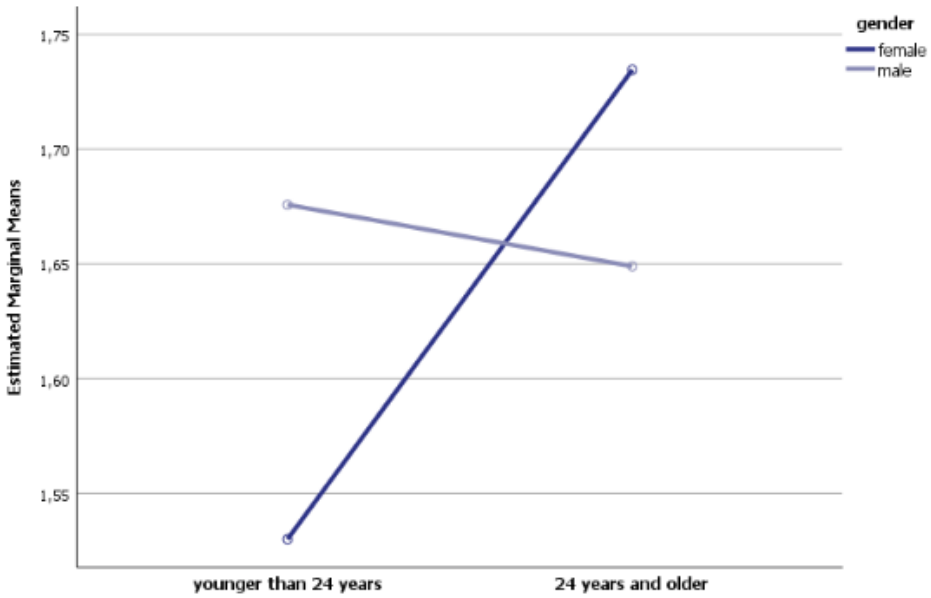

Figure 2. Interaction between age and gender

The scale "value of e-learning tools" ($\alpha = .93$) consists of 7 items regarding the perceived usefulness of e-learning tools and services (e.g. lecture recordings, virtual seminars) and 7 items regarding the importance of digital teaching and learning approaches (e.g. online exams and exercise, virtual internships and labs). A 2 x 2 x 2 ANOVA indicates significant differences for the all three main effects. Women (F (1, 497) = 5.96, $p = .015$, $\eta^2 = .012$) and students who are 24 years and older (F (1, 497) = 5.99, $p = .015$, $\eta^2 = .012$) value e-learning tools more than men and younger students. Moreover, students with a limited time budget attribute more importance to e-learning tools (F (1, 497) = 4.10, $p = .043$, $\eta^2 = .008$). However, the minimal effect size shows that this difference is not relevant.

The scale "usefulness of learning management systems" consists of seven items. Four of these items assess the perceived usefulness of e-learning tools and services. The other three items are related to the frequency of use. The conducted 2 x 2 x 2 ANOVA indicates significant differences for all three main effects and the interaction of age and time budget (F (1, 497) = 12.76, $p = .000$, $\eta^2 = .019$). In the group of older students the estimated means for "usefulness of learning management systems" are almost the same for students with a limited or normal time budget, whereas in the group of younger students those with a limited time budget show much lower values. Furthermore, learning management systems are more accepted by female students (F (1, 647) = 15.13, $p = .000$, $\eta^2 = .023$), by students who are 24 years and older (F (1, 497) =

8.57, p = .004, η^2 = .013) and by students who have no limitations regarding their time for studying (F (1, 497) = 15.04, ===0 = .000, η^2 = .023).

The scale "usefulness of office software" (α = .77) consists of five items regarding the frequency of use, as well as the perceived usefulness of office software such as word processing, presentation and spreadsheet software. A 2 x 2 x 2 ANOVA shows a significant main effect of the time budget and a significant interaction of gender and time budget (see figure 3). Students with a limited time budget indicate a higher usefulness of office software (F (1, 658) = 18.87, p = .000, η^2 = .028). The interaction of gender and time budget shows that students with a limited time budget value office software more than students with a normal time budget and this trend is more pronounced for male than female students.

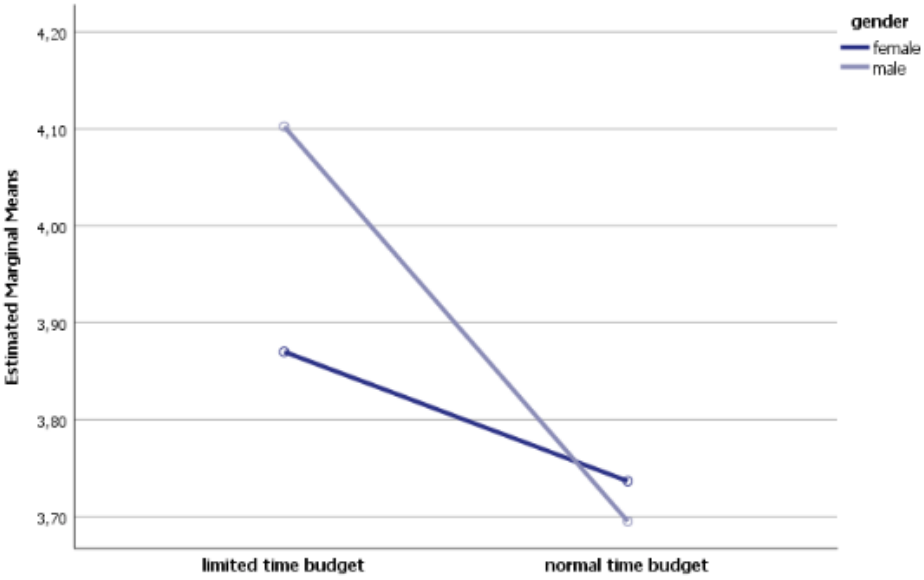

Figure 3. Interaction between time budget and gender

The scale "usefulness of computer applications of the university" (α = .69) consisted of four items regarding the frequency of use as well as the perceived usefulness of computers on campus and the university email account. A 2 x 2 x 2 ANOVA with this scale indicated a significant main effect of gender (F (1, 626) = 6.91, p = .009, η^2 = .011) and time budget (F (1, 626) = 36.14, p = .000, η^2 = .055). Female students and students with a normal time budget indicated that computer applications of the university are more advantageous.

DISCUSSION

To begin with, it can be ascertained that female and male higher education students differ neither in the number of devices owned nor in having Internet access at home. In addition, full coverage of Internet access at home can be assumed for German higher education students. Thus, media usage patterns of men and women cannot be distinguished by access but there is a significant difference in the amount of time they spend on the Internet with men being online about one hour longer each day. In other words, it can be said that differences in media usage patterns between male and female students are not a question of having access, but of the attitude toward and the reasons for using digital media.

Despite the finding that more than 99 % of higher education students in the sample have Internet access at home, more male than female students agree that study-related media are accessible to anyone and male students are more interested and curious about (new) technology. Reversely female students are shown to be more anxious when it comes to using digital media. These findings correspond to the results of a current German Digitalisation Index (Initiative D21, 2017). In this study competence comprises the knowledge and understanding of technology related terms (e.g. cloud computing, Internet of things, e-health), the

handling of computer and Internet applications (e.g. doing web searches, posting in social networks), and the handling of the Internet in general (e.g. knowing if a search engine result is an advertisement). Even if the digital literacy is increasing in the overall population, women tend to perceive their digital expertise much smaller than men (Initiative D21, 2017). Having a first look at the acceptance of the used media tools and services as an indicator for the experienced quality of media points in the same direction (see table 7): Male students show higher acceptance values for electronic texts than female students, for printed texts it is exactly the opposite. Assuming that reading electronic texts requires using the Internet this finding corresponds to the finding that male students use the Internet longer than female students. Likewise, male students show higher acceptance values for more general web tools than female students, but when it comes to e-learning related tools women show higher acceptance values for a lot more different tools and services than men. E-learning tools and services are seen to be more useful and used more often by female students. It, therefore, can be concluded that male and female students have different attitudes toward learning with digital media which also could have consequences for the further development of digital teaching and learning formats.

At this point special attention should be paid to social networks being the only general web tool that is accepted significantly higher among female students. This indicates an activity in as well as a high perceived usefulness of social networks for female students and corresponds to the finding that Facebook is used for more different purposes more often by women (Mazman & Usluel, 2011).

The results indicate that the value that is attributed to e-learning tools and services by female students is related to circumstances in their private lives, for example the amount of time they are free to use for studying (von Prummer, 2008). Beyond, an overall examination of the conducted variance analyses shows that female students, students with a limited time budget as well as older students apply e-learning tools more often and also attribute more importance to e-learning tools. Also noteworthy is the finding that students with a limited time budget and especially women indicate a higher usefulness of office software like word processing and presentation software and that female students indicate a higher usefulness of computer applications of the university as well as of learning management systems.

Overall it seems that female students, who more often have a limited time budget for studying (see table 3), tend to use digital media as a tool for (e-)learning, as they provide more flexible learning opportunities. On the opposite male students focus on using more general web tool and services and value e-learning tools less than their female peers. This corresponds with the concept of habitual differences in the media usage of women and men (Bourdieu, 1997).

CONCLUSION AND FURTHER RESEARCH PERSPECTIVES

The aim of the present study was to explore the use of digital media by male and female higher education students. Furthermore, it was investigated if gender differences persist and, if they do, what form they take. The presented results indicate that the since the advent of electronic media and information and communication technologies mentioned concerns about men being more technology savvy and women being left out of the virtual world did not come true. But women and men have a different attitude toward using digital media for studying as well as they have a different usage behaviour of digital tools. Accordingly, gender is still an important topic and has to be taken into account for designing digital learning environments in the context of higher education. In terms of suggestions for strategic media development and practical implication for improving the use of digital media at higher education institutions, the results can be summarized as follows.

More female than male students have a limited time budget for their studies (see table 3). Compared to male students, female students accept significantly and considerably more different e-learning tools and services (see table 7). Also, women value e-learning tools more than men. This target group in particular would benefit from the development of blended learning courses. In this way, a self-determined, locally and temporally flexible learning and the possibility of social interaction during presence phases can be didactically combined in a meaningful way. In the implementation of this concept it should be taken into account that women are more anxious to make mistakes while using technology (see table 6) and accept printed texts higher (see table 7) than men. Thus, it is critical to ensure a good mentoring as well as technical support for participants. Likewise, printed study materials should not be entirely abandoned.

Furthermore, mobile devices are increasingly popular and used by female and male students for learning in various ways (see figure 1). This leads to an increasing demand for a responsive design of learning environments, especially for those tools and services that are ranked high (see table 8).

Beyond gender-specific differences, age and the amount of time that students are free to spend for studying were considered. It has been shown that students' media use is affected by complex and numerous reasons. The present study is concerned solely with students' use of digital media and services and the added value to digital tools, but it is not possible to make an assertion about the effectiveness of students' media usage. In order to discover if higher education institutions should support male students to use e-learning tools or female students to use general web tools or if both sexes learn best the way they do, further research has to be done.

To build upon the presented results further quantitative research on the one hand and qualitative research on the other hand is recommended in order to deepen and broaden the understanding of students' media usage behaviour. Concerning further quantitative research apart from self-reported frequency of use and experienced usefulness the actual efficiency of using digital media as well as the performance of students should be examined. For this purpose, a pretest-posttest-design is recommended. Subsequent qualitative research can either deepen and illustrate the quantitative results and uncover explanation patterns that are not taken into account yet. Both approaches are aiming to broaden the possibilities of implementing digital media in formal teaching and learning processes, to explain contexts of justification and to provide new thought-provoking impulses.

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THE INFLUENCE OF TECHNICAL SUPPORT, PERCEIVED SELF-EFFICACY, AND INSTRUCTIONAL DESIGN ON STUDENTS' USE OF LEARNING MANAGEMENT SYSTEMS

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ABSTRACT

Learning Management System is a software-based technology that is widely adopted by universities. While the implementation of LMS has been successful in developed countries, the utilisation of LMS in developing countries is still considered low. It is believed that there are some barriers that may influence the use of LMS which include Technical Support, Instructional Design and Self-Efficacy. The present research aims at examining the influence of these factors on students' use of LMS. Thus, a research model will be developed based on extending Technology Acceptance Model (TAM). Using the Stratified Random Sampling (SRS), 400 students were selected from three Saudi universities. The participants completed the survey questionnaire that measures their responses to the seven constructs. The data was analysed using Structural Equation Modelling by AMOS. The results showed that the three proposed external factors including technical support, instructional design and perceived self-efficacy had a significant influence on students' use of LMS. These factors had significant direct effects on both perceived ease of use and perceived usefulness of LMS. The results confirmed the validity of the extended TAM model in determining users' usage of LMS. The study also addressed several significant implications for the practitioners and researchers in the field.

Keywords: Learning Management System, Technology Acceptance Model, Technical Support, Self-Efficacy, Instructional Design.

INTRODUCTION

Learning Management System (LMS) is a web-based application which implements internet services and web technologies to support the creation of online courses, delivery and maintenance, enrolment and management of students, administration of educational activities, and reporting the performance of students (Dagger, O'Connor, Lawless, Walsh, & Wade, 2007). Using LMS, learners are authorised to use multiple available features such as chatrooms, threaded discussion, and other ways of communication (Ssekakubo, Suleman, & Marsden, 2013). Goh, Hong and Gunawan (2013) defined LMS as a type of course application that manages and provides learners 24/7 access to the subjects' materials and also facilitates the reporting and monitoring students' activities.

There has been a permanent rise in the LMS market and its usage in the higher education (Kember, McNaught, Chong, Lam, & Cheng, 2010). Researches have revealed that 90% of American universities offer learners with courses and programmes through the use of LMS (Arroway, Davenport, Xu, & Updegrove, 2010). LMS has been adopted and used increasingly in Asia (Bonk, Lee, & Reynolds, 2009). In the Middle East region, the same pattern is found as LMS is becoming a promising tool (Robinson & Ally, 2009). A survey regarding e-learning services involving 26 Arab universities revealed that 96% of these universities have implemented and used LMS as a learning environment to support learning activities (Abdallah, 2010).

In Saudi Arabia, a remarkable development in technologies has taken place. Universities have implemented LMS along with other tools such as smart classrooms, interactive board, e-attendance, and video conference

(Unnisa, 2014). It is the result of the unlimited support and effort provided to the universities by the Ministry of Higher Education. The National Centre for E-learning and Distance Learning (NCeDL) was founded by the Higher Education Ministry in Saudi Arabia with the main aim of assisting in planning and providing educational tools and technologies for the local universities (Mirza, 2007). The NCeDL collaborated with a Meteor group of companies located in Malaysia and contributed to the development of e-learning services by designing its own LMS known as JASUR LMS (Al-Khalifa, 2010a). The JASUR LMS is not the only e-learning application implemented in Saudi universities. Other LMSs such as Moodle, Blackboard, and Design2learn have also been implemented in numerous Saudi universities (Alharbi & Drew, 2014).

However, the utilisation of LMS in Saudi Arabia is still not holistic. Al-Judi (2011) reported that the overall utilisation of LMS in Saudi Arabia is still below the satisfactory and required level. Other studies in Saudi Arabia have revealed that the utilisation level of technology for educational uses is still far from the requisite and adequate level (Al-Kahtani, 2006; Alnujaidi, 2008; Al-Judi, 2011; Bousbahi & Alrazgan, 2015). It is believed that university students in Saudi Arabia face multiple barriers.

Research have shown that the adoption and use of LMS is complex and can be influenced by different factors (Sa´nchez et al., 2013; Fathema et al., 2015; Algahtani, 2017). In Saudi Arabia which is one of the developing countries, it is believed that there are some barriers that may prevent from accepting and using LMS, which comprise of organisational, technological, and social personal barriers, namely from technical support, instructional design, and perceived self-efficacy (Asiri et al., 2012). Based on the literature review conducted in the present study, on all the studies that used TAM (whether original or extended TAM) for examining the influence of different factors on LMS usage, the influences of technical support, instructional design, and perceived self-efficacy on LMS usage have not been yet examined, not only in the context of Saudi Arabia but even globally. Since the adoption and use of LMS is a complex phenomenon which involves a complex interplay of internal and external factors, several researches have showed the need for further developing models to examine other factors which may have a significant influence on LMS usage (Hussein et al., 2007; Fathema, 2013; Fathema et al. 2015; Aliks et al., 2017). Hence, based on extending TAM, a theoretical framework model is proposed in this paper to examine the influence of technical support, instructional design, and perceived self-efficacy on students' use of LMS. The proposed model will contribute to literature, specifically to TAM literature, and will provide decision makers and Saudi Arabian universities with deeper understanding and proper insight regarding which factors may influence the students' intention towards the usage of LMS

LITERATURE REVIEW

Some studies have been conducted using TAM (weather the original or extended TAM) to examine the influence of different factors on LMS usage. Al-hawari and Mouakket (2010) conducted a study for examining the impact of the original TAM factors along with some extra external factors such as feature design of blackboard and enjoyment on students' e-satisfaction and e-retention using Blackboard in United Arab Emirates. Almarashdeh et al. (2011) used the original TAM model without extending it to examine its main factors (perceived usefulness and perceived ease of use) on both students and instructors' use and acceptance of LMS in Malaysia and tested the TAM applicability. Al-Aulamie et al. (2012) extended TAM model to include some external factors, namely computer playfulness and enjoyment, in order to examine their effects on undergraduates and postgraduates' behavioural intention to use LMS in the UK.

Sa´nchez et al. (2013) conducted an empirical study to examine the factors which are responsible for determining the acceptance and use of LMS (WebCT) among students in Spain. They extended TAM to include two external factors (Technical support and computer self-efficacy along with the original TAM factors) and examined their influences on LMS use and acceptance among students. Furthermore, Cheng (2013) extended TAM model to include the interactivity factors (controllability, responsiveness, and personalisation) and enjoyment and examined their influences on students' behavioural intention for using LMS in Taiwan. The results have revealed that the interactivity factors and enjoyment indirectly affected students' behaviour intention to use LMS via perceived usefulness and perceived ease of use. Coşkunçay and Özkan (2013) conducted a study to understand academics' behavioural intention in higher education toward using LMS and determined the factors beyond that. They extended TAM model to include these external factors such as

technology complexity, self-efficacy, compatibility, and subjective norms and examined their influences on academics' behavioural intention to use LMS.

Majdalawi et al. (2014) applied TAM including its core component constructs: perceived usefulness and perceived ease of use and adding additional external factors, namely GPA, faculty, and academic year, to examine their influences on students' behavioural intention to use LMS (Moodle). The results confirmed the findings of original TAM and showed that the academic year and GPA had no effect on perceived ease of use whereas they affected the perceived usefulness. The faculty had an effect on both perceived usefulness and perceived ease of use. Moreover, Juhary (2014) conducted an empirical study using the original TAM constructs such as perceived usefulness and perceived ease of use to examine their influence on students' attitude and behavioural intention to use LMS in Malaysia. However, there are criticisms on using the original TAM without extending it as the main components of TAM, which are various external factors can influence perceived usefulness and perceived ease of use, which are needed to be examined to provide a better understanding about how users intend to use and accept a technology.

Shin and Kang (2015) extended TAM and included some external added factors, such as self-efficacy, system accessibility and subjects' norms, to examine their influences on students' behavioural intention to use LMS through a mobile application**.** Furthermore, Fathema et al. (2015) extended TAM model to include factors, such as perceived computer self-efficacy, system quality and facilitation conditions, to examine their effect on TAM belief constructs, such as perceived usefulness and perceived ease of use that have significant effect on academics' behavioural intention to use and their actual use of LMS**.** Results revealed that the added external factors were significant predictors of academics' behavioural intention towards using LMS and the results confirmed the validity of extended TAM for explaining and determining the individuals' behaviour regarding accepting technology.

Fisol et al. (2016) conducted a study to examine the influence of the main original TAM construct: perceived ease of use and perceived usefulness on educators' behavioural intention to use LMS at the University of Teknologi Mara (UiTM) in Malays, and the results showed that both PU and PEU had a significant direct effect on educators' behavioural intention to use LMS. In the same year, another study was conducted by Cigdem and Ozturk (2016) who extended TAM model to examine the influence of multimedia instruction, system interactivity, and self-efficacy on students' behavioural intention to use LMS through PU and PEU and perceived satisfaction, in a secondary military school in Turkey. The results showed that multimedia instruction had a significant direct effect on both PEU and PU, whereas system interactivity had a significant direct effect on only perceived satisfaction. Perceived self-efficacy did not take any position in their model as it did not have any influence on other constructs. Furthermore, perceived satisfaction was also influenced by both PU and PEU. Perceived Ease of use had a direct influence on perceived usefulness and perceived usefulness had a great influence on students' behavioural intention to use LMS.

Baleghi-Zadeh et al. (2017) extended TAM model to examine the influence of technical support and system interactivity on students' behavioural intention and use of LMS through PEU and PU, in higher education in Malaysia. The results revealed that system interactivity had a direct significant effect on perceived usefulness, but not on the perceived ease of use. Technical support had a direct significant effect on perceived ease of use but not on perceived usefulness. Furthermore, another study was conducted by Essel and Wilson (2017) who applied the original TAM without extending it to examine the influence of the original constructs: Perceived ease of use and perceived usefulness on students' behavioural intention to use LMS at University of Education in Winneba, inGhana. The findings revealed that both Perceived ease of use and perceived usefulness were the main determinants of the students' behavioural intention toward the usage of LMS.

As far as Saudi Arabia is concerned, recently TAM was used only in two studies for examining users' behavioural intention and their use of LMS**.** Alharbi and Drew (2014) extended TAM model to incorporate additional external factors, such as the usage experience of LMS and job relevance, along with the original TAM constructs to examine their influence on academics' behavioural intention towards using LMS**.** The findings revealed that all mentioned factors, directly or indirectly, influenced on academics' behavioural intention to use LMS**.** These results confirmed the applicability of TAM to explain the behavioural intention of users to use LMS and in line with the findings of original TAM**.** A year later, Bousbahi and Alrazgan (2015) conducted an empirical study to understand the factors that may lead to not fully use LMS among academics**.** They extended TAM model to include external factors, namely origination support, load anxiety

and motivation, and examined their influences on academics' behavioural intention and their use of LMS. Findings revealed that these external factors played significant roles in affecting the academics' perception toward the usage of LMS through the perceived usefulness.

Based on the current review, it is clearly that the factors that believed to be barriers with LMS usage namely Technical Support, Instructional Design of LMS and Perceived Self-Efficacy have not been examined simultaneously not only in Saudi Context, but even globally. Therefore, this study will develop TAM model to examine the influence of these factors on students' behavioural intention and their use of LMS. This is needed as many other studies in Saudi Arabia confirmed that the utilisation of LMS among students are still under the satisfying level, and increasing the use of LMS cannot be achieved without empirically understanding the factors that may influence them. According to Adzharuddin and Ling (2013), understanding the barriers (factors) that may influence students' behavioural intention to use and accept LMS is essential and lead to attracting more learners to intent to use and accept LMS. Furthermore, Since the adoption and use of LMS is a complex phenomenon which involves a complex interplay of internal and external factors, several researches have showed the need for further developing models to examine other factors which may have a significant influence on LMS usage (Hussein et al., 2007; Fathema, 2013; Fathema et al. 2015; Aliks et al., 2017). Thus, this research will develop a model by extending Technology Acceptance Model to examine the factors may influence the use of LMS, namely Technical support, Perceived self-efficacy and instructional design of LMS.

Technology Acceptance Model

TAM is defined as an information system theory, which models and provides an explanation of how an individual uses and accepts the technology. TAM aims to provide an elucidation regarding the technology acceptance determinants, which is in general able to explain the behaviour of a user across a wide array of end-user computing technologies as well as user populations, while justifying simultaneously both in the economical and theoretical perspectives (Davis, 1989).

Five constructs form part of the TAM model including 1) Perceived Ease of Use "PEU", 2) Perceived Usefulness "PU", 3) attitude towards the use of "ATT", 4) behavioural intention to use "BI", and 5) actual use of "AU". According to TAM, the PEU and PU are considered as the primary determinants for individuals with regards to the usage and acceptance of the technology.

According to TAM presented by Davis (1989), PEU influences the PU, which means that if individuals consider that the technology is "Easy to Use", then they will consider the technology as "Useful". TAM claims that both PU and PEU influence the attitude towards the use of technology for individuals. To explain this, if individuals perceive the technology as "easy to use" and "useful", then they will formulate a positive attitude towards using a particular technology. Furthermore, Davis noticed that both PU and ATT directly influence the behavioural intention to use technology (BI). It means that if users find a technology "useful", they will then build a positive behavioural intention to use the technology "BI". In the same line, a positive attitude "ATT" of users towards a specific technology builds a positive intention to use it "BI". Finally, this positive behavioural intention "BI" of individuals regarding a particular technology shapes the actual use of it "AU", meaning that if users have a positive intention toward using a particular technology, they will then use it. Figure 1 illustrates the model of TAM.

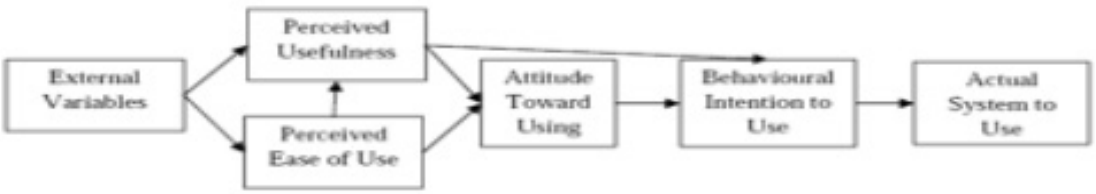

Figure 1. The technology acceptance model (TAM) - theoretical framework

(**Source:** Davis et al., 1989).

Technology Acceptance Model (TAM) has been chosen to be applied in this research for various reasons. First, there is no particular theory that is a free of limitation and could overcome all concerning issues in the previous theory. Second, the validity of extended TAM in a different context with different application has been proposed and confirmed with huge previous studies (e.g. Venkatesh & Davis, 2000; Henderson & Divett, 2003; Hussein et al., 2007; Al-hawari & Mouakket, 2010; Lai & Zainal, 2015; Lai, 2016). Moreover, TAM was the most used theory to explain the IT/IS acceptance and usage (Venkatesh et al., 2003). Furthermore, based on the review carried out by the researcher, the factors that believed to be barriers from accepting and using LMS in Saudi universities, namely technical support, perceived self-efficacy and instructional design of LMS have not been examined using the extended TAM whether in Saudi or even globally. Therefore, this study will develop a model based on Technology Acceptance Model (TAM) to examine the influence of Technical Support, perceived self-efficacy and instructional design of LMS on students' usage of LMS. This developed model will contribute to TAM literature by proposing an extension of the original TAM model.

RESEARCH QUESTION

1. Do the factors:
   a. Technical Support
   b. Perceived Self-efficacy
   c. nstructional Design

Influence students' use of LMS in Saudi Universities?

2. Is TAM model applicable in Saudi Universities in Saudi Arabia?

Research Model and Research Hypotheses

For providing a better understanding of LMS's acceptance and usage among students in Saudi universities, these particular factors including "Technical Support", "Perceived Self-efficacy", and "instructional Design" will be examined as external factors in the original TAM model. The developed model which will be examined is shown in Figure 2.

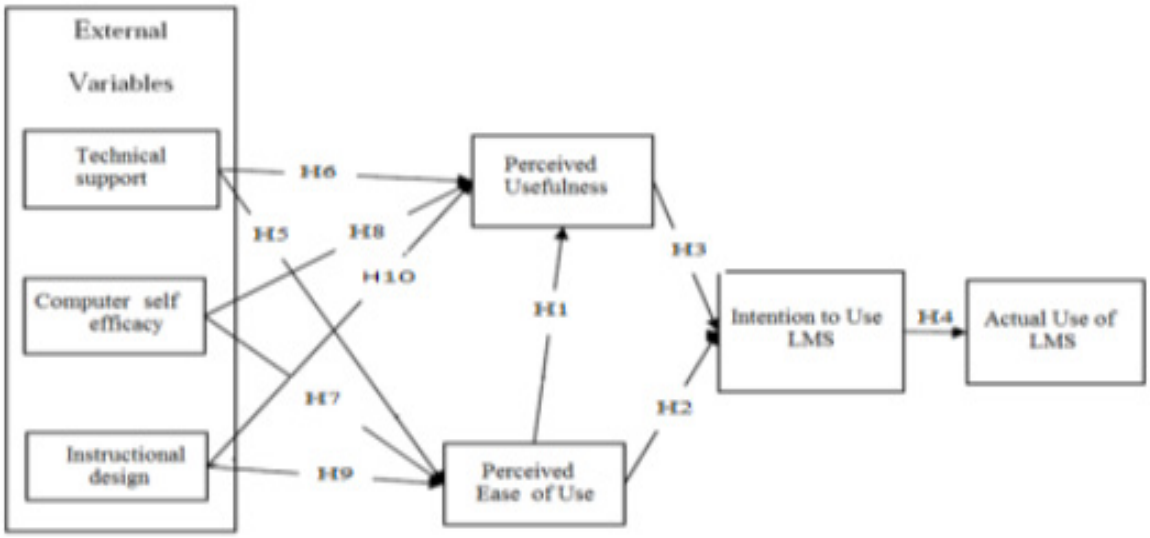

Figure 2. The hypothesised proposed model of students' intention toward the usage of LMS in Saudi universities.

The Influence of Original Constructs of Tam and Its Hypothesis

According to the hypothesis of the original TAM by Davis (1989), the perceived ease of use has a significant direct positive effect on perceived usefulness, whereas perceived usefulness and perceived ease of use have a direct effect on the behavioural intention to use. Moreover, behavioural intention to use has a significant positive effect on the actual use. Many recent studies have confirmed and proven this relationship empirically with several technologies such as e-learning systems (Ong et al., 2004; Liu et al., 2010), and in the context of LMS (Alharbi & Drew, 2014; Fathema et al., 2015). Thus, it is hypothesised in this research that:

H1: Perceived ease of use affects positively the perceived usefulness of LMS.

H2: Perceived ease of use affects positively the behavioural intention to use LMS.

H3: Perceived usefulness affects positively the behavioural intention to use LMS.

H4: Behavioural intention to use LMS affects positively students' actual use of LMS.

The Influence of the External Factors and Its Hypothesis

The Influence of Technical Support

Technical support is defined as knowledge people, who assist users of software products and computer hardware, which could include hotlines, services of online support, help desks, faxes, machine-readable support for knowledge bases, telephone system of voice responding, control remote software along with other services (Ralph, 1991).

Some studies confirmed the influences of technical support on the adoption of different types of educational technology tools in different setting context. Chau (1996) asserted that the perceived ease of use of spreadsheet application is influenced by the technical support. Compeau and Higgins (1995) stated that technical support positively affects the usage of information technology. Since previous studies found out that technical support influences students' usage of technology through the perceived usefulness and perceived ease of use, it is hypothesised in this study that:

H5: Technical support affects positively the perceived ease of use of LMS among students.

The Influence of Perceived Self-efficacy

Perceived Self-Efficacy (PSE) can be defined as the judgment of users regarding his or her capability of executing and organising the multiples of required action to achieve the designed kinds of performance. It is not associated with the skills that the individual has, however it is associated with the judgments of what individual could do, whatever the skills that individual possesses (Bandura, 1986). Previous researches have revealed that perceived self-efficacy is associated with the acceptance of technology (Brown, 2002; Miller et al., 2003; Grandon et al., 2005). It was found out that users, who feel having a sense of weakness in perceived self-efficacy, are more easily frustrated in performing any computer tasks as compared to those who have a strong sense of perceived self-efficacy (Compeau & Higgins, 1995). However, the effect of perceived self-efficacy on LMS use is still unclear, as very rare researches have examined it. Based on the literature, it is hypothesised in this study that:

H7: Students' perceived self-efficacies (PSE) affects positively students' perceived ease of use of LMS.

H8: Students' perceived self-efficacies (PSE) affects positively students' perceived usefulness of LMS.

The Influence of Instructional Design

Instructional design is defined as the entire structure of the system-design process which includes the definition of what is aimed to be learnt, producing the instructional resources and materials, showing the authoring process, applying the use of materials in contexts and making an evaluation for both the effectiveness of the materials formatively and efficacy of the materials (Seels & Richey, 1994). Some previous studies have been undertaken to indicate the influence of instructional design as an external factor on the acceptance and usage of different technologies through the perceived ease of use and usefulness. A study conducted by

Hussein et al. (2007) examined the influence of instructional design among other factors on students' usage of e-learning in the Indonesian Open University. Findings revealed that instructional design was a strong predictor of both perceived ease of use "PEOU" and perceived usefulness "PU", which influenced on students' use of the e-learning. Similar studies have been conducted and confirmed the influence of instruction design on the system usage through the users' perception about the ease of use and usefulness of the system (Dickson et al., 1986). Therefore, based on the previous findings, it is hypothesised in this research that:

H9: Instructional design affects positively students' perceived ease of use of LMS.

H10: Instructional design affects positively students' perceived usefulness of LMS.

METHODOLOGY

This section describes the research methodology used in this study. It covers all the aspects of: research design, population and respondents, the instruments, pilot study, data collection, analysis of data, and the research procedure.

Research Design

This study is purely quantitative, employing a survey, specifically a written questionnaire for the collection of data from the target population. Creswell (2013) defined quantitative research as a type of research that explains the phenomena using the collected numerical data which is analysed using mathematical approaches, in particular, statistical approaches. According to Kumar (2008) quantitative research is objective, formal, and systematic. It can help with describing and testing the relationship and exploring the causes and effects among the interactions of the different variables. This research aims to extend the Technology Acceptance Model (TAM) to examine the influence of the external factors that are believed to be barriers, namely, technical support, instructional design of LMS, and the perceived self-efficacy on students' usage of LMS. It aims at determining the factors that influence the students' usage of LMS as well as examining the underlying causal relationships among all factors which are known as constructs in the instruments by using the proposed extended TAM model.

Sampling and Population

In this study, two sampling methods are applied: a purposive sampling method is used to determine the Saudi universities that will take part in this study, and a stratified random sampling is used to determine the participants from these chosen Saudi universities.

A purposive sampling technique is defined as a type of sampling method where specific settings, events, and people are deliberately chosen for seeking the important information that they have and cannot be taken from other sampling choices (Maxwell, 1997). It is also known as purposeful sampling or nonprobability sampling. As mentioned earlier, a purposive sampling method involves choosing cases or units based on a particular purpose and reason rather than at random (Teddlie & Tashakkori, 2009). In this study, and based on using a purposive sampling method, three government Saudi universities are chosen and involved in this study because of that they implement all different types of LMS such as Blackboard, Desire2Learn, and Moodle which are used by most Saudi government universities.

Based on using a purposive sampling method, the University of Hail which implements Blackboard, Shaqra University which uses Desire2Learn, and the University of Tabuk that uses Moodle are involved and take part in this study.

The participants involved in this study are undergraduate students using the different LMS platforms during their first year in the faculty of preparatory year at the three chosen universities: University of Hail who applies Blackboard, Shaqra University which applies Desire2Learn, and University of Tabuk which uses Moodle. The first-year students have been chosen as the participants because the faculty of preparatory year in all Saudi Government Universities is equipped with the latest technologies including LMS and is stricter with implementing and using them when compared with other faculties. The population of undergraduate

students in the faculty of preparatory year in the three universities is 7838: University of Hail is 3369, 1141 in Shaqra University, and 3328 in University of Tabuk. Table 1 shows the university, the type of LMS used, and the population.

Table 1. Type of LMS used and population in univerisites.

No	University Name	Type of LMS	Population
1	University of Hail	Blackboard	3369
2	Shaqra University	DesiretoLearn	1141
3	University of Tabuk	Moodle	3328
	TOTAL		**7838**

Using Krejcie's and Morgan's (1970) table, the minimum sample size of the total population for 7838 should be 367. Therefore, the sample size of this study is 400 which is convenient and meets the requirement of Morgan and Krejcie's.

The stratified random sampling technique has been applied for determining the samples from each chosen university. Stratified random sampling aims at ensuring that all groups (strata) of the population are represented by the sample for increasing efficiency and consequently decreasing the estimation errors. The population of this study consists of three groups that use different LMS platforms in the three universities. Therefore, using the stratified random sampling technique is convenient and ensures that all the samples "strata" from these groups are representative of the population. Table 2 illustrates the number of samples for each university using stratified random sampling.

Table 2. Stratified Random Sampling for each university.

No	University Name	Type of LMS	Population	Sample
1	*University of Hail*	Blackboard	3369	172
2	*Shaqra University*	DesiretoLearn	1141	58
3	*University of Tabuk*	Moodle	3328	170
	TOTAL		**7838**	**400**

The sample for each group (strata) is chosen based on the following calculation. The population of students in the first preparation year in the three universities consists of three groups "strata" that use different LMS platforms; N = n1 + n2 + n3. For having the sample from the first group, 3369 students who are using Blackboard in University A, the total number of this group is 3369, divided by the total number of the population which is 7838, and then multiplying this by the sample size that this study is looking for, 400: Sample = n1/N * 400. Therefore, 172 undergraduate students are chosen as a sample from the first university "University A" that are using Blackboard. The same procedure is applied to obtain the sample for the other two groups.

Data Collection Procedures

Questionnaires were used for the collection of data. The questionnaires were distributed to the students in the preparation years in the three Saudi universities during the first semester of year 2016-2017. A total of 449 questionnaires were distributed to students but only 400 of the questionnaires were valid and used for further analysis due to the incomplete responses leading to missing their validity (172 from University of Hail, 58 from Shaqra University, and 170 from University of Tabuk). The data collection was anonymous and no identifiable information from the respondents were collected. The questionnaires consisted of two parts: the first part covered the respondents' demographic information, while the second part was questionnaires for measuring the constructs in the model.

Instrumentation

The instruments are questionnaires adopted and modified from four previous studies: Davis (1989), Igbaria (1995), Compeau and Higgins (1995), and Hussein et al. (2007). To ensure the content validity, the questionnaires used were adopted from the original study by Davis (1989) for measuring the original constructs of the TAM model, namely perceived usefulness, perceived ease of use, behavioural intention to use, and the actual use. Most recent studies adopted the questionnaires of Davis' study for measuring TAM constructs as they have been validated by several previous studies (Lule et al., 2012; Chih-Min Ma et al., 2013; Ranta & Mehra, 2015; Sanchez-Mena et al., 2017). Questionnaires that measure the technical support construct were adopted and modified from Igbaria's (1995) and Amoroso and Igbaria (1993). Questionnaires that measure computer self-efficacy construct were adopted and modified from the studies of Compeau and Higgins (1995) and Park (2009). Finally, the questionnaires that measure the instructional design construct were adopted and modified from the study of Hussein et al. (2007) and Liu et al. (2010). Some required word changes and modifications to the adopted questionnaires have been incorporated to make them suitable within the context of LMS usage. For example, the question in original TAM model that measure the perceived ease of using CHART-MASTER "My interaction with CHART-MASTER would be clear and understandable" has been changed to be "I feel that my interaction with using LMS would be understandable and clear". All of the aforementioned questionnaires were sent to the experts in this field to assess their validity and their alignment with the constructs' definitions. These questionnaires are used for measuring all seven constructs "variables" in this study, namely (i) technical support "TS", (ii) perceived self-efficacy "PSE", (iii) instructional design of LMS "ID", (iv) perceived ease of use "PEU", (v) perceived usefulness "PU", (vi) behavioural intention to use LMS "BI", and (vii) the actual use of LMS "AU".

The Questionnaires

The questionnaires that measure constructs in the model consist of two parts: the first part includes seven items providing the demographic information of the respondents. It covers aspects such as age, current semester, experience period with LMS usage, previous qualification, university name, device used with LMS, and attendance of training or workshops. The second part of the questionnaires contains 66 items that measure the seven latent constructs of the proposed model in this study. These questionnaires have items that contain the five-point Likert scale with ranges starting from "5 strongly agree" to "1 strongly disagree". The adopted questionnaires are provided in the appendix.

Pilot Study

The pilot study examined the constructs' reliability for the collected data. The questionnaires' items were pilot tested with 200 undergraduate students at UoH. The reliability of constructs means the extent to which the construct shows consistent results and free from errors. Reliability relates to the ability of the instruments used for measurements to produce the same result when it is used in the same circumstances with the same participant (George, 1995). It can be assessed by conducting Cronbach's Alpha which is widely applied and used for measuring the constructs' items internal consistency in the study. The value of Cronbach's Alpha should be higher than 0.70 to be considered reliable and adequate for measuring the internal consistency (Hair et al., 2006). The pilot data was entered into the SPSS software (Statistical Package for the Social Science) to assess the reliability and validity of the constructs' items. Cronbach's Alpha was run to determine the internal consistency for the items scales which are used here. According to Nunnally (1978), when the Cronbach's score is higher than 0.70, it is considered to be reliable. The results in Table 3 show that the Cronbach's Alpha values for all seven factors range from 0.76 to 0.92, indicating that all values are above the suggested threshold level of 0.70 and are considered to be internally consistent and reliable.

Table 3. Reliability statistics

	Reliability Statistics	
Factors	**Cronbach's Alpha**	**N of Items**
Technical Support (TS)	0.804	8
Self Efficacy (SE)	0.767	8
Instructional design (ID)	0.863	10
Perceived Usefulness (PU)	0.923	10
Perceived Ease of Use (PEU)	0.920	10
Behavioural Intention to Use (BI)	0.888	8
Actual Use (AU)	0.861	12
Total of Items		**66**

The Exploratory Factor Analysis (EFA), using the method of Principle Component Analysis (PCA) with Varimax rotation, was run. With the first run of EFA using PCA, there were some items that have low loading, some have cross loading, and the communality of some items was also low. To tackle the problem of cross loading and low loading values, the following criteria were applied: all items loaded should have a value above 0.5, they should not be cross loaded, the communality should be higher than 0.4, and the factors are expected to be remained with at least five items. If any items do not follow these criteria, they will be eliminated. These chosen criteria have been set based on the literature. According to Osborne and Costello (2005), the factors that have at least five items with a load value of 0.5 or above are solid factors and desirable. The communality explains the proportion of the variance of items which are explained by the factor. The communality value that is less than 0.4 might indicate that the item in that factor is not related to the other items (Osborne & Costello, 2005). Thus, any item with a communality value less than 0.4 will be eliminated. As a result, 12 items have been removed: three items from the perceived self-efficacy construct (SE1, SE7 and SE8), four items from the instructional design construct (ID2, ID4, ID5, ID6), two items from the perceived usefulness constructs (PU1, PU6), two items from the actual use construct (AU1, AU3), and one item from technical support construct (TS5). In the final analysis, out of 66 items, only 54 items were retained and used. The finalised questionnaires with 54 questions for collecting field data are provided in Appendix A.

Procedure of Data Analysis

Two types of statistical analysis for the collected data from the respondents, using the finalised questionnaires after conducting the pilot study, are used in this study. As the questionnaires have two parts, a descriptive statistical analysis using SPSS is applied to analyse the respondents' demographic information, which may include the percentage, frequency, etc.

To answer the research questions and determine the factors that influence the undergraduate students' usage of LMS, as well as testing the goodness fit between the proposed structured model and obtained data, this study has followed the suggestion of Anderson and Gerbing (1988) and conducted a two-step analysis for Structural Equation Modelling (SEM) using AMOS version 18. In the first step, CFA, which is a confirmatory factor analysis, is applied for assessing the measurement of the model. To explore the causal relationship among constructs, the proposed structural model has been tested using SEM. SEM is applied since it simultaneously analyses the path in the proposed model for examining the causal relationship among all constructs as well as testing the goodness of fit of the proposed structural model.

DATA ANALYSIS AND FINDINGS

Part 1: Demographic Information of Respondents

A total of 449 students responded to the surveys but only 400 questionnaires were used for further analysis because of the incomplete responses and their invalidity. Table 4 shows the name of the university that was involved, the number of distributed questionnaires, and the incomplete and valid questionnaires used for further analysis.

Table 4. Summary of questionnaires for data collection.

University name	Distributed questionnaires	Incomplete questionnaires	Valid questionnaires for further analysis
University A	192	20	172
University B	70	12	58
University C	187	17	170
Total	**449**	**49**	**400**

Using Stratified Random Sampling (SRS), 172 (43.0%) students' respondents were from the University of Hail, 58 (14.5%) students respondents were from Shaqra University and 170 (42.5%) students respondents were from University of Tabuk. In terms of age, the respondents were mixed. Most of the respondents (69.0%; n = 276) were aged between 19-20, while 17.8% (n = 71) and 7.8% (n = 31) were aged between 17-18 and 21-22, respectively. Only 5.5% (n = 22) of the respondents were more than 23 years of age. In terms of experience, 57.5% (n = 230) had 3-4 months of experience and 17.0% (n = 68) had 1-2 months of experience. However, those with no experience or more than 5 months of experience were reported to have the same number of respondents at 12.8% (n = 51). Their previous qualifications were mixed, with most of them (97.3%; n = 389) having a general high school qualification, while 1.8% (n = 7) had an art high school background. Only 1.0% (n = 4) had other qualifications. In terms of devices used, most of the students (39.8%; n =159) had laptops for their job, while 34.5% (n = 138) and 25.8% (n = 103) used a PC or iPhone, respectively. A majority of the respondents (85.5%; n= 342) reported to have never attended any workshops, while the rest (14.5%; n = 58) had attended some of the workshops. Table 5 summarises the demographic information of the respondents and the universities that were involved in this study.

Table 5. Demographic information of respondents.

Characteristics	N	%
Age		
17-18	71	17.8
19-20	276	69.0
21-22	31	7.8
More than 23	22	5.5
Qualification		
General High School	389	97.3
Art High School	7	1.8
Others	4	1.0
University Name		
University A	172	43.0
University B	58	14.5
University C	170	42.5
Previous Experience		
0	51	12.8
1-2	68	17.0
3-4	230	57.5
More than 5	51	12.8
Device Used		
PC	138	34.5
Laptop	159	39.8
iPhone	103	25.8
Workshop Attended		
No	342	85.5
Yes	58	14.5

Part 2: Confirmation Factor Analysis And Structural Equation Modelling

In Structural Equation Modelling (SEM), there are two types of modelling: measurement and structural modelling. These models need to be executed when testing the research hypotheses. In the case of the measurement model, the Confirmatory Factor Analysis (CFA) is performed to validate or evaluate the measurement model by inspecting their factor loadings, fitness indices, and construct correlation. According to Hair et al. (2010), the results from the structural model would be biased if the validation of the measurement model fails. Therefore, the measurement model needs to first be satisfied by modifying the model (e.g. delete poor loadings) in order to increase the measurement fitness (Bakar et al., 2016; Kline, 2016; Byrne, 2010). In this study, individual and pooled CFA is used to assess the measurement fitness. The purpose is to produce a robust result before testing the hypothesis.

The study has six exogenous constructs and one endogenous construct. All constructs have undergone the Exploratory Factor Analysis (EFA) procedure to assess their dimensionality. The model has one endogenous construct, namely actual use, and six exogenous constructs, namely behavioural intention, perceived usefulness, perceived ease of use, self-efficacy, instructional design, and technical support. All constructs are measured in the form of the first-order construct. These constructs were assessed by several items as follows:

1. Actual use: AU1, AU2, AU3, AU4, AU5, AU6, AU7, AU8, AU9, and AU10.
2. Behavioural intention: BI1, BI2, BI3, BI4, BI5, BI6, BI7, and BI8.
3. Perceived usefulness: PU1, PU2, PU3, PU4, PU5, PU6, PU7, and PU8.
4. Perceived ease: PEU1, PEU2, PEU3, PEU4, PEU5, PEU6, PEU7, PEU8, PEU9, and PEU10.

5. Self-efficacy: SE1, SE2, SE3, SE4, and SE5.
6. Instructional design: ID1, ID2, ID3, ID4, ID5, and ID6.
7. Technical support: TS1, TS2, TS3, TS4, TS5, TS6, and TS7.

Confirmation Factor Analysis (CFA):

The global fitness index is used to assess the measurement model in order to ensure that the empirical data can be tailored with the proposed measurement model. The fitness indices achieved the required level as suggested by previous researchers. However, three out of 54 items (e.g. AU4, AU8, and SE5) showed a low factor loading (< 0.60) implying that these items are not meant to assess the actual use and self-efficacy construct. Hence, these items were deleted. The finalised pooled CFA is presented in Figure 3.

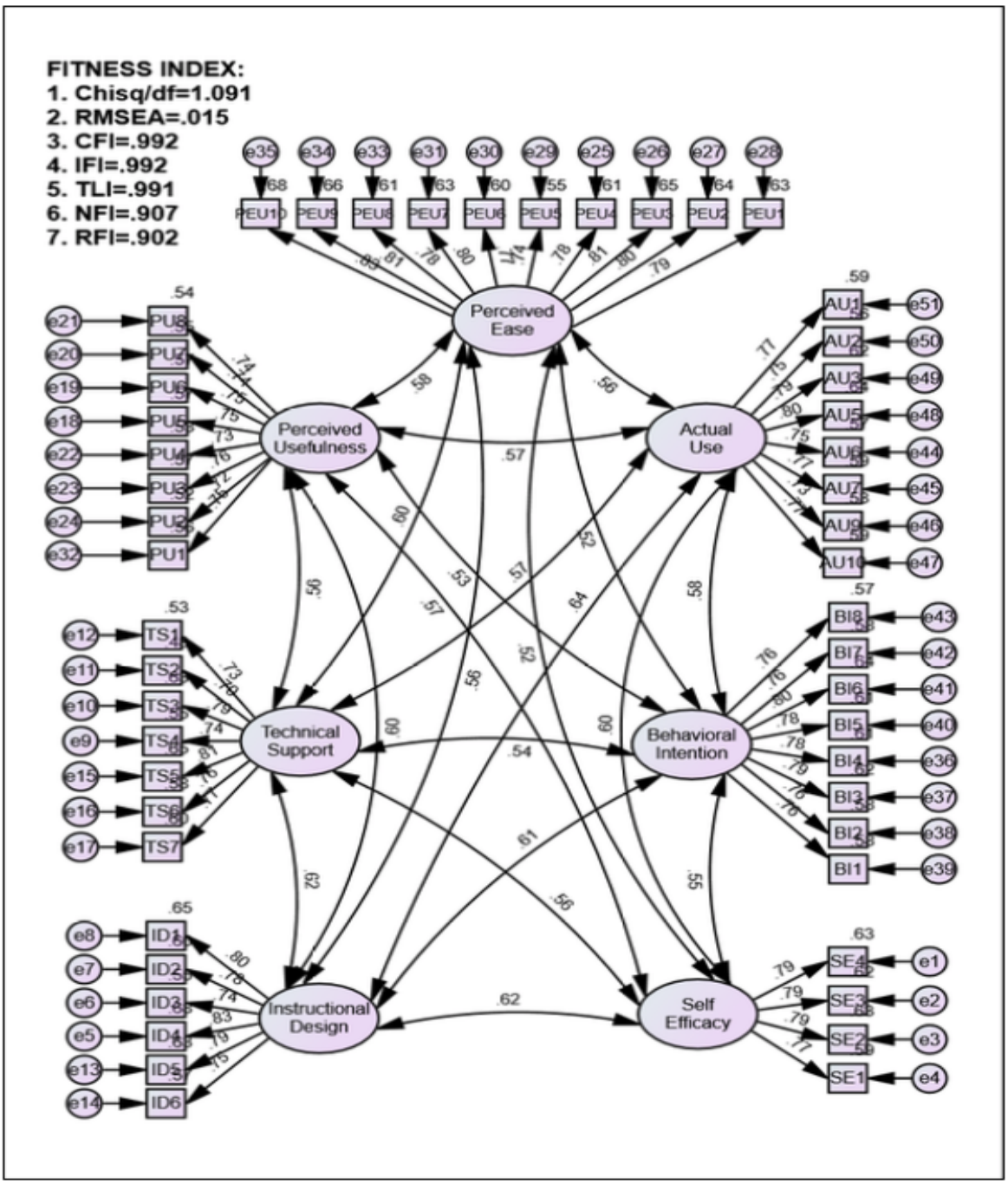

Figure 3. Pooled CFA.

The pooled CFA is known as the best approach to validate the measurement model because it can take various forms of measurement errors and construct correlations (Hair et al., 2010). This implies that a large number of constructs can be handled in the same treatment. Moreover, it can avoid the identification problem due to the lack of item per construct (Awang, 2015). As a result, the use of pooled CFA is a method of choice for those interest to the structural equation modelling. This method can assess the construct correlations by applying the double-headed arrow between the constructs involved. At the first step, the fitness index of this model needs to be considered and followed by the factor loading, reliability, and validity.

Table 6. The fitness indices results (full model).

Name of category	Name of index	Index value	Decision
Absolute fit	RMSEA	0.015	Achieved the required level
Incremental fit	CFI	0.992	Achieved the required level
	IFI	0.992	Achieved the required level
	NFI	0.907	Achieved the required level
	RFI	0.902	Achieved the required level
Parsimonious fit	Chisq/df	1.091	Achieved the required level

The fitness indices' results for pooled CFA are shown in Table 6. The absolute fit (RMSEA) is achieved as it is lower than the threshold value (< 0.08). Meanwhile, the incremental fit was assessed by CFI, IFI, NFI, and RFI, and all of their indices are achieved as their index values are above 0.90. Moreover, the Parsimonious fit was represented by the assessment of Chisq/df which shows that its index value is at an excellent level because it is below the threshold of 3.0. Therefore, the model was achieved and satisfied in terms of the construct validity. To assess the construct reliability and convergent validity, the composite reliability and AVE are reported in Table 7. This table shows the CR and AVE for all constructs.

Table 7. Criteria for convergent validity (all constructs).

Constructs	Items	CR	AVE
Actual Use (AU)	8	0.919	0.586
Behavioural Intention (BI)	8	0.923	0.600
Perceived Usefulness (PU)	8	0.907	0.550
Perceived Ease of Use (PEU)	10	0.943	0.625
Self Efficacy (SE)	4	0.866	0.618
Instructional Design (ID)	6	0.904	0.612
Technical Support (TS)	7	0.904	0.574

It can be seen that the recommended value for CR which is above 0.60 and AVE which is above than 0.5 have been met. Therefore, the construct reliability and convergent validity for this model are achieved.

Lastly, the discriminant validity is performed. Discriminant validity is the extent to which the measure is indeed novel and not simply a reflection of other constructs (Hair et al., 2010). This means that all the constructs involved in the empirical study should differ from each other to capture the information independently. The discriminant validity is considered satisfied when the constructs' correlations are less than 0.85 (Kashif et al., 2016). The summary of the discriminant validity indices is presented in Table 8.

Table 8. Discriminant validity.

	BI	TS	SE	ID	PU	PEOU	AU
BI	0.775						
TS	0.537	0.758					
SE	0.551	0.556	0.786				
ID	0.613	0.615	0.624	0.783			
PU	0.533	0.560	0.570	0.605	0.742		
PEOU	0.519	0.601	0.518	0.559	0.577	0.791	
AU	0.578	0.566	0.604	0.640	0.574	0.557	0.766

The diagonal values in Table 8 are the square root of the AVE for each respective construct, while the other values are the correlations between constructs. The expected discriminant validity is achieved when the bold value is higher than the values of their constructs' correlations (Awang, 2015). In other words, discriminant validity is achieved if the value (in bold) is higher than any other value in its column and row. It should be noted that the model is not claimed satisfied if discriminant validity is failed. This is because the construct proposed in the research model should differ from each other which could capture information independently. In this case, discriminant validity is achieved as all values in bold for each construct are above than the values of its correlations with other constructs.

Structural Equation Modelling (SEM)

An SEM procedure contains two types of outputs, namely unstandardised and standardised regression weights. The unstandardised regression weight could be considered as the true value yielded from SEM result. Meanwhile, standardised regression weight is the standardised value that can produce the value range from 0 to 1. It consists of a standardised beta coefficient between constructs, the factor loading of items, and R^2 for both items and equation. Therefore, most researchers use the standardised regression weight when they want to find out the factor loading, R^2, and the standardised beta coefficient between constructs. This can help the researcher to identify the strength of the path relationships. However, the unstandardised regression weight (beta estimates) is essential in statistics to compute the critical ratio for hypothesis testing. The standardised estimate model was first run and presented in Figure 4.

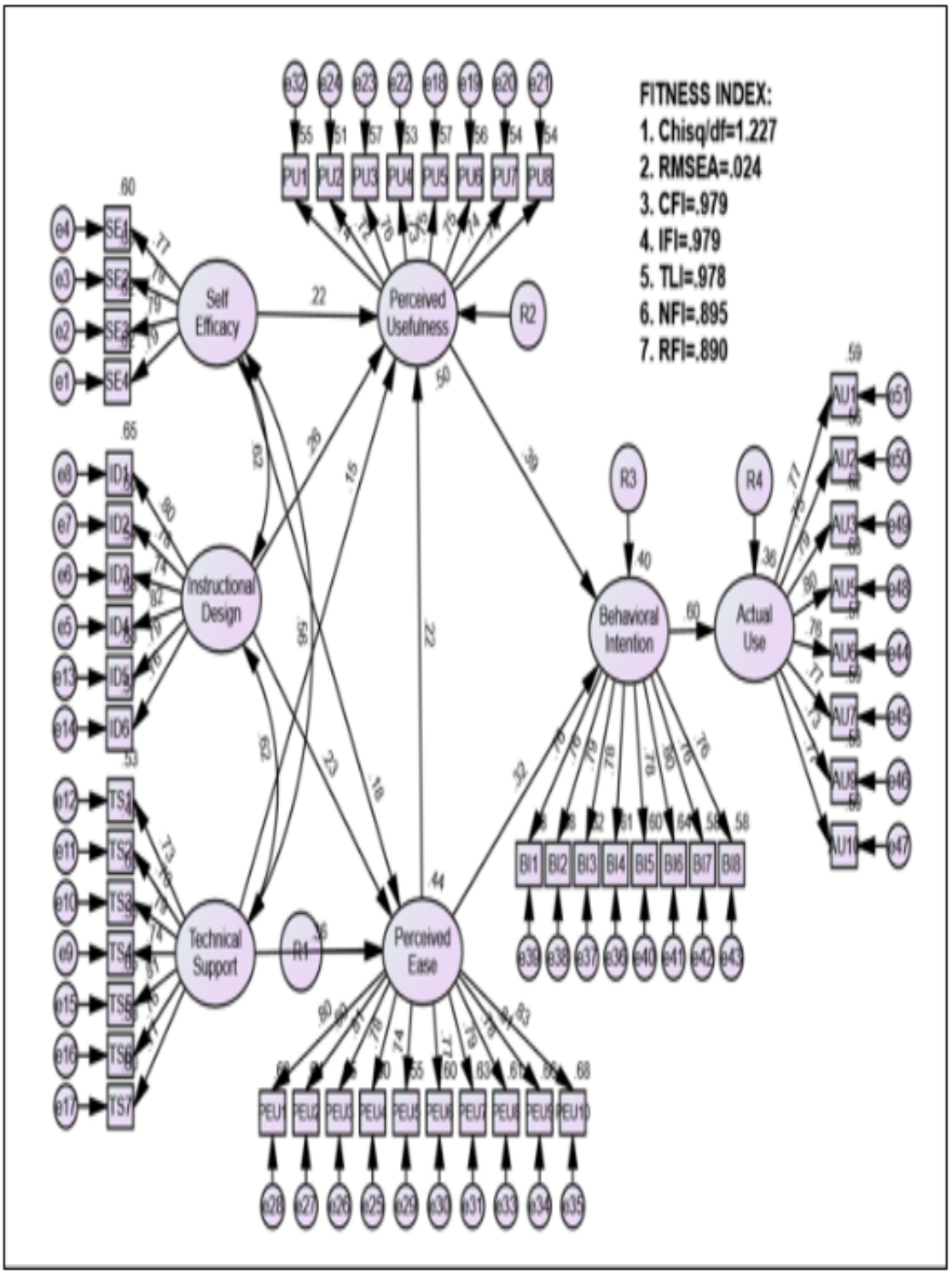

Figure 4. The standardised estimate model.

The results of the proportion of variance or square multiple correlations is shown in Table 9. As mentioned earlier, the endogenous construct of this study is actual use. The other constructs involved in the current study are recognised as an exogenous construct. The R^2 appeared in this study is 0.36 which indicates that 36.0 % of actual use is explained by the behavioural intention construct. Among exogenous constructs, perceived usefulness is considered as the main contributor in predicting the actual use which was 50.3%.

The amount of variance explained in perceived ease is much lower than the perceived usefulness which was about 44.3%. This variance could be due to the effects contributed by three predictors of self-efficacy, instructional design, and technical support. The contribution of perceived usefulness is higher than perceived ease in this model. Nevertheless, both perceived usefulness and perceived ease contribute 39.8% of the explained variance to behavioural intentions. Table 9 provides all the information related to the results of the square multiple correlation (R^2).

Table 9. Square multiple correlation (R2).

Constructs	Estimate
Perceived Ease	0.443
Perceived Usefulness	0.503
Behavioural Intention	0.398
Actual Use	0.361

Structural Model (Unstandardised Estimate):

The unstandardised estimate model is essential to unstandardised the regression weight (beta estimates) and to compute the critical ratio for hypothesis testing. The unstandardised estimate model is shown in Figure 5.

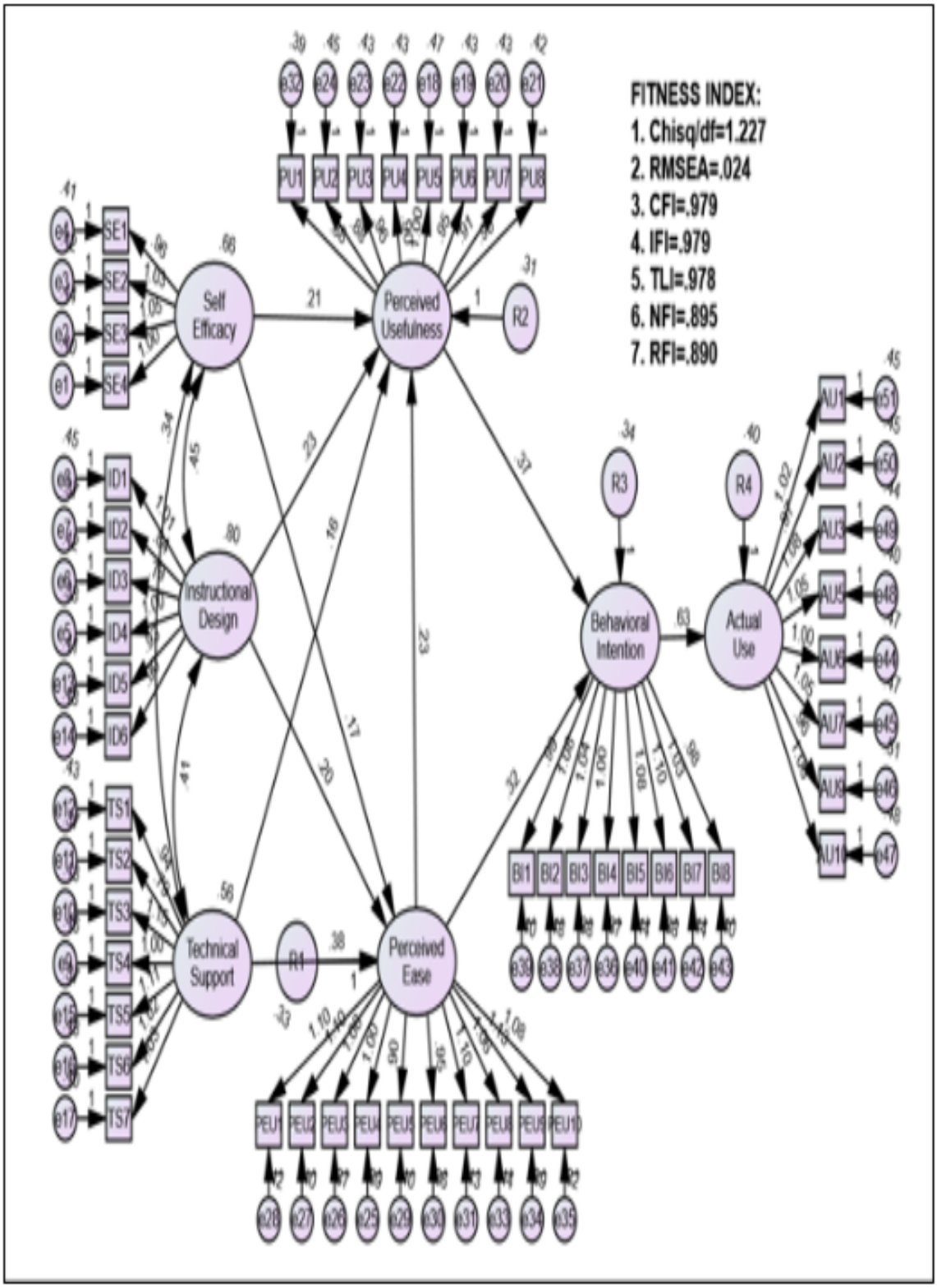

Figure 5. Unstandardised estimate model.

Table 10 shows the regression weigh for between constructs in the model.

Table 10. Regression weights.

Path			Estimate	S.E.	C.R.	P	Result
Self Efficacy	→	Perceived Ease	0.167	0.059	2.835	0.005	Significant
Instructional Design	→	Perceived Ease	0.199	0.056	3.548	***	Significant
Technical Support	→	Perceived Ease	0.376	0.065	5.807	***	Significant
Self Efficacy	→	Perceived Usefulness	0.208	0.060	3.437	***	Significant
Instructional Design	→	Perceived Usefulness	0.232	0.058	4.025	***	Significant
Technical Support	→	Perceived Usefulness	0.160	0.066	2.435	0.015	Significant
Perceived Ease	→	Perceived Usefulness	0.226	0.059	3.830	***	Significant
Perceived Usefulness	→	Behavioural Intention	0.371	0.058	6.413	***	Significant
Perceived Ease	→	Behavioural Intention	0.316	0.057	5.587	***	Significant
Behavioural Intention	→	Actual Use	0.630	0.060	10.489	***	Significant

Results of Hypothesis Testing

Table 11. Results of hypothesis testing.

Hypothesis	Results
H1: Self Efficacy has a significant impact on Perceived Ease	Supported
H2: Instructional Design has a significant impact on Perceived Ease	Supported
H3: Technical Support has a significant impact on Perceived Ease	Supported
H4: Self Efficacy has a significant impact on Perceived Usefulness	Supported
H5: Instructional Design has a significant impact on Perceived Usefulness	Supported
H6: Technical Support has a significant impact on Perceived Usefulness	Supported
H7: Perceived Ease has a significant impact on Perceived Usefulness	Supported
H8: Perceived Usefulness has a significant impact on Behavioural Intention	Supported
H9: Perceived Ease has a significant impact on Behavioural Intention	Supported
H10: Behavioural Intention has a significant impact on Actual Use	Supported

DISCUSSIONS AND CONCLUSION

This study aimed to develop a model based on TAM to examine the factors, namely technical support, perceived self-efficacy, and instructional design that influence the students' usage of LMS in Saudi universities. Data was collected from a sample of 400 students from three Saudi universities. The developed research model was tested and analysed using structural equation modelling. The results of the study generally support the developed model and confirmed the influence of technical support (TS), perceived self-efficacy, and instructional design on the students' use of LMS in Saudi universities.

Starting with the perceived self-efficacy, the students' perceived self-efficacy was found to be a significant factor in determining the usage of technology (as shown in Figure 6) which is consistent with the findings of previous studies (Panda & Mishra, 2007; Holden & Rada, 2011; Fathema et al., 2015). Furthermore, the results revealed that perceived self-efficacy had a significant positive effect on both perceived ease of use (PEU) and perceived usefulness (PU) (SE→PEU: $\beta = .167$, $p<0.05$); SE→PU: $\beta = .208$, $p<0.05$). The finding of this study is consistent with most prior studies (Ong, et al., 2004; Ong &Lai, 2006; Yuen & Ma, 2008; Park, 2009; Fathema et al., 2015). In practice, the findings indicate that students with a higher self-efficacy find LMS easy to use and useful when it is compared with students with lower self-efficacy. In other words, students who are confident in their skills when dealing with LMS, such as knowing the LMS

functions, operating the LMS features, dealing with the learning contents, etc., find LMS easy to use and useful technology and experience less complexity with using it. Consequently, confident students use LMS more than those who are less confident. This can be justified by the theory of Bandura (1986) who stated that higher self-efficacy leads to a more active process of learning. Students who have more self-efficacy on using LMS find it easier and they will be more likely to use it.

However, the findings of this study are also inconsistent with some previous studies which proved that perceived self-efficacy (PSE) had no influence on perceived usefulness (PU) (Motaghian et al., 2013; Cigdem & AuzTurk, 2016). The interpretation of their findings could mean that students nowadays enter universities with more experience and knowledge of technologies compared to their predecessors. This is a result of the rapid spread of computers and the internet in the educational settings. As a result, students' self-efficacy is already improving day by day. This could be a reason for asserting that perceived self-efficacy does not seem to influence the perceived usefulness. In other words, perceived high self-efficacy might not necessarily make the technology useful. Al-Haderi (2013) also found out that perceived self-efficacy had an insignificant effect on perceived usefulness of information technology. He provided an explanation that an information system is composed of sub-systems working together which may not be synchronised or integrated effectively. Once that happens, managers and employees perceive the system as not being useful. Future studies should be carried out to examine this precise relationship between these two constructs.

The findings also revealed that technical support was a significant factor that determines the usage of LMS (Figure 6). Technical support has a direct positive effect on both perceived ease of use and perceived usefulness (TS→PEU: $\beta = .376$, $p<0.05$; TS→PU: $\beta = .160$, $p<0.05$). The results of this study are consistent with most prior studies (Ngai et al., 2007; Sa´nchez & Hueros, 2010; Sa´nchez et al., 2013). In practice, the findings indicate that students who have a technical assist, understand the provided assistance that can be through the web, email etc., are keener and more motivated toward learning, and more receptive toward the use of LMS. In other words, the better the technical support and assistance provided to learners to help them solve problems, the easier and useful LMS usage that students find.

However, the result of this study is also inconsistent with Baleghi-Zadeh et al. (2017) study which revealed that technical support had a significant effect on perceived ease of use, but not on perceived usefulness. Their findings could mean that when technical support is provided, it would make technology easier to use, but not useful.

As far as the instructional design factor is concerned, the findings revealed that instructional design determines the usage of LMS (Figure 6). It has significant effects on both perceived ease of use and perceived usefulness (ID→PEU: $\beta = .199$, $p<0.05$; ID→PU: $\beta = .232$, $p<0.05$). This result is consistent with previous studies (McGiven, 1994; Liu et al., 2010; Al-Ammary et al., 2014). The findings indicate that having a clear and simple instructional design of LMS leads to increasing the students' perceived usefulness and ease of use it. In other words, if the instructional design of LMS is clear and simple with user-friendly features, then the student perceives LMS as easy and useful to use, which then influences their behavioural intention in using it.

However, the findings of this study is inconsistent with some previous studies such as the study of Hong (2002) and Ros et al. (2015), who found that instruction design has a significant influence on only perceived ease of use but not on perceived usefulness. The interpretation of their findings may indicate that if the instructional design is provided such as it is clear, simple, and has a user-friendly interface, then that would make the use of LMS easy but this does not guarantee that it will make it useful.

Previous studies have shown the importance of instructional design in determining the acceptance and usage of different systems. Hussein et al. (2007) examined the influence of instructional design along with other external factors in students' usage of e-learning in the Indonesian Open University. The findings of their study revealed that instructional design has a significant effect on both perceived ease of use "PEOU" and on perceived usefulness "PU", which influences the students' use of e-learning. Al-hawari and Mouakket (2010) examined the effect of instructional design features on the students' e-retention and satisfaction level of e-learning. Their results suggested that instructional design must be considered for increasing students' e-retention and satisfaction toward e-learning.

The instructional design in this study is also found to be a significant factor that determines the acceptance and usage of LMS. It has a significant effect on both perceived ease of use and perceived usefulness, which

in turn has an increasing influence on the students' behavioural intention toward the usage of LMS. Thus, a well instructional design in LMS attracts students and further motivates them towards its acceptance and usage. It will make them perceive LMS as easy to use and useful, which results in building a positive impression toward the use of LMS. This positive behaviour leads to the use of LMS. Several studies showed the higher power of instructional design compared to other factors in determining the acceptance and usage rate of technology. Hussein et al. (2007) found that instructional design had more influence than the instructor's characteristics and convenience in explaining and determining the use of e-learning. Grandon et al. (2005) found convenience to be a weak factor in explaining the users' acceptance of online learning. The results of this study also confirm this fact. Instructional design, as an external factor in the model, had a higher significant influence on perceived usefulness ($\beta = 0.232$) when compared with other external involved factors, namely technical support and self-efficacy. This shows the importance of considering instructional design for determining the acceptance and usage of LMS.

The findings of this study confirm the significant relationships that exist between the TAM constructs: PU, PEU, BI, and AU in the context of LMS and students' usage (Figure 6). It was also revealed that PU of LMS was significantly determined by PEU of LMS. Furthermore, these constructs have a significant effect on students' behavioural intention (BI), which has a significant effect on the students' usage (AU) of LMS. These findings are in line with most previous studies (Mun & Hwang, 2003; Saade & Bahli, 2005; Lee et al., 2009; Al-ammary, 2014; Fathema et al., 2015; Alkış et al., 2017). These outcomes are in line with the claim of Davis (1989). In the LMS usage context, the claims of Davis (1989) can be illustrated as: students first evaluate how easy or difficult it is to work with LMS, then they look how useful using LMS is for them. If they find LMS as "easy to use" and "useful" technology, then they will have a positive intention toward using it. Finally, this positive intention leads to their actual use of LMS. The study's findings illuminate the underlying relationships between the proposed external constructs and the existing TAM's constructs. Therefore, all of the original TAM constructs significantly explained students' use of LMS. Furthermore, the external constructs: technical support, perceived self-efficacy, and instructional design directly or indirectly influence students' behavioural intention and their actual use of LMS.

Implication

The study revealed that technical support is a significant salient factor which shapes students' usage of LMS in Saudi universities. Therefore, policy makers and universities should focus on technical support for improving the usage of LMS. Several recent studies were conducted in Saudi Arabia such as a study conducted by Al-Shehri (2010), AlMegren & Yassin (2013), and Alqahtani (2017), which found out that universities might lack in providing the technical support for supporting technologies and e-learning. Therefore, providing the required technical support in universities is essential and will support students toward the usage of LMS. Moreover, there is a need for identifying other barriers such as poor networks, lack of technical support, and addressing them in order to ensure and increase the usage of LMS among students. Universities should dedicate more resources, time, and strong technical support for students to motivate them toward using LMS. A failure to provide the required technical support to the students for using LMS may lead to the decrease or prevention of its usage.

This study has revealed that perceived self-efficacy is a vital factor that determines the usage of LMS among students in Saudi universities. This indicates that improving students' self-efficacy on LMS usage is an important issue to focus on. Thus, university authorities are advised to focus on providing students with training, regular support, online help, and communication for LMS use. An extensive and consistent training programme would provide students with the opportunity to become skillful in using LMS. These training programmes would assist beginner students to be more comfortable and familiar with using at least the basic features of LMS. These programmes will also help students who have a basic understanding of the usage of LMS features to be confident in dealing with the advanced LMS capabilities.

When a new LMS is implemented, it is essential to inform students about its features and usage. This will enable the students to have a deep understanding of LMS features and feel more confident with using it. This can be achieved by providing training programmes and workshops. According to Fathema and Sutton (2013), the users reported that they would like universities to offer them an extensive training programme

and workshops on the features of LMS, benefits, and its usage to assist in increasing the use of LMS among them. In a recent survey, 57% of faculty members indicated that they will be more active and effective in using LMS in their courses if they were better skilled (Dahlstrom et al., 2014). Therefore, to increase the students' self-efficacy and ensure the increased usage of LMS, Saudi universities should provide periodic training sessions and online help on LMS usage. These will help students to have more experience, improve their skills, and be more competent with using LMS, which in turn will increase their usage of LMS.

This study showed that instructional design of LMS was a strong significant factor that determines the usage of LMS among students in Saudi universities. Therefore, LMS university policy makers and designers should focus and pay more attention to improving the LMS instructional design to make it much easier and usable for students. The user-friendly interface, features, contents, and easiness to use need to be periodically monitored and developed based on students' needs. To develop a better instructional design of LMS, a continuous process of the instructional design improvement should be evolved, which requires collecting a feedback from LMS users about the design of LMS, problems that they may face, recommendation and suggestion for improvements, and based on that, set a plan and commit a quick action for improvement accordingly. Universities should update and improve LMS instructional design regularly so that it can assist and support students more efficiently toward the usage of LMS.

As the instructional design of LMS has a strong influence on LMS usage and it influences both perceived ease of use and perceived usefulness, which was confirmed by this study, it is important to ensure that students will actually use it. To achieve this goal, more attention should be given to design user-friendly interfaces, well-depicted icons and buttons, high-quality interface style, and easy navigation flow. Designers and developers of LMS can invest efforts in offering different customised interfaces for different students' needs to accommodate their different background needs and knowledge. Moreover, universities should arrange training programmes for introducing the LMS instructional design features to make it easier and increase students' knowledge about how to use it more effectively. If all of these steps are taken and the instructional design of LMS becomes clear and simple, students will then perceive LMS as easy to use and useful, which will in turn their behavioural intention and lead to the increased usage of LMS.

Contribution

Theoretical Contribution

The underlying purpose of this research was to develop a model based on TAM for LMS utilisation in the sector of higher education in Saudi Arabia. To achieve this, the current study has developed a model based on TAM and confirmed the influence of three external factors on students' usage and utilisation of LMS. Technical support, perceived self-efficacy, and instructional design, in addition to original TAM constructs: perceived ease of use, perceived usefulness, and behavioural intention are shown to be significant determinants of LMS usage among students in Saudi universities. This research substantially contributes to the literature, specifically to TAM literature by providing a developed model and confirming the influence of its external factors on the utilisation of LMS. The findings of this study confirmed the explanatory power of extended TAM and original TAM constructs in determining LMS usage.

Limitation

Similar to any research project, this study has its own limitations. The factors that influence the usage of LMS have been investigated. Heterogeneous Purposive Sampling is used in this study to collect data from students in three Saudi government Universities who use different LMS platforms: Moodle, Desire2Learn, and Blackboard. Therefore, the results of this study might be restricted to that particular settings. The replication of this study with different sample groups (such as focusing on academics or administrators) and other settings (such as different applications) could also help in understanding the implication of the extended TAM. The future researchers may consider examining the influence of the three external factors: technical support, perceived self-efficacy, and instructional design on the usage of different applications and different sampling groups.

Moreover, this study conducted a quantitative research. However, undertaking a qualitative study could reveal further details and deep personal opinions to explain the relationships between all constructs in the proposed developed model.

Furthermore, the participants of this study were students from three Saudi universities. However, students in private Saudi universities may differ from those who are in Government universities in terms of lifestyle, educational experience, and background etc. Therefore, more studies are expected to focus on those who are enrolled in private universities.

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APPENDIX

The Questionnaire

Please tick (√) at your best choice to each item below:

Technical Support (TS) (while using LMS)

1	A help desk always available
2	A hotline always available
3	Enquiries through the website can be done
4	Enquiries by e-mail can be done
5	A person or group are available for assisting me with solving the problem
6	A clear educational instruction in software is available to help me
7	A clear educational instruction in hardcopy is available to help me

Perceived Self-Efficacy (PSE) (while using LMS)

1	I can freely navigate the course contents
2	I can use LMS without getting detailed instruction on its use
3	I can overcome the obstacles that appear
4	I can use it if system manuals are not available
5	I have the necessary skills for using LMS

Instructional Design (ID) (while using LMS)

1	The information I need is easy to find
2	The learning objectives are clearly stated in each lesson
3	The content of the course is clear and simple
4	The content of course meets all my needs in the learning
5	I'm satisfied with the course quality
6	Generally, I'm satisfied with the design of course content

Perceived Usefulness (PU) (while using LMS)

1	It would improve the performance of my learning
2	It would increase my productivity in learning
3	It would enhance my effectiveness in learning
4	It would make the learning process easier
5	It would improve the quality of my learning
6	It would enable me to control my learning
7	It would support the critical aspect of my learning
8	Over all, I would find it useful in my learning

Perceived Ease of Use (PEU) (while using LMS)

1	I find using it easy for me
2	I feel that my interaction with it would be understandable and clear
3	I feel that it would be easy to become skilful with using it
4	I would find it to be flexible to interact with
5	Learning how to operate it would be easy for me
6	It would be easy for me to let it do what I want it to do
7	It would be easy for me to remember how to perform tasks
8	I do not find it cumbersome to use
9	It would not make the learning often frustrating
10	It would not require a lot of mental effort

Behavioral Intention to Use LMS (BU) (assuming that I have access to LMS)

1	I intend to use LMS for assisting my learning activities
2	I intend to use LMS as often as possible
3	I will use LMS in the future
4	I intend to increase my use of LMS in the future
5	I will use frequently LMS in future
6	I intend to use LMS more than any alternative applications
7	I intend to use LMS because of flexible time
8	I intend to use LMS because of the current trend in the 21st century education

Actual Use of LMS (AU)

1	The frequency that I use LMS for my learning
2	I use it for following the advertisement of my lecturer regarding my courses
3	I use it for viewing all different uploaded files such as MS, PDF and Videos
4	I use discussion forums for asking questions and sharing knowledge
5	I use it for submitting my assignments
6	I use it for doing online quizzes
7	I use it for checking my results
8	I use it for checking the comments received by my lecturer
9	I use it for communicating with my peers
10	I use it for communicating with my lecturers

THE INVESTIGATION OF NOVICE PROGRAMMERS' DEBUGGING BEHAVIORS TO INFORM INTELLIGENT E-LEARNING ENVIRONMENTS: A CASE STUDY

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ABSTRACT

This study aims to provide a comprehensive and in-depth investigation of the debugging process in programming teaching in terms of cognitive and metacognitive aspects, based on programming students who demonstrate low, medium, and high programming performance and to propose instructional strategies for scaffolding novice learners in an effective way. Data were collected from 41 novice programming students from C++ and Python programming language courses of the same instructor in the scope of case study methodology, and data instruments included paper-based programming questions. The questions were framed under three categories as questions' difficulty levels (low, moderate and high), error types (syntax and logic), and question types (if-else and while). As having three categories, a total of 12 different data (3x2x2) were taken from each student, which means 492 data rows were evaluated in the study. Chi-square test results revealed that while error detection and correction are significantly high in low difficulty level questions, error detection and error correction attempts for logic errors were substantially higher compared to syntax errors. Further analysis conducted for paper-based markings that were used by students throughout their error detection, correction, and completion attempts. Chi-square test results revealed significant relationships between marking availability and error types, as well as difficulty levels. Results were discussed for both traditional learning and e-learning environments in terms of what kind of educational implications and strategies can be outlined by data for increasing the effectiveness of programming education for novice learners.

Keywords: Programming instruction, debugging, novice programmers, correlational study, intelligent e-learning environments

INTRODUCTION

Programming is a complex process where there are many sub-stages, and each sub-stage requires different knowledge and cognitive activities (Ambrosio, Costa, Almeida, Franco, & Macedo, 2011). This complex process can be a challenging and disappointing situation for novice learners (Fitzgerald et al., 2008). Studies conducted in the field of cognitive psychology stated that programming is beyond low-level mental activities (Weinberg and Shulman, 1974). Besides, studies on programming claim that debugging in programming are one of the critical indicators of one's programming skills (Ahmadzadeh, Elliman, & Higgings, 2005; Fitzgerald et al., 2008; Ko & Myers, 2003; Nivala, Hauser, Mottok & Gruber, 2016). Several studies have described the debugging process as a complex cognitive activity that requires different types of information

and a complete mapping of the programming process (McGill & Volet, 1997; Soloway & Ehrlich, 1984). That is, comprehending programming is a complicated process for students (Lin et al., 2016). Researchers conducted various studies on programming. The common point of all these studies is to examine the pedagogical tools and methods that can make the programming skills of the novice programmers more effective (Brooks, 1977; Lin et al., 2016; Renumol, Janakiram, & Jayapraksh, 2010; Xu, & Rajlich, 2004). One of these studies emphasized the importance of the teacher's appropriate guidance in acquiring debugging skills and stated that students should be encouraged to develop the cognitive skills necessary for debugging. In addition, it emphasized the importance of developing adaptive teaching strategies with educational media. However, to develop these strategies with media, it is necessary to study the cognitive processes during debugging processes (Lin et al., 2016). Lin et al. (2016) reviewed the cognitive processes of novice learners when they are engaging in debugging activities. The study was based on low and high-performance programming skills during debugging. They suggested that students should be divided into groups according to their programming success, providing an environment where they could think aloud and creating a note-taking the field on the screen for the debugging process. Apart from examining programming in terms of cognitive processes, some studies have made suggestions to make these processes more productive, and some have examined the effectiveness of instructional tools that have been developed based on various instructional strategies. While a number of studies emphasized the effectiveness of the developed instructional tools (Salleh, Shukur, & Judi, 2018; Stachel et al., 2013), others stated that the tool they developed was not effective (Denny, Luxton-Reilly, & Carpenter, 2014).

Debugging in programming is the process by which programmers can determine the potential errors in the source code and resolve these errors. There are three types of errors, regardless of the programming language, which are syntax errors, system errors, and logic errors. Syntax errors are caused by incorrect use of the programming language syntax or violations of syntax rules, which are the errors that can be captured easily by compilers. System errors are errors that can be detected when the program is running, and they are mostly related to numerical calculations. Lastly, logic (semantic) errors, which are caused by incorrect translation of the algorithm, is the type of error that compilers cannot determine. However, it is possible for the programmers to carefully detect the logic errors in the source code in their minds (Savitch, 2012). Numerous studies on programming have focused on error types. Although logic errors are perceived more challenging to detect and correct, various studies have indicated that the detection and correction of syntax errors are not as easy as it is thought (Denny et al., 2014; Hristova, Misra, Rutter, & Mercuri, 2003; McCauley et al., 2008). One of these studies claimed that the error messages given by the compiler should be more meaningful to be understood by students (Hristova et al., 2003).

Denny et al., (2011) claimed students at different levels of programming knowledge experienced difficulty in debugging syntax errors. They observed that even the top quarter students in the classroom had more difficulty than they expected in correcting syntax errors. Literature suggested enhanced compiler feedback as a solution to this issue. Denny et al. (2014) developed an enhanced feedback module for syntax errors; however, empirical study results revealed the ineffectiveness of the module and offered follow-up researchers for investigation of compiler feedbacks. On the other hand, numerous studies conducted on logic errors. Based on the literature review of Hristova et al. (2003), conducted a study on Java programming language errors. They analyzed both their own programming experience and faculty's, teaching assistants', and students' experienced and revealed six common logic errors. These are (p. 155):

1. Improper casting,
2. Invoking a non-void method in a statement that requires a return value,
3. Flow reaches the end of the non-void method,
4. Methods with parameters: confusion between declaring parameters of a method and passing parameters in a method invocation,
5. Incompatibility between the declared return type of a technique and in its invocation,
6. Class declared abstract because of the missing function.

Debugging has a critical role in programming. Several studies stated that students who are competent in debugging are also skilled in programming (Ahmadzadeh, Elliman, & Higgings, 2005; Fitzgerald et al., 2008). While some studies claimed that debugging is one of the two essential skills that show competence in

programming (Nivala, Hauser, Mottok, & Gruber, 2016), some have taken this claim to a higher level and argued that debugging is at the highest importance in programming (Ko & Myers, 2003). By the fact that this importance, debugging can be complicated, and novice learners need to synthesize their new knowledge and skills with previous ones. Moreover, they need to use them effectively to create mental representations of these complex cognitive processes (Gilmore, 1991 & Lin et al., 2016). All these complexities during programming have a possible experience of frustration and difficulty when novice programmers do not acquire debugging skills at an acceptable level (Perkins & Martin, 1986).

Due to its critical importance in programming, various studies have examined the factors that affect the debugging skills of novice programmers (Putnam, Sleeman, Baxter, & Kuspa, 1986; Murphy et al., 2008). Besides, researchers who wish to conduct a systematic review for debugging processes seem to focus on the cognitive processes of students during debugging (Brooks, 1977; Renumol, Janakiram, & Jayapraksh, 2010; Xu & Rajlich, 2004). The common point of all these studies is to examine the pedagogical tools and methods that can make the programming skills of the novice programmers more effective. One of these studies emphasized the importance of the teacher's accurate guidance in acquiring debugging skills and offered students should be encouraged to develop the cognitive skills necessary for debugging skills. Besides, he emphasized that it would be essential to develop adaptive teaching strategies and educational media. However, to develop these strategies and media, it is necessary to study the cognitive processes in debugging processes (Lin et al., 2016).

Debugging in programming instructions pinpointing the novice debugging strategies has not been a hot research topic in Turkey context. This gap makes it challenging to design instructions for programming in align with the cultural considerations. When we examine learners' question-solving behaviors and cognitive levels on this level, it will be easier for us to identify instructional strategies and design and develop instructional materials for effective programming teaching. This study was framed by Lin et al. (2016)'s suggestions on debugging instruction under two concerns: (i) classification of learners according to programming skills and (ii) the need for paper-based debugging questions to see the relationship between types of programming questions and completion rate of these questions. By framing the study around this gap, problem-solving behaviors and learners' debugging performances characterized by the rates of error detection, error correction, and error completion will help us in offering instructional design issues for potential pedagogical tools considering novice programming learners at different skill levels.

Studies in Programming Instruction

Programming instruction is still a challenge due to its complex nature, which may cause misconceptions on learners' mental models and limited knowledge of what kind of environments may develop learners' programming skills. Cakiroglu (2012) conducted a quasi-experimental design and compared novice programmers' performance between blended and face-to-face sessions to examine the effectiveness of programming instructions in both mixed and face-to-face environments. He mentioned delayed tests showed face-to-face meetings were more effective on the increase in the performance. This finding brought us to the identification of the factors in instructional design on a computerized programming instruction environment for enhancing effectiveness. Although studies utilize the high correlation between problem-solving skills and programming, another point of view is having potential misconceptions of crucial concepts during learners engage in programming instructions. To specify these key concepts held by novice programmers, Ma, Ferguson, Roger, and Wood (2011) investigated the mental models of novice programmers and proposed a visualization program to scaffold novices by giving feedback to foster learners' understanding of key programming concepts.

Similarly, supporting novice programmers while they are engaging in programing instructions is a critical factor for improving learners' programming skills. Rum and Ismail (2017) examined metacognitive-related strategies that support programming learning. They proposed metacognitive scaffolding, reflective prompts, self-questioning, self-directed learning, and graphic organizers for computer-assisted programming learning.

Visualization in programming instruction and metacognitive support have been supported by findings as they have effective outcomes in programming comprehension, integrating these factors with multimedia courseware is an essential aspect in novice learners' understanding of abstract concepts in programming

(Annamalai & Salam, 2017). The investigation of tools providing metacognitive support for supplementing traditional courses. Fabic, Mitrovic, and Neshatian (2018) offered a mobile Python tutor platform, including activities for supporting debugging, code-tracing, and code writing skills. Their results revealed advanced programmers differed in terms of code writing skills compared to novice programmers, and novice programmers could not show any learning gain for coding writing. Although they found debugging others' programmers is beneficial for advanced programmers who require higher-order skills compared to code writing, it was not effective for novice programmers.

On the contrary, a longitudinal study has been offered the effectiveness of debugging for novice learners as well (Ahmadzadeh et al., 2005). Similar to this finding, Lee, Yu, Tang, Wong, and Poon (2017) experimented with the effectiveness of a virtual debugging advisor for novice programmers. This interactive environment was designed to analyze the students' programming outputs and suggested potential mistakes for them as an alternative for debugging. The results showed that, along with increased motivation of novice programmers during engaging in virtual debugging advice tool, provided feedback for them to foster their understanding of errors.

Learner Characteristics in Debugging Researches

Learner characteristics, including dichotomies such as expert/novice, experienced/inexperienced, or successful/unsuccessful, have an essential role in research focusing on debugging. Many of the research studies on debugging classified the learners based on these dichotomies and reported learning process and outcomes of these students by adhering to them (Bednarik, 2012; Fitzgerald et al., 2008; Lin et al., 2016; Rodrigo, Andallaza, Castro, Armenta, & Jadud, 2013).

Rodrigo et al. (2013) examined the data log of novice programmers based on their success rates on debugging and they have concluded that low-achieving and high-achieving students differ in understanding the basic programming concepts. In addition, Fitzgerald et al. (2008) classified novice learners based on their high and low success rates and examined the relationship between programming and debugging skills. The results showed that novices who are successful at debugging are also successful in programming activities; however, the novices who are successful in programming activities did not achieve the same success rate in debugging.

In another study, novice programmers classified based on their success rates, as being experienced or inexperienced (Bednarik, 2012). The study examined the visual attention strategies of experienced and inexperienced programmers and revealed that novices often go back and forth between code and output, however, experienced learners showed behaviors on using their prior knowledge while they are associating the code with output in a more systematic way. Similarly, Lin et al. (2016) have achieved similar results. They revealed that while low-performers showed flawless debugging behaviors and focused on syntactical details rather than the logical side of the codes. On the other hand, high-performers tend to break the code into meaningful pieces systematically and develop debugging strategies based on their prior knowledge.

Methodologies in Debugging Researches

Research studies conducted on debugging in programming show methodological differences. These methodological differences are mostly depending on the target group, type, and content of the used materials and research method. Yen, Wu, and Lin (2012) conducted a qualitative study on novice and expert programmers to classify the difficulty levels among different types of errors. They asked participants to think aloud throughout their debugging behaviors while using a compiler for syntax, semantic and logic errors. Study results showed that during the debugging process, syntax errors are more straightforward compared to semantic errors and semantic errors are more manageable compared to logic errors. In the study, two debugging exercises were presented to participants with a total of six errors, each with syntax, a semantic, and a logic error. At the end of the study, it was found that experienced programmers have a better understanding of the feedback received from the compiler, show similar thinking processes with novices during the debugging process, and predict the output of semantic errors. Besides, it is reported that novice programmers experience confusion while they are debugging for semantic errors and make a backward inference. This study reported the debugging time, the completion time and the frequency of debugging

the behavior. The frequency of debugging behavior was investigated in seven phases as comprehension, questioning, estimation, execution, observation, correction and confirmation. Also, Lin et al. (2016) assured that think-aloud protocol results in cognitive load during debugging so that to observe students' insight without verbalizing their actions, they preferred to use eye-tracking methodology. They conducted retrospective interviews with each participant after each programming task. Lin et al. (2016) reported that for debugging tasks, a computerized environment with note-taking field and conducting retrospective interviews after each task pose validity thread for an eye-tracking study.

Besides the difficulty levels among types of errors and differences powered by student characteristics, qualitative findings on students' markings during debugging may facilitate in understanding students' debugging behaviors. Ahmadzadeh, Elliman ve Higgins (2007), in their longitudinal experimental research with university students, observed changes in the markings on activities given as students' debugging experiences increased in 15 activities spread over the period. In the study, the number of errors and types of errors that students did during 15 weeks, online programming exam notes, and semantic errors was reported. At the end of this study, although the number of errors in conditional expressions, loops, methods, arrays, classes, and objects decreased for each student, no significant difference was found.

Nivala, Hauser, Mottok, and Gruber (2016) used Gilmore and Green's error classification framework in their work and prepared codes based on a surface level, the flow of control, structure of the plan and structural interaction. There are eight tasks in the study, and each task includes two stages, which are reading and response stages. They determined the reading phase as the time duration until the programmers began to write after they have shown the code, and the response phase includes the time duration, which they started to write until the question ended with pressing the end key. As a result of the study, experienced programmers reported a shorter saccade length and focus duration during the reaction phase and shorter focus durations in the reading phase. They also suggested for future studies that debugging durations for analysis should be added.

Intelligent E-Learning Systems in Programming

Recent researches have been focusing on students' behaviors to enhance their learning outcomes on intelligent e-learning systems within a variety of course domain such as mathematics education (Ozyurt, Ozyurt, Baki & Guven, 2014), and computer programming (Huang, Chen, Luo, Chen & Chuang, 2008). Also, based on students' profiles, systems may refer to personalized learning outcomes and procedures to them to enhance the educational effectiveness in those domains. Knowledge tracking via computer-aided learning or intelligent e-learning platforms seems to have become an essential way in programming education as well for personalized learning (Trifa, Hedhili & Chaari, 2019).

The personalization processes in the e-learning environment require a flexible and adaptive system for each student. Markovic, Kadoic, and Kovacic (2018) investigated the adaptivity criteria for a proposed prototype of an intelligent e-learning system. They mentioned that the selected adaptivity criteria, which are students' cognitive style, learning style, and learning goals, could be included for an adaptive intelligent e-learning system for better predictions of their learning progress. Moreover, Trifa, Hedhili and Chaari (2019) classified each students' response or question via an intelligent agent so that the accuracy rate of the students' learning outcome prediction was measured by considering any interaction that students make throughout their learning process. And, Trifa et al. (2019) discussed adding mod-related influencing factors such as stress, anxiety, and depression to have a better prediction rate of their learning outcomes.

By focusing on programming instruction, Huang, Chen, Luo, Chen, and Chuang (2008) proposed an e-learning tool for introductory programming courses based on an intelligent diagnosis and assessment. Their experimental study suggested that low-performance learners can be assisted effectively by providing immediate feedback after diagnosing learners' source codes and comments. Although this course of work constructs a learning diagnosis model for the learners during their planning of wrong solutions to guide them, influencing factors such as gender, grading, and other collaborative mechanisms are absent in the diagnosis model.

Similarly, a study emphasizing the importance of personalization in intelligent tutoring systems described student modeling as a critical factor (Chrysafiadi, & Virvou, 2013). The student-model keeps information about students' current and prior knowledge, misconceptions, knowledge gap, interests, etc. (Durrani & Durrani, 2010). Chrysafiadi and Virvou (2013) developed a method called PeRSIVA, which evaluates the effectiveness, validity, and accuracy of a student model. This model is a web-based learning environment for teaching C programming language. The study revealed that student performance is affected significantly by the utilized model. Besides, Liang et al. (2017) designed a student profile model by studying students' online learning behaviors at a deep level. They claimed that for the development of effective e-learning environments, the student-profile model has importance.

The studies mentioned above on intelligent e-learning systems show that tracking students' cognitive, metacognitive, and emotional knowledge is a complicated problem. For programming instruction, factors affecting students' programming behaviors are still a question mark to be asked. Mining debugging processes may bring a piece of knowledge about what kind of facilities should be embedded into the intelligent e-learning platforms to predict students' programming performance better and guide them in a way about their programming behaviors. This study constructs a foundation for this future e-learning platform by detecting students' debugging behaviors in a paper-based environment.

METHOD

Research Design

This study aims to provide a comprehensive and in-depth investigation of the debugging process in programming teaching in terms of cognitive and metacognitive aspects, based on programming students who demonstrate low, medium, and high programming skills and propose instructional strategies for scaffolding novice learners in an effective way. The research design that allows a detailed investigation of a subject, event, and person context is the case study. The case study is expressed as an in-depth examination of an environment, subject, person, or a particular event (Merriam, 1988; Yin, 2013; Stake, 1995). Bogdan and Biklen (2007) described the case study with a funnel metaphor. The case study begins with a wide opening, like a funnel, and the gap narrows as it moves downward. In case studies, the researchers aim to discover potential participants and places that may be the subject or source of the study. They try to find a clue on what is feasible and how to continue in the process. They think about when and how to collect data and focus on the point in which they want to move the study. When necessary, they can put the old plans aside and create new ones. In this process, the subject, place, participant, material, and theme of the research activities become more specific. That is, they move from broader and exploratory beginnings to more structured data collection and analysis.

In the present study, the case study was selected as the research methodology. The researchers agreed on the content of the paper-based debugging questions in line with a comprehensive literature review and elaborated discussions. Accordingly, it was decided to include course type (C++, Python) types of errors (syntax & logic), question types (if-else & while), question difficulty levels (low, moderate, & high), marking types (marking availability in general, note, strikethrough, underline, circle, and arrow), and course grades. When data collection started, the researchers have attempted to change the plan, if necessary. Thus, the aim of the research became more specific and progressed in a more specific direction. Since in case studies, generalizing the results is one of the major concerns, in this study, purposeful sampling is used rather than random sampling (Mills, Durepos, & Wiebe, 2010).

Participants

By using a purposeful sampling method, a total of 41 students (*Female*=30, *Male*=11) who were taking either Python or C++ programming language courses for the first time by the same instructor participated in the study. 5 of the 41 students were graduated from a vocational high school. Therefore, 12,2 % of the students (n=5) had a background in programming education and 87,8 (n=36) had not. Table 1. represents student demographics. The data were collected in basic programming courses given at the Department of Computer Education and Instructional Technology in a public university in the 2017-2018 Fall semester. Due to the difficulty levels of the problems (low, moderate, and high), error types (syntax and logic), and question type (if-else and while), a total of 12 different data (3x2x2) were taken from each student (N=492).

Table 1. Frequency of high school graduation of novice learners by gender

	Gender	
School Type	**Female**	**Male**
Vocational	2	3
Not vocational	28	8

Data Collection

During two weeks, students were given paper-based codes with syntax and logic errors in three different difficulty levels, in the subjects of if conditionals and while loops. Each question was chosen with the items used in previous studies and expert programmer approval. Students were given the following warning before they start debugging: "Please refer to the codes presented to you and decide if there are any errors in the codes. If there is an error you found, specify it, explain the cause(s) of the error, and correct it."

Data Analysis

The collected data were analyzed by the Chi-square test via SPSS 24. There are four different types of question characteristics regarding paper-based debugging questions. First one is *course type,* which is a categorical variable having two subcategories as and *C++*. The second one is the *error* type with two subcategories as *syntax* and *logic*. The third one is the question type, with *if-else* and *while* subcategories. The final one is the *question's difficulty level* having three subcategories named as *low*, moderate, and high. Based on these questions and due to students' varying frequent attempts in detection, correction, and completion of errors, students' answers were categorized into three variables as *error detection, error correction attempt,* and completion of error correction. All these variables have two subcategories as *yes* and *no*. In addition to detection, correction, and completion variables, students' markings on the paper-based question were categorized into six types as *marking availability, note-taking, strikethrough, underline, circle, and arrow*. Similar to students' observation of metacognitive outcomes, these categories were also coded as *yes* and *no*.

FINDINGS

Chi-Square Tests for Error Detection, Error Correction Attempt and Completion of Error Correction

A chi-square test was performed to examine the relationship between the question's *difficulty* level and error detection. As demonstrated in Table 2, the relation between these variables was significant (X^2 (2) = 11,05, p = .004, Crammer's V=.15). Novice programmers are more likely to detect errors in low difficulty level of questions than moderate and high difficulty level of questions. Besides, the *question's difficulty* level has a small to moderate effect on error detection.

Table 2. Frequency of novices' error detection by question difficulty level

	Question Difficulty Level		
Error detection	Low	Moderate	High
Detected	97	72	70
Not detected	67	92	94

X^2 (2) = 11.05, p = .004

In order to examine the relationship between the *question's difficulty level* and *error correction attempt,* a chi-square test was performed. The relation between these variables was significant, (X^2 (2) = 12,17, p = .002, Crammer's V=.16) (See Table 3.). Post Hoc analysis revealed that error correction attempt was high in low difficulty level of questions than moderate and high difficulty level of questions. Besides, the level of difficulty has a small to moderate effect on error detection. A chi-square test revealed no significant relationship between the *question's difficulty level* and *completion of error correction*.

Table 3. Frequency of novices' error correction attempt by question difficulty level

	Question Difficulty Level		
Error correction attempt	Low	Moderate	High
Corrected	92	63	67
Not corrected	72	101	97

X^2 (2) = 12.17, p = .002

A chi-square test was performed to examine the relationship between *error type* and *error detection*. As seen in Table 4, the relation between these variables was significant (X^2 (1) = 7.82, p = .005, Crammer's V=.13). Students are more likely to detect *logic errors* than *syntax errors*. Besides, the error type has a small to moderate effect on error detection. A chi-square test revealed no significant relationship between *error type* and *error correction attempt*. Similarly, no relationship was found between error type and completion. Finally, the relation between the question type (*if-else, while*) and the *error detection*, correction attempt, and *completion of error correction* are not significant.

Table 4. Frequency of novices' error detection by error type

	Error Type	
Error detection	Syntax	Logic
Detected	104	135
Not detected	142	111

X^2 (1) = 7.82, p = .005

Chi-Square Tests for Paper-Based Markings

A chi-square test was performed to examine the relationship between *question's difficulty level* and *marking availability* both in general and under the aforementioned categories as a note, strikethrough, underline, circle, and arrow. A significant relation with small to moderate effect was revealed between the questions' difficulty levels and marking availability (X^2 (2) = 8.20, p < .05, Crammer's V=.13) (See Table 5.), note (X^2 (2) = 14.26, p < .01, Crammer's V=.17) and underline (X^2 (2) = 7.08, p < .05, Crammer's V=.12). To examine the relationship between questions' difficulty level and marking availability, Post Hoc analysis was performed. According to Bonferroni correction results, significant relations between question in high difficulty level and marking availability (X^2 (2) = 8.20, p = 0.006), question in high difficulty level and note (X^2 (2) = 14.26, p = 0.002) and question in low difficulty level and note (X^2 (2) = 14.26, p = 0.002) were revealed.

Table 5. Frequency of novices' marking availability by question difficulty level

	Question Difficulty Level		
Marking availability	Low	Moderate	High
Marked	101	94	76
Not marked	63	70	88

X^2 (2) = 8.20, $p < .05$

A chi-square test was performed to examine the relationship between *question's error types* and *marking availability* both in general and under the categories as mentioned earlier as a note, strikethrough, underline, circle, and arrow. A significant relation with small to moderate effect was revealed between the questions' error types and marking availability (X^2 (1) = 12.49, $p < .01$, Crammer's V=.16) (See Table 6.), note (X^2 (1) = 27.53, $p < .01$, Crammer's V=.24) and strikethrough (X^2 (1) = 12.18, $p < .01$, Crammer's V=.16). To examine the relationship between question's error types and marking availability, Post Hoc analysis was performed. According to results, Bonferroni correction did not reveal any significance between variables.

Table 6. Frequency of novices' marking availability by error type

	Error Type	
Marking availability	Syntax	Logic
Marked	116	155
Not marked	130	91

X^2 (1) = 12.49, $p < .01$

A chi-square test was performed to examine the relationship between the *question's types* and *marking availability* both in general and under the categories as mentioned earlier as note, strikethrough, underline, circle, and arrow. Chi-square results did not reveal a significant relationship. Moreover, no significant relationship was revealed for marking availability in the comparison between Python and C++ courses.

DISCUSSIONS AND CONCLUSION

The aim of this study was to investigate the relationship between debugging outcomes of novice programmers and various question characteristics and propose instructional strategies for scaffolding novice learners in an effective way. Results revealed that error detection and correction are high in low difficulty level questions. The level of difficulty was found to have a low-to-moderate significant negative relationship with both error detection and correction. The reason for these meaningful negative relationships (in favor of low difficulty level questions) may be due to that programming requires keeping various information at different levels in the working memory. This information is stated as syntactic details, mental models for problem-solving and specifying the solution for problems (Balzert, 2004; Rist, 1995; Stachel et al., 2013). As the level of difficulty increases, the load on the working memory also increases, considering the requirements of programming. Therefore, the decrease in the problem-solving rates of moderate and high difficulty level questions may be related to this increase. There are several research studies conducted on instructional strategies like scaffolding and decreasing the cognitive load. Sweller (2008) claimed that instructional strategies and activities, which include scaffolding systems, have a big influence on cognitive load. Directly linked to the current study, Stachel et al. (2013) provided scaffolding tools to the programming learners in their experimental research, and results showed that the tool decreased their cognitive load and made a modest contribution to course scores. Similarly, Salleh et al. (2018) generated a scaffolding tool based on cognitive load theory and decreased cognitive load of novice learners. Based on the literature, the difficulty level of the question can be one of the factors in the development of the scaffolding tool.

There was a significant low to moderate relationship between error type and error detection and a low and significant relationship between error type and error correction attempt. Novice programmers detected logic errors more than syntax errors. These results are surprising, given that debugging logic errors require higher cognitive activities than debugging syntax errors. However, several studies claim that it is more complicated than it seems to handle syntax errors (Denny et al., 2014; Denny, Luxton-Reilly, Tempero, & Hendrickx, 2011; Fitzgerald et al., 2008; Nienaltowski, Pedroni, & Meyer, 2008). For novice learners, detecting syntax errors, understanding compiler messages and doing right corrections are more difficult compared to thinking on that error.

Moreover, logic errors mainly addressed in programming courses and syntax errors are perceived as superficial errors to address (Denny et al., 2014; Denny et al., 2011). It can also be a factor that affects the results of this study. Besides, since syntax errors are detected by the compiler, and the user is provided with error codes for correcting, novice programmers may not need to keep such errors in the working memory and therefore, those errors may have less detected; as a result, they are less attempted to be corrected.

Significant interaction was found between academic achievement and error detection, error correction attempt and completion of error correction supporting the previous studies in debugging (Bednarik, 2012; Fitzgerald et al., 2008; Lin et al., 2016; Rodrigo, Andallaza, Castro, Armenta, & Jadud, 2013) Similar to other studies' findings, student characteristics (expert/novice, experienced/inexperienced, successful/unsuccessful etc.) have an essential role in debugging. These studies classified the learners according to their skills in programming and reported the study process and its results by adhering to this distinction (Bednarik, 2012; Fitzgerald et al., 2008; Lin et al., 2016; Rodrigo, Andallaza, Castro, Armenta, & Jadud, 2013). One of the studies examined the data logs of novice programmers at the time of compilation and concluded that low and highly successful students differ in understanding the basic programming concepts (Rodrigo et al., 2013). Another study showed that participants who have achieved similar results are trying to sort out the error flawlessly and remain in the details of the syntax, while high-performance participants tend to systematically code the code into pieces which means that they tend to develop debugging strategies according to their current knowledge (Lin et al., 2016). Although our finding on a significant relationship does not reveal a qualitative difference in terms of learners' characteristics, it is a crucial factor to find significance for each learners' problem-solving behaviors and how this is related to their achievement levels. The relationship between these factors may show us the more students practice programming in a detailed manner, the more they gain programming learning. As learners practice programming questions by taking feedbacks and being supported in a metacognitive way, it is easier to develop insight regarding key programming concepts and skills (Rum & Ismail, 2017; Ma, Ferguson, Roper & Mood, 2011).

Moreover, when novice programmers' marking behaviors on paper were examined, a significant relationship was found between the difficulty level of the questions and the marking presence on paper and between the error types and marking presence on paper. In the significant relationship between the type of error and the frequency of taking notes, it was seen that the students took more notes for logic errors compared to the syntax errors, and the frequency of taking notes decreased as the difficulty level of the questions increased. When the marking behaviors on paper are examined, it can be attributed to three reasons that students have more markings on paper during debugging logic errors: (i) reducing the cognitive load, (ii) guiding the problem solving with the aim of guiding itself, and (iii) increasing the error awareness by taking visual feedback. By considering these reasons, it is thought that visual signs, which can be prepared for the learners, can form the feedback leg of the debugging training and thus reduce the cognitive load of the learners during the use of mental resources. To this end, during the debugging questions embedded in the paper-based or computer screen, considering Mayer's (2014) cognitive load-reducing principles within the cognitive theory of multi-learning can play a facilitating role for a novice learner to recognize the set of syntax and logic errors. Similarly, Stachel et al. (2013) examined the effect of scaffolding tools for decreasing the cognitive load of learners for the Visual Basic programming assignments and revealed that they are effective for decreasing cognitive load. Although the cognitive load is a fuzzy field of the research area to be integrated into debugging in programming researches, the reason why learners could not demonstrate more note-taking behaviors in high difficulty level questions may show their needs to be supported. Similar to this finding, Fabic et al. (2018) found that debugging could not reveal high learning gains for novice programmers and even 39% of advanced programmers were reported as competent in debugging.

Markings on paper-based debugging questions revealed that as the difficulty level of the problems increased, the frequency of taking notes of the learners decreased. The reasons for this can be discussed by considering the difficulty level and types of questions. Syntax errors require preliminary information and brief interventions; whereas, logic errors involve processes of intuitive problem solving and require understanding the result of the code. While the difficulty levels of questions may be raised by short interventions, students may need to refer to their mental resources more during problem-solving as the difficulty level of the questions increases. With the rise in the number of lines in the code, students' negative attitudes towards the question may be blocking their taking notes for logic errors in the questions having long blocks. To overcome this gap, debugging training may be planned to be prepared exhibiting a gradual teaching approach in the questions containing long code blocks can provide the students to develop a positive attitude. In addition, note-taking behaviors for logic errors were found to vary. The reason for this finding can be seen as students' use of intuitive problem-solving behavior and trial/error strategy, and supporting working memories to reach a solution, but also to keep multiple information and thus reduce cognitive load. With this finding, the strategies supported by the students can be supported by the computer-aided debugging programs having the opportunity to see the students' previous markings can be prepared so that students can get tips based on their current behaviors or selected strategies.

Finally, scaffolding tools for novice learners may be effective in decreasing cognitive load and increase the effectiveness of the programming course. However, in programming courses, there are students at different expertise levels regarding their programming abilities. Kalyuga (2009) claims that although strategies developed for novice learners based on cognitive load theory may improve understanding, learners with high expertise can be influenced by these strategies in a negative way. Moreover, prior knowledge is seen as one of the most influential learner characteristics that decide the success of instructional tools on learning (Kalyuga, Chandler, & Sweller, 1998). Therefore, learners need to be supported regarding their characteristics by the scaffolding tools. Mayer (2014) suggests the personalization principle allows learners to interact with computers in a conversational style to improve motivation and learning. Therefore, the scaffolding tool to be developed should use a language that aims to keep interaction with the learner at a high level and encourage the learner to communicate as far away from formality as possible.

This study focused on the aspects of how novice programming students performed during debugging processes on the paper-based debugging question materials to construct a foundation for future intelligent e-learning platforms. The relationship between the result of error-detection, error-correction, and error-completion and the marking availability was stated as significant. These findings are essential to offer student-model for intelligent e-learning environments during the prediction of their performance. Previous researches suggested that cognitive, metacognitive, and emotional factors influencing students' performance are crucial for better prediction (Huang, Chen, Luo, Chen & Chuang, 2008; Trifa, Hedhili & Chaari, 2019). Thus, visual guidance can be provided in a personalized way within these environments.

RECOMMENDATIONS

The results of the study have recommended potential effective strategies for debugging syntax and logic errors regarding stepwise instruction, guided hints, and visualization issues. First of all, there may be stepwise instruction for novice programmers to make significant contributions for debugging in high-level difficulty questions. Secondly, since syntax errors may not be detected by novice programmers due to instant return of errors in compilers, novice programmers may be trained for writing code blocks on paper-based environments by referencing to their stepwise instruction, and they may be guided by code blocks for guiding students with hints in a computerized environment for detection of syntax errors. As a final recommendation, since looking at students' debugging behaviors of solved paper-based programming questions provided in-direct observation for their debugging processes on how, when and in which question types they demonstrate marking behaviors. Based on these observations, supporting working memory by having a note region on both paper-based and computerized environments may be recommended. In addition, the results may suggest that novice programming students may need visualized guidance, and in debugging training, students may be provided such kind of visualized guidance to students for self-guidance. Although the presence of different types of markings did not reveal significant relationships in this study apart from note-taking behaviors, the

follow-up analysis should be conducted for prediction of the outcomes as error detection, error correction attempt and error completion by each marking type and types of questions. This may bring personalized visual guidance for each type of question and error types for novice learners within e-learning environments.

LIMITATIONS

Limitations of this study are three-folded as (i) study duration, (ii) study environment, and (iii) unfamiliarity of the exam questions. First of all, this study endured two weeks, so that limited the observation of programming topics with if-else conditionals and while loops. Secondly, learners took paper-based debugging questions individually in a laboratory setting as a whole class. Therefore, it was not possible to observe and record learners' think-aloud data. Finally, exam questions did not include any types of debugging questions used in paper-based study protocol so that students could not be followed in regard to their debugging behaviors.

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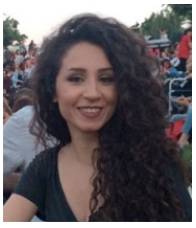

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ARTIFICIAL NEURAL NETWORK APPROACH TO PREDICT LMS ACCEPTANCE OF VOCATIONAL SCHOOL STUDENTS

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ABSTRACT

The contribution of e-learning technologies, especially LMS which has become an important component of e-learning, is significantly increasing in higher education. It is critical to understand the factors that affect the behavioral intention of students towards LMS use. The aim of this study is to explore predictors of students' acceptance of Course Portal at a postsecondary vocational school level. We utilised a framework suggested by Sezer and Yilmaz (2019) for understanding students' acceptance of LMS. This framework obtains the main constructs in UTAUT: namely, performance expectancy, effort expectancy, social influence and facilitating conditions. More external variables, associate degree programs, high school type, academic grade point average were also adopted. Accordingly, 387 students were answered the questionnaire for investigating behavioral intention. Artificial neural network analysis (ANN) was used to predict students' acceptance of LMS use according to variables associated with their use of LMS technology. ANN analyses in the present study revealed that performance expectancy, effort expectancy, social influence and facilitating conditions are important predictors of students' behavioral intention to use LMS. Nevertheless, performance expectancy was found to be the most influencing predictor of LMS use. The analyses of this research provides evidence on the utilization of ANN to predict the determining factors of LMS acceptance.

Keywords: Artificial neural networks, LMS acceptance, UTAUT, MOODLE, social influence, vocational school

INTRODUCTION

With the rapid advancement in information and communication technologies and the result of investments in technological infrastructures at schools, electronic learning (e-learning) has been an important component of teaching and learning processes at every level from primary to higher and post-graduate education. Like in all educational institutions in developing countries, various institutions in Turkey have invested vastly

on e-learning to support the quality of teaching and learning processes. Having been considered as one of the e-learning technologies, the learning management system (LMS) has been in use in various state and private universities to support either face-to-face or online instruction. LMS is one of the ever-developing information technologies instruments that facilitates e-learning and enables instruction with no time and space restraints. Specifically with the onset of LMS, e-learning has turned into an important method enhancing the use of new instructional practices that have been not carried out in traditional classroom settings (Cigdem, 2015).

With the utilization of technology, especially distance instructional technologies, in the education process, all stages from planning to classroom management and assessment were facilitated (Masud, 2016). LMSs are those technologies that enable presentation of instructional content in an orderly and various ways to students with no time and space restraints. As evident from its name, LMS is a management tool that can be used to manage instructional materials, observe the students and teachers and customize the teaching and learning processes. In other words, LMS is a web-based software designed to manage the learning activities. Today, some of the LMSs used by institutions are open source (e.g. Sakai, MOODLE-Modular Object-Oriented Dynamic Learning Environment, Dokeos, Drupal), while others are commercial (e.g. eFront, Blackboard, Brightspace). The institutions' purpose behind the use of LMS is to ease the learning activities and have them performed in a more systematic and planned way. It has been established that LMSs encourage a constructive approach to knowledge acquisition and support active learning (Emelyanova & Voronina, 2014).

Among their many functions, LMSs are used to share instructional materials, plan debates, manage classrooms, assign homework and tasks, record the exams, receive feedback, organize learning materials, keep systems records of both students and teachers, and compose reports. LMSs offer both students and instructors various tools to improve the learning process and management (Stantchev et al., 2014). Together with these advantages, LMSs have a great potential for instructional utilization. Literature reveals that the utilization of LMSs in higher education has increased student motivation and attention, provided more flexible learning environments, and enabled better management of the teaching and learning time (Corbeil & Valdes-Corbeil, 2007; Findik-Coskuncay & Ozkan, 2013; Jacob & Issac, 2008). While educational institutions spend a lot of money and effort to improve LMSs (Cigdem, 2015) and there is an increasing trend in the use of LMSs to facilitate the instructional activities, many higher education institutions that offer e-learning programs are facing difficulties in their course delivery (Legris, Ingham & Collerette, 2003; Park, 2009).

As in other technologies, in terms of factors like usability, efficiency and suitability, LMSs need to be well-received by their potential users, the students and the instructors. If students make no use of LMSs, there is no profit in the investments (Pituch & Lee, 2006). The precondition for better utilization of these technologies in educational settings is to get students ready for LMS use and create positive attitude, belief and intention towards their use, in other words, have students accept this technology (Davis, Bagozzi, & Warshaw, 1989; Findik Coskuncay & Ozkan, 2013; Sezer & Yilmaz, 2019). For this particular purpose, if successful use of LMS is intended, it is important to understand students' intentions and the factors influencing their actual use. The acceptance of LMS technology has gained importance since internet infrastructure has developed in recent years and Web 2.0 technologies have become so popular that they compelled higher education institutions to take part in and manage such settings. In this respect; technology acceptance, which entails attitude, belief and intention towards technology use is an important factor. The model most widely used to investigate users' acceptance of different technologies is the Technology Acceptance Model (henceforth TAM) developed by Davis in 1989 (Davis & Venkatesh, 1996). Technology acceptance has a construct that comprises cognitive and psychological components towards technology use (Venkatesh, Morris, Davis, & Davis 2003). This construct aims to explain individuals' acceptance of a certain technology and the factors behind their acceptance. Studies on LMS have examined technology acceptance at university level by utilizing varying technology acceptance models. TAM measures technology use intention under three components: perceived usefulness, perceived ease of use and behavioral intention.

Many researchers have criticized TAM for its limitations and tried to improve its explanatory power by adding various factors. Venkatesh et al. (2003) discussed the inadequacy of a single model to explain technology use and advocated multi-dimensional examination, hence developed the Unified theory of Acceptance and Use of Technology (UTAUT) model. According to Chen (2011) and Sumak, Polancic and Hericko (2010),

UTAUT with its fundamental and sound model of new information technology acceptance can explain LMS acceptance and use. By incorporating similar components in eight different models, UTAUT includes four basic elements that determine an individual's aim of use: performance expectancy, effort expectancy, facilitating conditions and social influence (Venkatesh et al., 2003). The fundamental elements of UTAUT are briefly summarized below.

Performance expectancy (PE) is the belief that performance increases with the use of technology (Venkatesh et al., 2003). Several past studies (Raman & Don, 2013; Venkatesh et al.,2003) found significant influence of PE on acceptance of LMS. Sumak et al. (2010) reported direct influence of PE on the intention to use LMS developed with Moodle. Another result found in the same study is that students' positive opinions about the benefits LMS may have on instructional practices affect their intention to use LMS.

Effort expectancy (EE) represents the belief that technology use will be easy and shows the effort expected to be spent by students on LMS (Venkatesh et al., 2003). Raman and Don (2013) highlighted the significant positive influence of effort expectancy on pre-school teachers' LMS acceptance. They also pinpointed that students' perceptions that LMS use doesn't necessitate effort influences their positive intentions on LMS use.

Social influence (SI) reflects the influence of beliefs of others (peers, instructors and friends) on an individual's intentions or behavioral use (Venkatesh et al., 2003). It also projects that individuals' intentions or behavioral use may be influenced by other people's beliefs on the necessity of technology use and their beliefs on the utilization of e-learning. In their research, Raman et al. (2014) and Marchewka, Liu and Kostiwa (2007) found significant relationship between social influence and intention of LMS use. With the study at hand, the authors think that students' intention of LMS use may be influenced by their friends' or instructors' beliefs about LMS.

Facilitating conditions (FC) implies the existence of various elements that support technology use and focuses on the necessity of technical and institutional elements including instruction, support and infrastructure needed for e-learning (Venkatesh et al., 2003). Since this influences LMS use in some instances, students may need technical and/or instructional support.

Thus far, several research studies have examined LMS use and/or acceptance with those elements of UTAUT in mind. In their study using UTAUT as a model, Maina and Nzuki (2015) investigated the influence of performance expectancy, social influence, effort expectancy and facilitating conditions on LMS acceptance in higher education institutions in Kenya. The results confirmed that performance expectancy, infrastructure development, institutional policies, instructional support provided to users, ease of use and leadership had an influence on acceptance of LMS at higher education institutions.

In a study conducted by Raman et al. (2014), performance expectancy, facilitating conditions and social influence were found to have a significant influence on LMS, developed with Moodle.

Lwoga and Komba (2014) examined the factors influencing student LMS use. The results showed that, while actual use was determined by students' self-efficacy, the intention to use web-based learning system could be predicted by performance expectancy, social influence, self-efficacy and actual use. Additionally, LMS use was found to fail because of infrastructure barriers, limited skills, and the unfriendly nature of LMS, the inadequacy of managerial and technical support, lack of awareness, lack of time for e-content preparation, the e-learning system itself and resistance to change.

Taken together, LMS acceptance is deemed important for e-learning environments. With lack of related research in Turkey and in overall the need for further research to contribute to the understanding of the topic, the study at hand endeavors to examine the factors influencing students' acceptance of a Course Portal, a specific LMS developed by the utilization of Moodle to support the face-to-face instruction in a vocational school that accepts blended teaching methodology.

METHOD

In this study, Artificial Neural Network (ANN) modelling was used to investigate the important factors of the acceptance of LMS use among vocational school students.

Participants

Convenient sampling method was used since the researchers worked at the vocational college where the participants were studying. The participants comprised 387 students having blended learning experience using Course Portal during the spring semester of 2018-2019 academic year. All participants were male living on the college premises. Some participants were studying Business Administration (n=85) while the rest were from technical programs (n=302). With regard to high school graduation, majority of them were vocational high schools graduates (n=246) and the others were graduates from state public schools (n=141). 38.2% of the students had an academic GPA ranging between 2.00-2.99 and 61.5% of the students had GPAs between 3.00-4.00. Only one student had a GPA below 2.00.

Course Portal

In order to support the face-to-face instruction at the vocational school, an LMS called "Course Portal" was developed by the use of MOODLE version 3.6. After class hours, students spent time at the Course Portal, loaded on computers in the computer labs. Since internet access was quite limited at school, instructors tried their best to keep the Course Portal content rich and updated. Teachers shared their lectures, presentations, sample projects, learning activities and videos related to their courses on the Course Portal, which could be accessed via an intranet system. Students also had the opportunity to login the system to take exams and upload their homework. Despite all those efforts on the part of instructors and the technical staff, students were not eager to use the Course Portal as it was desired. Hence, the authors of the study at hand decided to investigate the factors behind that reluctance. One of the screenshot examples of the Course Portal can be seen in Figure 1.

Figure 1. A screenshot of Course Portal

Data Collection and Analysis

"Learning management system acceptance scale (LMSAS)" (Sezer & Yılmaz, 2019) was used as the data collection instrument. LMSAS has four dimensions of performance expectancy, effort expectancy, facilitating conditions and social influence. The reliability was calculated using Cronbach's alpha (α). The α coefficient for the whole scale is .926 and coefficients for the four dimensions are given in Table 1. Having all coefficient values above 0.70 confirms the reliability of all subscales under consideration (Hair et al. 2010).

Table 1. Cronbach's Alpha (α) Coefficients for All Subscales of LMSAS

Subscale	Total Items	(α)
Performance expectancy (PE)	8	.934
Effort expectancy (EE)	5	.785
Facilitating conditions (FC)	5	.785
Social influence (SI)	3	.838

Students completed the scales on LMS. Additionally, students were required to enclose the program they were enrolling together with the type of school they graduated from and their current GPA scores. Artificial Neural Network (ANN) was utilized in data analysis.

Having been inspired by the human brain neural network, ANN is considered a mathematical model that stands for a substantially parallel and distributed processing system (Haykin, 2004; Greenwood, 1991; Pektas, 2013). In biological systems, learning incorporates modifications to the synaptic connections occuring between the neurones. The neural network approach was initially introduced to act like the human brain in solving problems. The novelty of this approach lies in its way of processing information (Greenwood, 1991). An ANN model comprises massive numbers of processing elements (neurones) that are interconnected and work together to solve sophisticated problems (Haykin, 2004). Among the three models of computer-based learning, namely supervised learning, unsupervised learning and reinforcement learning, an ANN model can be identified as supervised learning, since learning occurs depending on pre-existing examples known as training data. An ANN can be constructed for pattern recognition, data classification, and/or training and learning treatments.

As presented in Figure 2, an ANN model is composed of three layers of input, hidden and output. The hidden nodes is the layer where the inputs of x_1, x_2,…, x_n are processed and the output y_k is released.

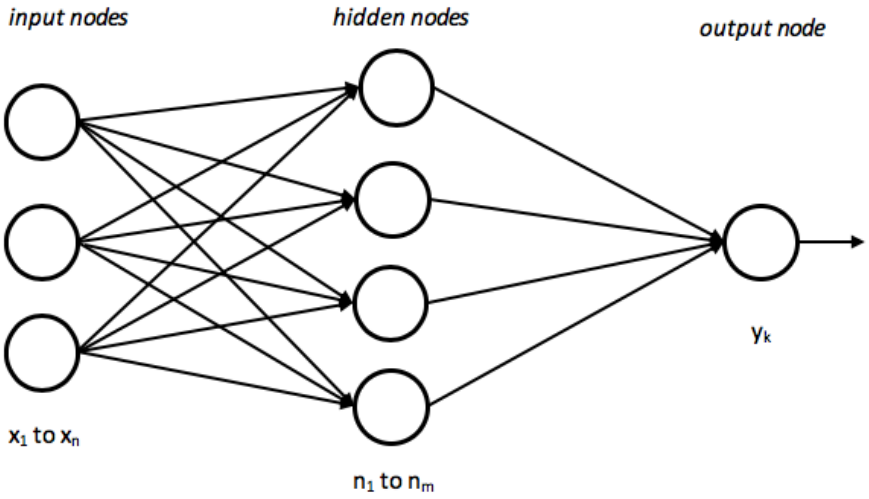

Figure 2. Sample ANN model

Owing to its computational power and the ability to process various types of data, the ANN model is utilized in various fields of information systems such as e-learning (Scott & Walczak, 2009; Shmueli & Koppius, 2011; Simoncini et al., 2017). Considered as non-parametric based models, the ANN models suggest diverse advantages with no consideration for distribution of input data, but with a strength of capturing linear and nonlinear relationships. Conversely, parametric based models hold certain concerns about distirbution of given data (Hair et al., 2010).

During ANN analysis, students' acceptance of LMS (AC) was taken as the output variable, also called the output layer, which corresponds to dependent variable in statistics. The programs students were enrolling, the schools they graduated from and their academic GPAs, which were estimated to influence all variables, were included into the analysis as categorical variables or factors. The predictive variables are the four

dimensions of LMSAS. All the variables in the model were undergone a transformation of "standardization". In the partition of data set, random cases were assigned in accordance with relative case number. The present data were classified as training data, testing data, and validation data. No specific method exists in the classification of data. According to Zhang et al. (1998), data are frequently classified as 80% training and 20% testing or 70% training and 30% testing. In this study, the rates were defined as 60% training data, 30% testing data and 10% validation data. IBM SPSS Statistic 22 pack was utilized during analyses, where the architecture of the ANN model was automatically designed. With the selection of automatic architecture, hyperbolic tangent function was identified as the interlayer activation function and identity function was selected for the output layer. In automatic architecture selection option, number of hidden layers is chosen as 1. Literature reveals frequent use of 3-layered network structures with one hidden layer (Han & Wang, 2011; Hippert et al., 2001; Zhang et al., 1998). IN ANN analysis, online learning was preferred as the learning method. The existence of interdependence of analysis data was the rationale behind this selection.

In the present research, the ANN analysis results were compared with the results of cross-correlation analysis. Cross-correlation analysis yields the highest correlations by analysing the cross-correlation function between two variables in a data set. With cross-correlation alaysis, the cross-correlations between the forward and backward series of independent variables and the dependent variable were examined to identify the highsy meaningful relationships between the dependent variable and the independent variables (Albayrak, 2014). IBM SPSS Statistics 22 default value of 7 was accepted as the forward and backward maximum number of lags.

FINDINGS

This research aimed to analyze the importance levels of predictors effective on students' acceptance of LMS use. The Sum of Squares Error and Relative Error found for the training level were .121 and .001, while the values for the testing level were .078 and .002. The Relative Error for the validation levels was .003. The error calculations of IBM SPSS Statistic 22 was based on testing example. This section presents the findings obtained about the order of significance of independent variables influencing students' acceptance of LMS use. The run summary of data included to ANN analysis is presented in Table 2.

Table 2. ANN Data Run Summary

	N	%
Training data	243	62.8
Testing data	106	27.4
Validation data	38	9.8
Valid data	387	100
Excluded data	0	
Total	387	

Table 2 shows that the whole data set was split into training (62.8%, n=243), testing (27.4%, n=106) and validation (9.8%, n=38). All data used were valid, no data were excluded. The structure of the established ANN model and the neural networks are presented in Figure 3.

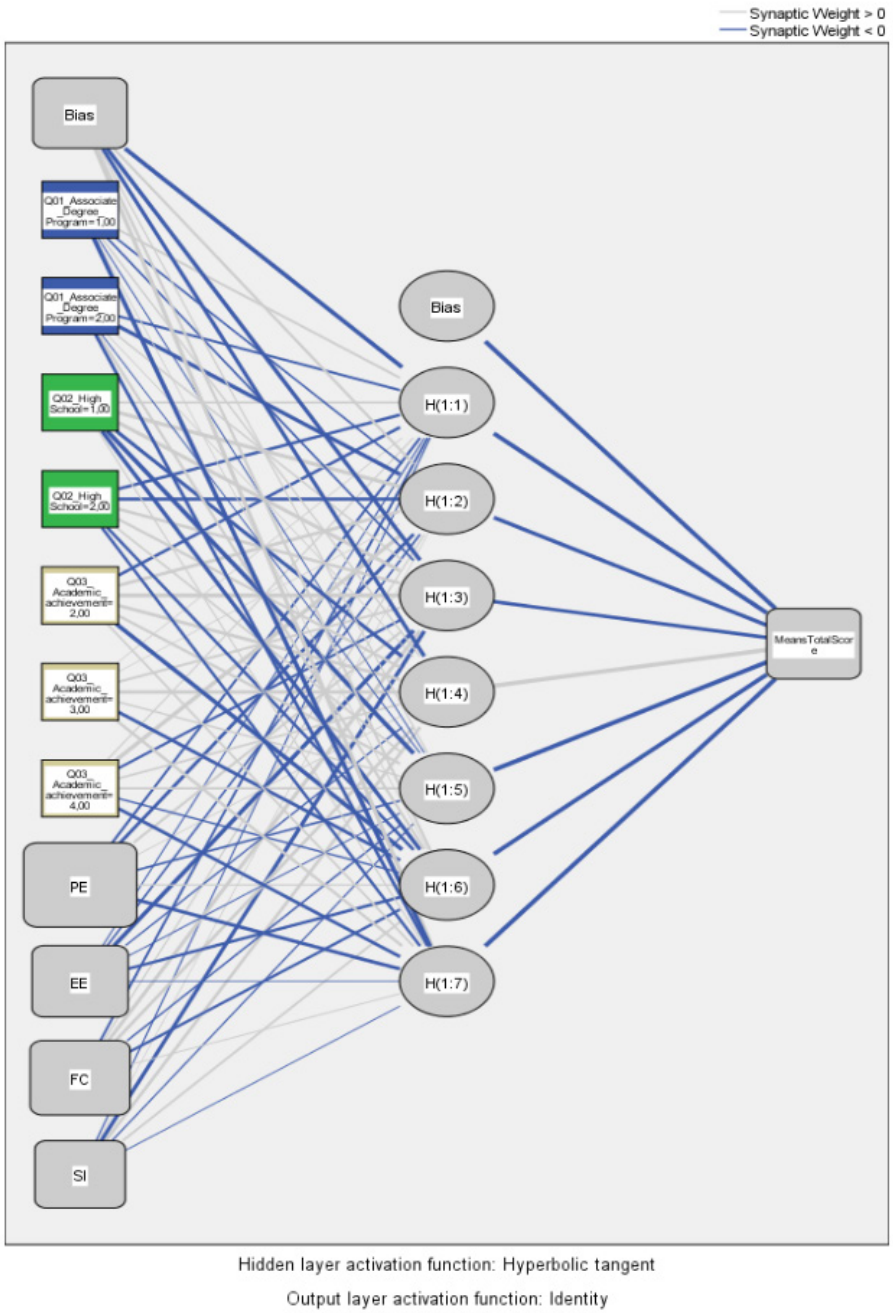

Figure 3. ANN model structure

The weights of independent variables in the artificial neural network can be seen in Figure 4. To determine the ratings of independent variables' importance, in accordance with the weights linking the artificial neural cells in the network, the ratings were defined in percentages and are presented in Table 3.

Table 3. The Importance Ratings of Independent Variables Related to Students' Acceptance of LMS Use

Independent Variable	Importance	Normalized Importance
Associate Degree Programs	.006	1.6%
High school type	.005	1.3%
Academic Grade Point Average	.011	2.9%
Performance expectancy	.378	100%
Effort expectancy	.206	54.4%
Facilitating conditions	.246	65.2%
Social influence	.149	39.3%

Figure 4 shows the graphical demonstration of importance ratings of independent variables.

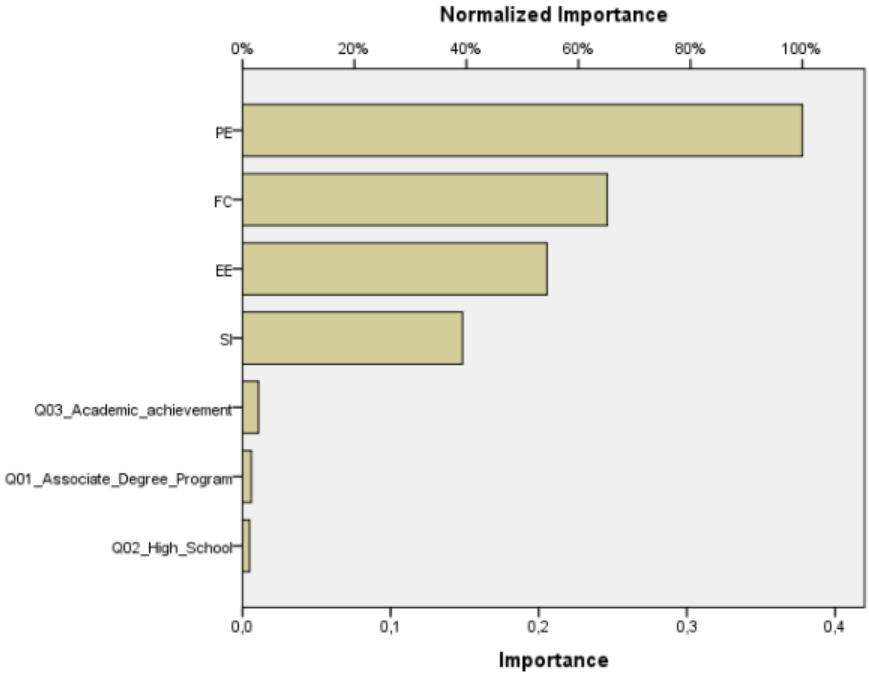

Figure 4. Importance Ratings of Independent Variables

Analysis of both Table 3 and Figure 4 reveals students' performance expectations as the most important independent variable in the ANN structured for students' acceptance of LMS use. This finding suggests more tendency towards LMS use after academic achievement is gained due to LMS use. The other variables following this independent variable are facilitating conditions (65.2%), effort expectancy (54.4%) and social influence of LMS use (39.3%). Those variables having the least effect on students' acceptance of LMS use can be listed as academic grade point average (2.9%), associate degree program (1.6%) and the type of high school students graduated from (1.3%). The basic reason behind this finding could be stated as students' free and equal access to both the internet and the LMS at school. Hence, these variables might not be a cause of anxiety when acceptance of LMS is considered.

ANN results were compared by cross-correlation analysis, which ensures the identification of the highest correlations among the variables. Table 4 below presents the cross-correlation analysis results between the acceptance of LMS and the four dimensions of LMSAS.

Table 4. Cross-correlations Between LMS Acceptance and the Four Dimensions of LMSAS

Performance expectancy and LMS Acceptance			Facilitating conditions and LMS Acceptance			Effort expectancy and LMS Acceptance			Social influence and LMS Acceptance		
Lag	Cross Correlation	Std. Error[a]	Lag	Cross Correlation	Std. Error[a]	Lag	Cross Correlation	Std. Error[a]	Lag	Cross Correlation	Std. Error[a]
-7	.075	.051	-7	.042	.051	-7	.045	.051	-7	-.005	.051
-6	.086	.051	-6	-.009	.051	-6	-.043	.051	-6	.070	.051
-5	.015	.051	-5	.043	.051	-5	.008	.051	-5	.044	.051
-4	-.018	.051	-4	.011	.051	-4	-.023	.051	-4	-.127	.051
-3	.022	.051	-3	.100	.051	-3	.008	.051	-3	-.021	.051
-2	.067	.051	-2	.028	.051	-2	-.026	.051	-2	.079	.051
-1	.083	.051	-1	.148	.051	-1	.059	.051	-1	.125	.051
0	.890	.051	0	.774	.051	0	.835	.051	0	.669	.051
1	.111	.051	1	.052	.051	1	.086	.051	1	.150	.051
2	.020	.051	2	.065	.051	2	.052	.051	2	.041	.051
3	.027	.051	3	.057	.051	3	.090	.051	3	-.068	.051
4	-.052	.051	4	-.014	.051	4	-.050	.051	4	-.009	.051
5	.025	.051	5	.054	.051	5	.011	.051	5	.010	.051
6	.041	.051	6	.081	.051	6	-.010	.051	6	.018	.051
7	.040	.051	7	.063	.051	7	.042	.051	7	.040	.051

The correlation values presented in Table 4 confirm the predictor of Performance Expectancy (.89) having the highest correlation with LMS acceptance. That variable is followed by Effort Expectancy (.835), Facilitating Conditions (.774) and Social Influence (.669). The ranking according to these values is parallel to the importance ranking in LMS analysis results. The cross-correlation analysis results between LMS Acceptance and student academic achievement as its predictor are shown in Table 5.

Table 5. Cross-correlations Between LMS Acceptance and Student Academic Achievement

Academic grade point: 1-1,99 and LMS Acceptance			Academic grade point: 2-2,99 and LMS Acceptance			Academic grade point: 3-4 and LMS Acceptance		
Lag	Cross Correlation	Std. Error[a]	Lag	Cross Correlation	Std. Error[a]	Lag	Cross Correlation	Std. Error[a]
-7	.000	.051	-7	-.136	.051	-7	.136	.051
-6	.000	.051	-6	-.137	.051	-6	.137	.051
-5	.001	.051	-5	-.145	.051	-5	.145	.051
-4	.001	.051	-4	-.147	.051	-4	.147	.051
-3	.000	.051	-3	-.152	.051	-3	.151	.051
-2	.000	.051	-2	-.156	.051	-2	.156	.051
-1	.000	.051	-1	-.153	.051	-1	.152	.051
0	-.085	.051	0	-.158	.051	0	.166	.051
1	.088	.051	1	-.163	.051	1	.153	.051
2	-.195	.051	2	-.135	.051	2	.155	.051
3	.007	.051	3	-.146	.051	3	.145	.051
4	-.012	.051	4	-.145	.051	4	.146	.051
5	-.008	.051	5	-.144	.051	5	.145	.051
6	-.063	.051	6	-.130	.051	6	.136	.051
7	-.038	.051	7	-.125	.051	7	.129	.051

Correlations values presented in Table 5 conclude the existence of very low correlations between acceptance of LMS and Student academic achievement. Taking all three score intervals into account, the highest correlation value is .195. This finding supports the results of LMS analysis. The cross-correlations between students' acceptance of LMS and their associate degree programs and type of high schools they graduated from are presented in Table 6.

Table 6. Cross-correlations Between LMS Acceptance and Students' Associate Degree Programs and Type of High Schools

Business Administration and LMS Acceptance			Technical Departments and LMS Acceptance			General High School and LMS Acceptance			Vocational High School and LMS Acceptance		
Lag	Cross Correlation	Std. Errora	Lag	Cross Correlation	Std. Errora	Lag	Cross Correlation	Std. Errora	Lag	Cross Correlation	Std. Errora
-7	,091	,051	-7	-,091	,051	-7	,062	,051	-7	-,062	,051
-6	,063	,051	-6	-,063	,051	-6	-,001	,051	-6	,001	,051
-5	-,009	,051	-5	,009	,051	-5	,045	,051	-5	-,045	,051
-4	-,017	,051	-4	,017	,051	-4	-,008	,051	-4	,008	,051
-3	-,007	,051	-3	,007	,051	-3	-,008	,051	-3	,008	,051
-2	-,007	,051	-2	,007	,051	-2	-,021	,051	-2	,021	,051
-1	,012	,051	-1	-,012	,051	-1	,033	,051	-1	-,033	,051
0	-,046	,051	0	,046	,051	0	,074	,051	0	-,074	,051
1	-,035	,051	1	,035	,051	1	-,105	,051	1	,105	,051
2	-,026	,051	2	,026	,051	2	,013	,051	2	-,013	,051
3	-,044	,051	3	,044	,051	3	-,028	,051	3	,028	,051
4	-,012	,051	4	,012	,051	4	,047	,051	4	-,047	,051
5	,044	,051	5	-,044	,051	5	,015	,051	5	-,015	,051
6	,007	,051	6	-,007	,051	6	-,082	,051	6	,082	,051
7	-,019	,051	7	,019	,051	7	,000	,051	7	,000	,051

As in the previous analysis, correlations values presented in Table 6 conclude the existence of very low correlations between students' acceptance of LMS and their associate degree programs and type of high schools they graduated from. This finding of having two predictive variables with the lowest importance could be considered as an evidence for the pertinence of the LMS analysis.

DISCUSSION

The contribution of e-learning technologies, especially LMS which has become an important component of e-learning, is significantly increasing in higher education. It is essential to understand the factors that affect the behavioral intention of students towards LMS use.

Artificial Neural Network Analyses in the present study revealed that performance expectancy, effort expectancy, social influence and facilitating conditions are important predictors of students' behavioral intention to use LMS. Nevertheless, performance expectancy was found to be the most influencing predictor of LMS acceptance. This could be explained as students' acceptance of LMS may increase when students realize its productive value. This finding is also consistent with the findings obtained by Raman and Don (2013) and Sumak et al. (2010), where performance expectancy was found to have direct effect on intention to use LMS. Thus, it might be a good practice on the part of instructors to furnish LMSs with rich content, which in turn might contribute to student performance in class.

This study at hand found that facilitating conditions is the second most influencing factor of acceptance of LMS. Preparing a manual for LMS use, having instructors explain LMS use in the first weeks of classes, offering students laboratories where they can have easy access to LMSs and extending support to those students having problems with LMS use could be counted as facilitating conditions.

Effort expectancy factor is the third important predictor of LMS acceptance among vocational school students. Similarly in their research, Raman and Don (2013) found significant effect of effort expectancy

on pre-school teachers' acceptance of LMS use. Ease of use and/or learning might contribute to intention to use LMSs

Social influence is the fourth most influencing predictor of acceptance of LMS. This could be discoverable, because students' LMS use can increase depending on the support or encouragement they get from their peers or instructors or if students realize the value of LMS use, they may tend to use it more. This finding is consistent with the results of several other studies (Marchewka, Liu & Kostiwa, 2007; Raman et al., 2014). Previous research found significant relationship between social influence and intention to use LMS. Without a doubt, a social influence develops when the instructors lead students to have more access to LMS or when the students discover themselves or observe from their friends the value of LMS use.

The results obtained are not in concordance with the results of the original UTAUT model and various other studies (Venkatesh et al., 2003), owing majorly to differences of context. It could be stated that students or users in developing countries, like in Turkey, would adopt more e-learning technologies such as LMS, if they had the knowledge and necessary resources which those developed countries already have.

On the contrary, the findings of the present study revealed that the type of high school students graduated from, their associate degree programs and academic achievements were not among the factors influencing students' acceptance of LMS use. Though, this could be adhered to the characteristics of the study group, it could also indicate that students used the LMSs equally no matter from which school they graduated from, what program they study or what level of achievement they have.

CONCLUSION

The research was conducted to identify students' acceptance of LMS at a vocational school and to find out to which extent variables such as high school graduation, degree program, academic achievement, performance expectancy, effort expectancy, social influence, and facilitating conditions predict that acceptance. This study is believed to contribute to the understanding of nature and degree of postsecondary vocational college students' acceptance of LMS. It is deemed essential to discuss such significant factors influencing the teaching approaches and it sounds important for investments on LMSs as well. Besides, since LMSs have been accepted by many higher education institutions, there is a need to see the factors that predict students' acceptance of LMS.

The findings in this study suggest that performance expectancy, facilitating conditions, effort expectancy, social influence predict students' acceptance of LMS. Another suggestion is that type of high school graduation, degree program, and academic achievement are not that influential on LMS acceptance.

In line with the results obtained, this research is considered to have some implications. Firstly, this research might support and extend the understanding of vocational school teachers in Turkey on the importance of having students' acceptance of LMS, so that they could successfully integrate them as part of their learning strategies. Students are believed to use LMS more after their expectations are met by the careful organization and improvement of courses by the teachers.

Internet is a giant door opening to vast amount of information, however students are often lost while doing a research and lose time. The LMSs developed by schools will help students have access to information they need more easily and quickly. To support students in their use of LMS, instructors could ensure them that the uploaded documents and videos etc. are useful for them. There won't be much time lost, since the instructors develop, filter and upload the necessary materials on the LMSs. Better gains could be achieved when students realize that they can have immediate answers to their problems at hand, when the LMSs is easy to learn, when the materials uploaded are up-to-date and essential to learning, when students are motivated to use the LMSs and when they see from others the benefits of LMS use. Thus, students rate of LMS use would increase owing to the instructors' integratation of LMS into curricula and encouragement of students.

Secondly, ANN analysis used in the research at hand provided additional findings regarding the relationships between acceptance of LMS and other independent predictors. So, ANN could be comfortably used in other technology acceptance studies and contribute to the understanding of factors influencing students or learners acceptance.

Limitations and Suggestions for Future Research

This present study has several limitations. First, the findings of the artificial neural network as a predictive model could be supported with other statistical models. Second, this study was carried on data derived from a Turkish vocational school, where MOODLE was used as an LMS. For generalization of the findings of the present research, subsequent studies may be required in other educational institutions in other countries and at different levels using various LMSs. Third, future studies can focus on students' permanent use of LMS, which was not handled in this research. Finally, further research focusing on prediction of instructors' behavioral intention to use LMSs could contribute to the understanding of technology use in classes.

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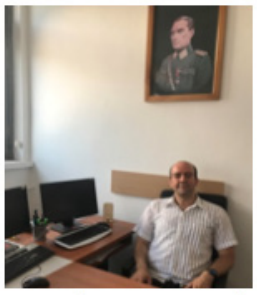

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EDUCATIONAL DATA MINING STUDIES IN TURKEY: A SYSTEMATIC REVIEW

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ABSTRACT

The purpose of this research is a comprehensive review of studies towards educational data mining (EDM) in Turkey. For the purpose of this study, graduate theses and articles conducted in Turkey were examined in detail. As a result of the literature review, 48 studies were analyzed in the context of the data mining purpose, the technique used in the study, the purpose of the study, the sample, the data sources and the analysis tool used in the study. In addition, the input variables used in the studies for estimating student achievement in EDM were examined. As a result of the research, it was found that EDM studies were mostly aimed at prediction from data mining tasks. One of the results of this study is that artificial neural networks are the most commonly used technique in EDM studies. When the distributions of EDM studies according to their objectives are examined, it is seen that studies are predominantly aimed at predicting student achievement. It is seen that university students are preferred as the sample in EDM studies, achievement scores are used as data source and SPSS application is used more as an analysis tool. In the last part of the research, recommendations were made based on the results to the researchers.

Keywords: Educational data mining, data mining, e-learning, review, classification, prediction

INTRODUCTION

Learning management systems and massive open online courses are now being used by various institutions to meet student needs (You, 2016). Educational data mining (EDM) is an interdisciplinary field in which data mining methods are applied to discover data in these systems and make future predictions (Romero & Ventura, 2013). EDM is a new and growing field of research in which meaningful information is extracted by applying data mining techniques on raw data in education systems (Bousbia & Belamri, 2014). EDM is used to provide information to managers and trainings on student interactions in a learning environment, to provide information on how to develop course content in the environment, to advise students on appropriate content, to predict students' achievements, and to be used for student modeling (Romero, Ventura, Pechenizkiy, & Baker, 2010). In order to achieve these objectives, data mining and machine learning methods are used in an integrated way (Baker, 2010; Romero & Ventura, 2010).

EDM can be used for (Berry & Linoff, 2004) classification (Baradwaj & Pal, 2012; Kaur, Singh, & Josan, 2015; Kamisli Ozturk, Erzurum Cicek & Ergul, 2017), prediction (Bucos & Dragulescu, 2018; Francis & Babu, 2019), clustering (Abu Tair & El-Halees, 2012; Dutt, Aghabozrgi, Ismail, & Mahroeian, 2015) and creating association rules (Avlijas, Heleta, & Avlijas, 2016; Man, Abu Bakar, & Sabri, 2018). EDM studies may address one or more of these objectives (Pena-Ayala, 2014).

a. Classification: In the classification, the data is grouped according to the determined features. For example some tasks are examined within the scope of classification such as which content is displayed according to learning styles and which characteristics of students are successful in the course.
b. Prediction: In the prediction, the data is separated into training and test data. Then, a model is formed by using training data and the accuracy rate of the model is examined with the test data. In the prediction, we can use categorical or continuos variables. For example, in an online learning environment, estimating final scores based on students' browsing behavior is a prediction process.

c. Clustering: Clustering is the process of dividing the data in the data set into homogeneous groups as in the classification. There are no predefined groups in the clustering process as in the classification process. For example, student profile creation based on student navigation in the e-learning environment is within the clustering process.

d. Association rules: Association rules, as the name suggests, is the process of generating rules from data. These rules take into account the frequency of coexistence of variables.

In the EDM studies, data mining techniques are applied for the specified purpose. In the literature, according to the purpose of the EDM; decision trees (Lin, Yeh, Hung, & Chang, 2013), bayes classifiers (Bhardwaj & Pal, 2012), regression (Bahadir, 2016), artificial neural networks (Yang & Li, 2018) and support vector machines (Al-Shehri et al., 2017) techniques are widely used.

There are different national and international screening studies related to educational data mining. In the research conducted by Romero and Ventura (2007) which reviewed studies between 1995 and 2005, it was emphasized that educational data mining is a new and developing research area. Three years later, the study by Romero and Ventura (2010) again showed an increase in studies on educational data mining. It is seen that traditional learning environments, e-learning environments, learning management systems, intelligent tutoring systems, adaptive educational systems, tests, questionnaires, texts and contents are used as data sources. In the classification made according to the purpose of educational data mining the studies were grouped as "analysis and visualization of data", "providing feedback for supporting instructors", "recommendations for students", "predicting student's performance", "student modeling", "detecting undesirable student behaviors", "grouping students", "social network analysis", "developing concept maps", "constructing courseware" and "planning and scheduling". In the study, the development of easy-to-use educational data mining environments for non-expert users, the development of data mining tools that work in integration with e-learning environments, storing and publishing models and data in a reusable manner to certain standards and the regulation of traditional data mining algorithms in the educational context were mentioned as future works.

Mohamad and Tasir (2013) examined 9 researches on data mining between 2004-2012. As a result of the study, it is understood that in addition to the use of available learning management systems (Moodle, Blackboard, etc.) in the researches, there are also systems developed within the scope of the research. In the study, it is suggested that social environments such as blog and facebook should be used for collaborative learning and the navigation data should be analyzed by integrating tools such as Google Analytics. Pena-Ayala (2014) reviewed 240 studies towards EDM between 2010-2013 1Q. In this research EDM works are grouped as EDM approaches and EDM tools. EDM approaches consists of "student modeling", "student behavior modeling", "student performance modeling", "assessment", "student support and feedback" and "curriculum, domain knowledge, sequencing and teachers support". EDM tools consist of "extraction, learning support and feature engineering, "visualization" and "analysis support". As a result of the study, it is emphasized that EDM is well-grounded and a new research area, which requires an interdisciplinary perspective.

Manjarres, Sandoval, and Suarez (2018) examined the researches between 2003 and 2015 according to the algorithms used in the EDM and the objectives of the EDM. As a result of the review, decision trees, classification, clustering, bayesian networks, artificial neural networks and association rules techniques are widely used in EDM. Tekin and Oztekin (2018) examined the studies on educational data mining between 2006-2016. In the study, Google Scholar, ERIC (Education Resources Information Center), Elsevier, Proquest, Ulakbim, Ebscohost and Springer databases were searched. Descriptive analysis of 140 articles examined in terms of different variables are presented. When the results of the research are examined, it is seen that the most researched topic is student performance, the participants are generally chosen from university students and web environments are preferred as data collection tools. Aldowah, Al-Samarraie, and Fauzy (2019) examined 402 EDM studies in higher education between 2000 and 2017. In the study, it was stated that student centered strategies could be developed with EDM.

Although there has been some review studies about EDM, it is seen that the limited number of studies conducted on this area in Turkey. In this study, we tried to determine the current situtation of educational data mining in Turkey through examine master theses, doctoral dissertations and papers in depth. The

purpose of this research is a comprehensive review of studies towards educational data mining in Turkey. For this purpose, Turkey addressed graduate theses and articles have been examined. For the purpose of the study, the following research questions were answered:

a. How are EDM studies distributed by years?
b. How are EDM studies distributed according to data mining tasks?
c. Which techniques are used in EDM studies?
d. What are the topics in EDM studies?
e. Which sample characteristics chosen in EDM studies?
f. What are the data sources in EDM studies?
g. Which analysis tools are used in EDM studies?
h. Which variables are used as input variables in the researches that predict success in EDM?

This study focuses on studies related to educational data mining in Turkey. The structure of this paper is organized as follows: in the following section the methodology of the study is described. In third section, results of review are presented. Finally, the results were discussed within the framework of the relevant literature and suggestions were made.

METHOD

Search Strategy

Council of Higher Education (CoHE) Thesis Center, Web of Science database and TR Index search tool were used in the review of the studies (Table 1). No date range is specified during the searching process. The review process was terminated in July 2019.

Table 1. Databases used in review process

Database name	Address
CoHE Thesis Center	https://tez.yok.gov.tr/UlusalTezMerkezi/
Web of Science	http://webofknowledge.com
TR Index Search Tool	https://trdizin.gov.tr/

In literature search process “data mining”, “machine learning”, “neural networks”, “decision trees”, “bayes” and “support vector machine” keywords were used. The searching using the CoHE Thesis Center was limited to the subject area of Education and Training. The initial search returned 67 studies. In Web of Science tool, “OR” boolean operator was used between keywords and Turkey addressed educational researches was searched. 62 articles were initially accessed in Web of Science. Using the TR Index Search tool, the keywords were searched respectively and the results were filtered by education subject area. Then, 25 studies were reached by eliminating repetitive studies.

Inclusion/Exclusion Criteria

In this study, the “Publication Classification Form” which was developed by the researcher was used to record the searched publications. The studies that were searched were determined in accordance with the inclusion/exclusion criteria and these studies were examined in detail. Studies which do not include any of the data mining tasks (classification, estimation, association rules, clustering), which are literature surveys, which are not educational research and which are not available in CoHE Thesis Center were excluded from the research. In addition, test equating, imputation of missing data, and comparison of two different methods in data mining were not included in this study because they were considered a different subject area.

Data Analysis

After examining the studies, the number of studies that meet the criteria are presented in Table 2.

Table 2. Distribution of accessed studies according to sources

Source	Number of Studies	Appropriate number of studies
CoHE Thesis Center	67	23
Master thesis	38	16
Doctoral dissertation	29	7
Web of Science	62	22
TR Index Search Tool	25	7*
Total	154	52**

*Note. * In addition to these studies, three studies were found in the Web of Science search results.,*
*** Four of these studies were not included in the results because they were produced from the thesis work of the authors.*

As a result, 23 thesis studies, 16 of which were master's and 7 of which were doctoral theses, were included in the analysis. (Table 2). After eliminating the repeated studies from Web of Science and TR Index Search Tool, 29 articles were found to meet inclusion criterias. The list of works that meet the criteria is presented in Table 3.

Table 3. EDM studies included in the research

No	Reference	Tool	Type/Journal Name
1	Aydin (2007)	CoHE Thesis Center	Doctoral dissertation
2	Somyurek (2008)	CoHE Thesis Center	Doctoral dissertation
3	Ucgun (2009)	CoHE Thesis Center	Master thesis
4	Y. Aydogdu (2011)	CoHE Thesis Center	Master thesis
5	Birtil (2011)	CoHE Thesis Center	Master thesis
6	Yelegin (2012)	CoHE Thesis Center	Master thesis
7	Yucel (2012)	CoHE Thesis Center	Master thesis
8	Bahadir (2013)	CoHE Thesis Center	Doctoral dissertation
9	Coskun (2013)	CoHE Thesis Center	Master thesis
10	Hark (2013)	CoHE Thesis Center	Master thesis
11	Saygili (2013)	CoHE Thesis Center	Master thesis
12	Sengur (2013)	CoHE Thesis Center	Master thesis
13	Akcapinar (2014)	CoHE Thesis Center	Doctoral dissertation
14	Aksoy (2014)	CoHE Thesis Center	Master thesis
15	Yildiz (2014)	CoHE Thesis Center	Doctoral dissertation
16	Ozbay (2015)	CoHE Thesis Center	Master thesis
17	Uysal (2015)	CoHE Thesis Center	Master thesis
18	Cebi (2016)	CoHE Thesis Center	Doctoral dissertation
19	Yildiz Aybek (2016)	CoHE Thesis Center	Master thesis
20	Barngrover (2017)	CoHE Thesis Center	Master thesis
21	Sahin (2018)	CoHE Thesis Center	Doctoral dissertation
22	Yagci (2018)	CoHE Thesis Center	Master thesis
23	Yorganci (2018)	CoHE Thesis Center	Master thesis
24	Dogan and Camurcu (2010)	Web of Science	Computer Applications in Engineering Education
25	Guruler, Istanbullu, and Karahasan (2010)	Web of Science	Computers & Education
26	Kentli and Sahin (2011)	Web of Science	Energy Education Science and Technology Part B-Social and Educational Studies
27	Aydogdu and Tanrikulu (2013)*	Web of Science	Education and Science

28	Turhan, Kurt, and Engin (2013)	Web of Science	Education and Science
29	Akcapinar (2015)	Web of Science	Computers & Education
30	Avsar and Yalcin (2015)	Web of Science	Education and Science
31	Baran and Kilic (2015)	Web of Science	Educational Technology & Society
32	Demir (2015)	Web of Science	Educational Sciences-Theory & Practice
33	Kayri (2015)	Web of Science	Educational Sciences-Theory & Practice
34	Sohsah, Unal, and Guzey (2015)	Web of Science	British Journal of Educational Technology
35	Bahadir (2016)	Web of Science	Educational Sciences-Theory & Practice
36	Idil, Narli, and Aksoy (2016)	Web of Science	International Journal of Education in Mathematics Science and Technology
37	Kose and Arslan (2016)	Web of Science	International Journal of Engineering Education
38	Onan, Bal, and Bayam (2016)	Web of Science	Croatian Journal of Education
39	Ayvaz, Guruler, and Devrim (2017)	Web of Science	Information Technologies and Learning Tools
40	Kose and Arslan (2017)	Web of Science	Computer Applications in Engineering Education
41	Akcapinar and Bayazit (2018)	Web of Science	Turkish Online Journal of Distance Education
42	Akgun and Demir (2018)	Web of Science	International Journal of Assessment Tools in Education
43	Aybek and Okur (2018)	Web of Science	International Journal of Assessment Tools in Education
44	Afacan Adanir (2019)	Web of Science	Turkish Online Journal of Distance Education
45	Hussain et al. (2019)	Web of Science	International Journal of Emerging Technologies in Learning
46	Guneri and Apaydin (2004)	TR Index Search Tool	Ticaret ve Turizm Egitim Fakultesi Dergisi
47	Tekin (2014)	TR Index Search Tool	Eurasian Journal of Educational Research
48	Akcapinar, Altun, and Askar (2015)*	TR Index Search Tool	Ilkogretim Online
49	Aksoy and Narli (2015)*	TR Index Search Tool	Turkish Journal of Giftedness & Education
50	Dalkilic and Aydin (2017)	TR Index Search Tool	Yuksekogretim ve Bilim Dergisi
51	Ozbay and Ersoy (2017)*	TR Index Search Tool	Gazi Universitesi Gazi Egitim Fakultesi Dergisi
52	Cifci, Kaleli, and Gunal (2018)	TR Index Search Tool	Anadolu Universitesi Egitim Bilimleri Enstitusu Dergisi

*Note. * Produced from the author's thesis.*

Articles indicated by asterisk (*) in Table 3 were not included in the results because they were produced from the thesis work of the authors. As a result, analyzes were conducted over 48 studies.

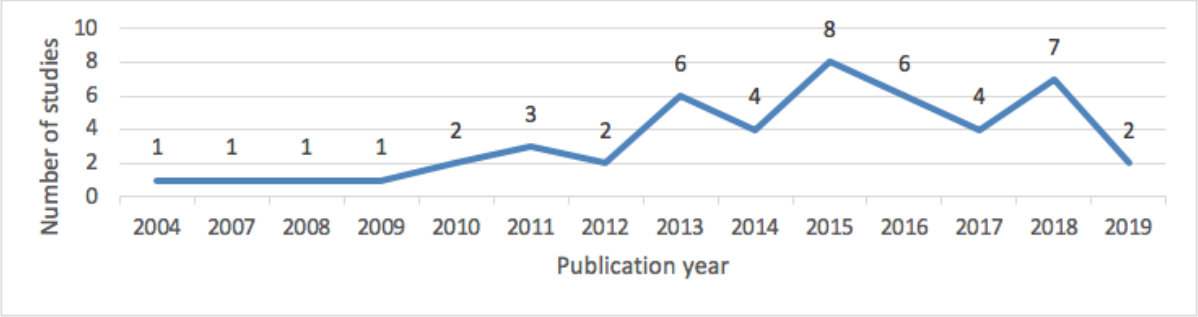


Figure 1. Distribution of EDM studies per year of publication

The classification results of the EDM studies according to the data mining tasks are given in Table 4. When Table 4 is analyzed, it is observed that 46.77% of the studies are for prediction task, followed by the tasks of classification, clustering and association rules respectively.

Table 4. Distribution of studies according to data mining tasks

Data mining task	References	%
Classification	Somyurek (2008), Yelegin (2012), Saygili (2013), Sengur (2013), Akcapinar (2014), Aksoy (2014), Ozbay (2015), Uysal (2015), Cebi (2016), Sahin (2018), Guruler et al. (2010), Sohsah et al. (2015), Idil et al. (2016), Ayvaz et al. (2017), Afacan Adanir (2019)	24.19
Prediction	Aydin (2007), Y. Aydogdu (2011), Sengur (2013), Bahadir (2013), Yildiz (2014), Akcapinar (2014), Coskun (2013), Uysal (2015), Yildiz Aybek (2016), Cebi (2016), Barngrover (2017), Yagci (2018), Yorganci (2018), Kentli and Sahin (2011), Turhan et al. (2013), Akcapinar (2015), Demir (2015), Kayri (2015), Sohsah et al. (2015), Bahadir (2016), Kose and Arslan (2016), Ayvaz et al. (2017), Kose and Arslan (2017), Akgun and Demir (2018), Aybek and Okur (2018), Hussain et al. (2019), Guneri and Apaydin (2004), Tekin (2014), Cifci et al. (2018)	46.77
Clustering	Aydin (2007), Ucgun (2009), Birtil (2011), Saygili (2013), Akcapinar (2014), Ozbay (2015), Dogan and Camurcu (2010), Avsar and Yalcin (2015), Baran and Kilic (2015), Onan et al. (2016), Akcapinar and Bayazit (2018), Dalkilic and Aydin (2017)	19.35
Association rules	Ucgun (2009), Y. Aydogdu (2011), Yucel (2012), Hark (2013), Onan et al. (2016), Dalkilic and Aydin (2017)	9.68

*Note. * Some publications are repeated in the table since they involve more than one task.*

The bar graph of the techniques used in EDM studies and the number of studies using these techniques is given in Figure 2. As shown in Figure 2, artificial neural networks is the most commonly used technique in EDM studies (n = 21). It is seen that artificial neural network techniques are used in the researches in predicting student achievement (Akcapinar, 2014; Kose & Arslan, 2016) and classification of words according to usage level (Sohsah et al., 2015). Another technique commonly used in EDM studies is the decision trees. It is seen that decision trees are used in the studies for estimating student achievement (Aydin, 2007), identifying the variables affecting the attitude towards a specific purpose (Idil et al., 2016) and classifying students according to certain characteristics (Guruler et al., 2010; Yelegin, 2012). Other techniques commonly used in EDM research include clustering techniques (Avsar & Yalcin, 2015; Baran & Kilic, 2015; Dogan & Camurcu, 2010), regression (Bahadir, 2016; Coskun, 2013; Turhan et al., 2013), association rules techniques (Hark, 2013; Onan et al., 2016; Yucel, 2012), bayes classifiers (Cebi, 2016; Cifci et al., 2018; Sahin, 2018; Uysal, 2015), and support vector machines (Kentli & Sahin, 2011; Sohsah et al., 2015; Tekin, 2014). In addition to these studies, fuzzy logic (Uysal, 2015), path analysis (Cebi, 2016) and genetic algorithm (Yildiz, 2014) techniques were used.

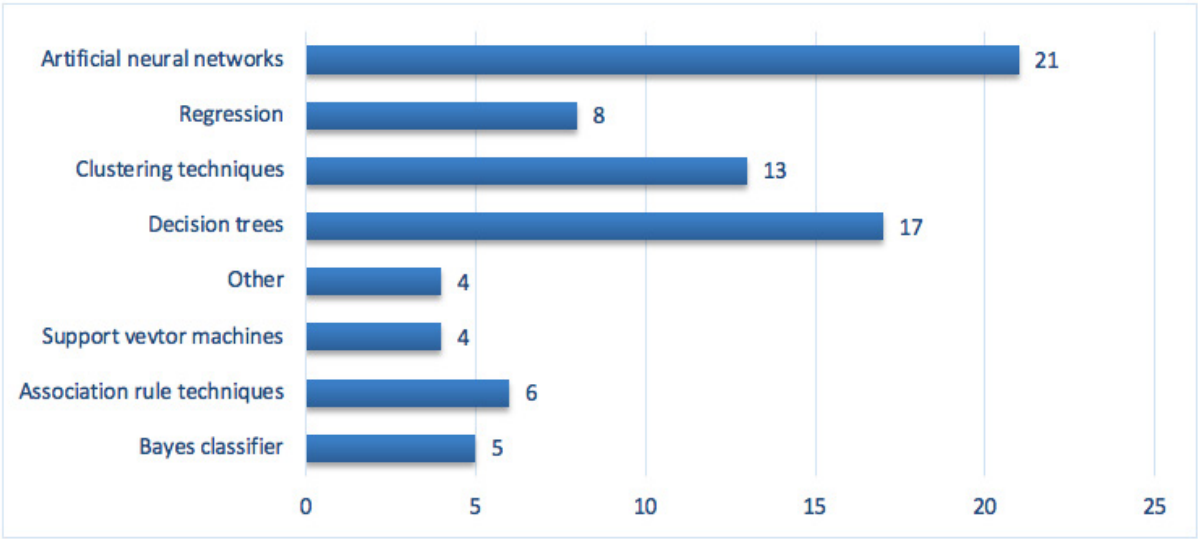


Figure 2. Distribution of the number of studies according to the techniques used in EDM

Classification results according to the topics of the studies related to EDM are given in Table 5. According to the results, publications were mostly aimed to predict student achievement in EDM studies (n = 20).

Achievement prediction studies have tried to predict future success by using the data of the students during the semester, other course achievements or demographic characteristics (Akcapinar, 2014; Akgun & Demir, 2018; Bahadir, 2013; Kayri, 2015; Sengur, 2013; Turhan et al., 2013; Uysal, 2015; Yildiz, 2014). Investigation of e-learning environments was the second most studied topic in EDM studies (n = 7). This topic consist of these studies: determination of the factors determining the efficiency of e-learning environment (Y. Aydogdu, 2011), development of early detection and intervention engine (Sahin, 2018), estimation of students' disorientation levels (Cebi, 2016), estimation of course content for students (Kose & Arslan, 2016, 2017) and the classification of students according to student navigation data (Ozbay, 2015).

Clustering or classification of students according to their success was the most studied another topic (n = 6). This topic includes these research aims: determining successful student characteristics with clustering or classification (Saygili, 2013), clustering by students' achievement (Dogan & Camurcu, 2010; Guruler et al., 2010; Ozbay, 2015) or survey/scale results (Yelegin, 2012) and creating association rules according to successful student characteristics (Onan et al., 2016).

Table 5. Distribution of studies according to topics

Topic of study	Number of studies	%
Achievement/performance prediction	20	39.22
Investigation of e-learning environments	7	13.73
Classification/clustering by success	6	11.76
Classification / clustering according to student characteristics	4	7.84
Investigation of causes of failure	3	5.88
Text mining	3	5.88
Determination of variables that affect attitude	2	3.92
Determination of reasons for absenteeism	1	1.96
Estimation of instructor performance	1	1.96
Determination of effective familial variables on reading skills	1	1.96
Predicting the department that students will prefer	1	1.96
Modeling video navigation	1	1.96
Predicting emotional states with facial recognition	1	1.96
Total	51*	100

*Note. * Since some studies are aimed at more than one purpose, the total value is calculated as 51.*

Classification or clustering according to student characteristics is another topic studied in EDM. This topic includes: clustering according to student profile (Aydin, 2007), student modeling (Somyurek, 2008), determination of the variables that are effective in student modeling (Cebi, 2016) and classification of students according to learning styles (Aksoy, 2014).

According to the results in Table 5, the topics studied in EDM are investigation the causes of students' failures (Baran & Kilic, 2015; Birtil, 2011; Ucgun, 2009), text mining (Afacan Adanir, 2019; Akcapinar, 2015; Sohsah et al., 2015), determination of variables that affect attitude (Hark, 2013; Idil et al., 2016), determination of reasons for absenteeism (Dalkilic & Aydin, 2017), estimation of instructor performance (Cifci et al., 2018), determination of familial variables affecting reading skill (Avsar & Yalcin, 2015), prediction of the department that students will prefer (Coskun, 2013), modeling of video navigations (Akcapinar & Bayazit, 2018) and prediction emotional states with facial recognition and (Ayvaz et al., 2017).

The distribution of the number of studies according to the characteristics of the sample group in EDM is given in Table 6. As seen in Table 6, the sample group in the studies was mostly selected from university students (n = 37). It is thought that researchers prefer to work with university students because the majority of the studies are aimed at prediction of achievement and databases records are used as data source in these studies. The sample group was followed by high school students (n = 5), secondary school students (n = 3) and postgraduate students (n = 1).

Table 6. Distribution of studies according to sample group characteristics

Sample group*	Number of studies	%
University students	37	80.43
High school students	5	10.87
Secondary students	3	6.52
Postgraduate students	1	2.17

*Note. * In some studies were not included in the analysis because they were only data sets (words and face recognition data).*

The distribution of the number of studies according to the data sources used in the EDM is presented in Table 7. When Table 7 is examined, it is seen that the achievement scores are mostly used in the researches as the data source (n = 20). Surveys (n=12), database records (n=10), demographic characteristics (n=7), navigation data (n=5), scales (n = 4) and web-based learning environment (n = 3) are other data sources used.

Table 7. Distribution of studies according to data sources

Data source	Number of studies	%
Achievement scores	20	26.32
Surveys	12	15.79
Database records (Assessment Selection and Placement Center (OSYM) data etc.)	10	13.16
Demographic Characteristics	7	9.21
Navigation data	5	6.58
Scales	4	5.26
Web-based learning environment	3	3.95
Opinion forms	2	2.63
Multiple intelligence scale	2	2.63
Student posts (message-chat tool)	2	2.63
Video interaction data	1	1.32
Disorientation scale	1	1.32
Satisfaction survey	1	1.32
Concealed shapes group test	1	1.32
Process-letter sequence test	1	1.32
Word data set	1	1.32
Prior knowledge level	1	1.32
Learning style inventory	1	1.32
Face recognition data	1	1.32
Total	79*	100

*Note. * Since there may be more than one data source in one study, the total number of studies was calculated as 79.*

The distribution of the number of studies according to the analysis tool used in EDM research is given in Table 8. According to the results, SPSS (n = 8), MATLAB (n = 5), SPSS Clementine (n = 5), WEKA (n = 4) and RapidMiner (n = 3) tools were used in the studies. In addition, data mining tool has been developed in 4 studies. Keras, Neural Connection, R Programlama, SAS Enterprise Manager, SPSS Amos, Tableau, Tensorflow tools were used in only 1 study.

Table 8. Distribution of studies according to the analysis tool used

Analysis tool	Number of studies	%
SPSS	8	22.22
MATLAB	5	13.89
SPSS Clementine	5	13.89
Developed in the study process	4	11.11
WEKA	4	11.11
RapidMiner	3	8.33
Keras	1	2.78
Neural Connection	1	2.78
R Programming	1	2.78
SAS Enterprise Manager	1	2.78
SPSS Amos	1	2.78
Tableau	1	2.78
Tensorflow	1	2.78
Total	36*	100

*Note. * Because in some studies the tool used is not specified or more than one tool is used in a study total value was calculated as 36.*

In the 20 studies (Table 5) for prediction the achievement of students, the results of the analysis on which data are used as input variables for predicting the achievement are presented in Table 9. As the input variable used in the prediction of achievement, it is seen that the midterm exam scores or the previous exam scores of the other courses are the most preferred (n = 13). Demographic characteristics such as gender, age, nationality and region of residence were used in 7 studies. OSYM placement data of university students were used as input variable in 5 researches. The data collected by applying the scale or survey to the students and the system interaction data of the students were used as input variables in 4 studies.

Table 9. Input variables used in predicting achievement

Input variable	Number of studies	%
Midterm or previous exam scores	13	39.39
Demographic characteristics (gender, age, nationality etc.)	7	21.21
OSYM data (high school type, teaching type, high school code, placement score etc.)	5	15.15
Scale or survey data	4	12.12
System interaction values (Duration of use, number of messages, navigation data etc.)	4	12.12
Total	33*	100

*Note. * In some studies, since the input variables were included in more than one class, the total value was calculated as 33.*

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this section, the results of the research were discussed in the context of the related literature and suggestions were made for the studies to be carried out regarding EDM. In addition, this section covers the issues that are not included in the results but which have attracted the attention of the researcher.

When the distribution of EDM related studies by years is examined, it is observed that there is limited study for this field. Pena-Ayala (2014) states in his study "EDM is living its spring time and preparing for a hot summer season." However, considering the number of studies conducted for EDM in Turkey, it can be said that this field is a new field of study.

It is seen that the studies carried out in EDM are generally conducted for prediction. In addition, there are studies in which classification, clustering and association rules are performed. Prediction, classification and clustering studies generally focus on model building on a data set and testing the accuracy of the generated model. On the other hand, there was no study in which the model was created dynamically and automatically updated. In the association rules studies, rules were established according to the frequency of coexistence of the data in the data sets. When examining the distribution of analysis tools used in EDM studies, it is observed that Keras (Chollet, 2018), R Programming and Tensorflow (Abadi et al., 2016) tools, which are widely used in Statistics, data mining and machine learning, are used limited research in Turkey and instead these programs ready package programs are preferred. Therefore, it is thought that it would be useful in terms of learning that integration of learning management systems with applications which open source applications developed as an alternative to ready-made package programs used in data mining or machine learning.

In most studies, one or more of the data mining techniques have been used, but the details of the parameters used in these techniques have not been specified. One of the factors determining the performance of a technique is which parameters this technique is used with. Therefore, it is considered that there is a need for studies about parameter optimization in data mining techniques used in EDM studies.

There should be a logical fiction between input and output variables determined for modeling or validation in data mining. For example, Sahin (2018) stated in a study which variables were used in the modeling and why. In some of the studies, it is seen that there is no logical validity to establish the relationship between the content of the questionnaire and student achievement. In particular, it is a big problem that how some input variables used in thesis studies (eg GSM No, TC Identity Number) will contribute to the classification or estimation of student achievement or profile, and how to explain this situation, even if the level of contribution it makes.

When the studies are examined, it is seen that quantitative data (frequency, response to questionnaire, etc.) are used as input variable in clustering, classification and prediction. It is thought that analyzing the content of the shares as well as the sharing frequency of students in educational settings will bring more in-depth results. Therefore, it is recommended that qualitative data should be used in data mining studies and that text mining methods should be employed in the process of preprocessing data. For example, the web-based application developed by Aydogdu and Guyer (2018) for the automatic generation of concept maps can be used as a tool in the preprocessing of textual data since it performs sorting according to the weight value of terms in a document set.

When the techniques used in EDM are examined in Turkey, it is observed that artificial neural networks are used more than other techniques. Similar results are noted in the study by Manjarres et al. (2018) In the literature, artificial neural networks are called "black box" (Benitez, Castro, & Requena, 1997; Olden & Jackson, 2002) and there are different methods for interpreting these networks (de Ona & Garrido, 2014; Olden, Joy, & Death, 2004). When studies on predicting student achievement with artificial neural networks are examined, it is stated in some studies how input variables contribute to student achievement. On the other hand, it is seen that the contribution level of input variables is not explained in the studies or the correlation coefficient between input variable and output variable is interpreted as contribution level. In this case, it is considered that the weight coefficient values in hidden layers in artificial neural networks are not taken into consideration. Finally, in some studies conducted with artificial neural networks, it is seen that midterm exam scores are used as input variables in predicting success. When the results of these studies are examined, it is stated that midterm scores are of great importance as an indicator of the success of the

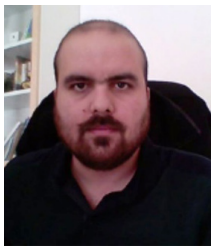
students. In the case of artificial neural networks, it is normal for the variable to have a significant role if the variable that directly calculates a certain percentage of the output variable is used as the input variable. Therefore it is considered that the use of latent variables or variables that do not have a direct percentage effect on the output variable in these networks is more suitable for the purpose of use of these networks.

In EDM studies, predicting student achievement has been the most studied subject and university students the most selected sample. These results support the results of the review study conducted by Tekin and Oztekin (2018). It is thought that student achievement level and university students are preferred more in the studies because of their ease of access. In addition to these studies, it is recommended to conduct studies at different sample levels and to investigate different variables related to student achievement as well as learning.

LIMITATIONS

In this study, CoHE Thesis Center, Web of Science database and TR Index Search Tool were used according to certain keywords. The studies that exist in the literature but which are not listed in the search results of incomplete or incorrect identification of users, authors or systems in databases are not included in this study.

BIODATA and CONTACT ADDRESSES of AUTHOR



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TEACHERS' ICT LITERACY AND ICT INTEGRATION IN ELT IN THE INDONESIAN HIGHER EDUCATION SETTING

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ABSTRACT

The use of Information Communication Technology (ICT) in English Language Teaching (ELT) in higher education settings in Indonesia is still under research. This is a correlational study that investigates teachers' knowledge, experiences, ICT literacy levels, and to what extent they integrate ICTs in ELT. Numbers of 280 English lecturers of different universities in Indonesia completed the online questionnaires that are distributed through emails and social media messengers during December 2018. The result shows that more than 60 % of the respondents' ICT literacy levels are above average and they frequently use ICT in their daily teaching, although they still face problems in internet facility and lack of ICT training. The study also reveals that there is a significant correlation among teachers' ICT literacy levels with their training experiences, internet frequency usage, and ICTs integration in language teaching. The more frequent teachers implement the ICTs, the more literate they will become. Training experiences surely generate teachers' ICT literacy. The majority of English lecturers in Indonesia are ICT literate and ready to integrate their ICT skills in their teaching-learning activities. More frequent training and stronger policy support of ICT facilities from the institution and government would be advantageous to encourage greater ICT integration in education, especially in ELT.

Keywords: ICT Literacy, ICT Integration, ELT, Higher Education

INTRODUCTION

Education in the 21-st century era demands teachers and learners to be *Digital Literate* or *Tech-Savvy*, able to use ICT applications and procedures as teaching and learning tools. The term ICT was commonly used in the early 1990s when education started to facilitate the practices of the Internet, computer technology, and other telecommunication media into education settings, especially ELT. ICT Literacy Panel (2002) defines ICT literacy as the capability to practice digital technology, communications tools, and/or networks to access, integrate, manage, evaluate, and create information to function in a knowledge society. It is in line with Hockly (2012) who defines digital literacy covering information, media, and technology skills needed to face the 21st-century education era.

Previous studies suggest that teachers should perceive the benefits of technology, update the technology issues, equip themselves with the ability of teaching savvy-students, and more importantly make use of the technology by applying it in teaching to increase students' achievements and make them ready in facing the multimedia technological expansion and digital literacy era. (Ahmed & Nasser, 2015; Prinsloo & Sasman, 2015). ICT in many forms has demonstrated to give many advantages in English language teaching. ICT

becomes a global policy of education and give a massive impact on the changes of an education system in many developed countries, (Zhao, Yao, & Kong, 2016). Teachers, as well as students, are welcoming ICT as new ways to promote modern and efficient learning activities to enhance better achievement in English.

The Indonesian education policy has put digital literacy in the National curriculum as one of the skills, besides numerical and literacy skills, that students and teachers must acquire in 21st-century teaching and learning for the primary and secondary level of education. (UNESCO, 2003, 2010; UNESCO Institute for Statistics, 2014) As stated in the latest document of the P21 framework(Partnership for 21st Century Learning, 2015) that accounted for 4C: communication, collaborative, critical thinking, and creativity, students must fulfill all those skills in current educational settings. ICT competency is one of the main aspects of communication skills and has become the goals and learning outcomes of the Indonesian national curriculum. Computers and internet technology have become daily normal use in students' and teachers' activity because the internet and social media could easily be access by the citizens at a very reasonable price. However, there are still some problems with ICT implementation regarding the facility and literacy. Survey result of Technology Development; Internet users in Indonesia is 20.4 %, which is 53,236,719 people from the population of 260,581,100, however, their ICT skills are still below average compare to other OECD countries (OECD, 2015). Indonesian Students and Teachers still have problems with digital learning skills and implementations. (Harendita, 2013; Kusumo, Kurniawan, & Putri, 2012). Therefore, this study is conducted to reveal English educators' ICT literacy levels and to find out how far they have integrated ICT in language teaching in higher education settings in Indonesia.

Studies on teachers' perspectives of technology integration in English Foreign language teaching found that most English teachers in Indonesia believe the importance and the usefulness of technology for teaching all skills of English, but it contradicts with their teaching practices in class. It reveals that most teachers do not have the ICT pedagogy that they can implement in their classroom although they have a positive attitude toward the development of technology (ICT) for language learning. (Febriani & Hafifah, 2019; Inayati, 2014; Silviyanti, T. M., & Yusuf, 2015)"type":"article-journal"},"uris":["http://www.mendeley.com/documents/?uuid=f8dc8051-0bc3-494a-b046-529ac01766ef"]},{"id":"ITEM-2","itemData":{"abstract":"This study focused on identifying EFL teachers' perceptions on the use of ICT in their teaching. A number of 42 EFL teachers from two state universities in Indonesia were involved. A closed-ended questionnaire based on the Technology Acceptance Model (TAM. Indonesian teachers are newcomers of the digital era so that ICT expectations often conflicted with the pedagogical issue in the classrooms, therefore they need further training to improve their technological and pedagogical knowledge. It is also found that CPD in ICT and TPACK help teachers to improve their technological skills and ICT understanding as well as their attitude toward it (Hismanoglu, 2012; Olofsson, Lindberg, & Fransson, 2017; Tallvid, 2016)depending on the ways in which it is applied. In this study, parametric analysis such as Independent samples t-Test was utilized to explore any statistically significant differences between prospective EFL teachers' ICT attitudes before and after ICT-interwoven training. Moreover, the qualitative information was analyzed from the transcriptions of the interviews, and synthesized with the results from the quantitative study. A questionnaire made up of nine items and an interview consisting of nine questions were employed as data collection tools. (Contains 4 tables.. Teachers' knowledge and incapacity toward technology also affect their teaching practices of ICT (Deryakulu & Atal-Köysüren, 2018)

Other researchers also investigated the impact and result of teachers' professional development in ICT and TPACK. They found that the program helped the teacher to improve their technological skills as well as their understanding of ICT for enhancing education quality. (Goktas, Yildirim, & Yildirim, 2008; Kalogiannakis, 2010; Olofsson et al., 2017). Specific training is also done in comparing teachers' attitudes before and after ICT training for English Language Teaching. (Hismanoglu, 2012; Kalogiannakis, 2010; Luik, Taimalu, & Suviste, 2018). Most studies approve that training is important to increase teachers' knowledge and competence of ICT in teaching. Furthermore, the existence of specific courses related to ICT taught at university levels to support the importance of ICT literacy for language teaching and learning is not yet explores. Thus, this study figures out how ICT training and experience might affect teachers' ICT literacy and integration in ELT.

PURPOSE OF THE STUDY

Based on the previous research, there are still limited studies investigating ICT literacy in higher education in the Indonesian context, especially in ELT. This study aims to explore further the teachers' ICT literacy lev-

els, knowledge, training experiences and the integration of ICT in English language teaching. The findings of this study are beneficial to map teachers' ICT literacy and readiness in implementing more ICTs using blended learning and the online course at a higher education level to support the higher education ministry policy. Based on the policy of the Ministry of higher education and research, Indonesia is enhancing the education system is facing the industrial revolution era of 4.0 by having a more online course *(SPADA-Sistem Pembelajaran Daring Indonesia)*. (Direktorat Jendral Pembelajaran dan Kemahasiswaan, 2018).The result gives a full description of how far teachers integrate ICT in ELT context as well as identify problems of ICT implementation. At last, this will promote digital learning practices to support the 21st-century education framework and lead to a supplementary recommendation to improve the teaching and learning quality of ELT in the current era.

METHOD

Research Design

It's a correlational study using an online survey to investigate several aspects; ICT literacy (knowledge), training experiences, internet frequency, and kinds of ICT activities.

Participants

The respondents of this study are lecturers with a master's degree qualification, who teach English Subjects at the university level. There are 280 respondents from more than 130 different universities located in 34 provinces in Indonesia. The sample represents most of the main islands of Indonesia as an archipelago country (Sumatera, Java, Madura, Bali, Lombok, Sumbawa, Nusa Tenggara, Papua, Sulawesi, and Kalimantan)

Data Collection and Analysis

The validated questionnaire is converted into an online questionnaire using Google-form and distributed through 670 emails and 150 social media accounts to English lecturers who teach English in a higher education institution in Indonesia. The return rates were 330 respondents, but have been sorted to 280 respondents. The other 50 respondents do not fulfill the characteristic of targeted respondents who must be English lecturers teaching at the university level. The survey was done for a month during December 2018. The data collected then analyzed using chi-square to find the correlation between each aspect. Kinds of training experiences, ICT activities and problems of ICT implementation were described statistically.

The Scale

The questionnaire was adapted from(Muslem, Yusuf, & Juliana, 2018; Son, Robb, & Charismiadji, 2011), consisting of 35 items and five scales of measurements. There are five scales of measurement for the variable of knowledge and ICT literacy skill; *Strongly agree, agree, neutral, disagree, and strongly disagree*. For the variable of Internet and ICT activities frequency, there are also five scales of measurement; *always, often, sometimes, rarely, and never*. The instrument is validated by some experts before applying it to collect the data and also undergone validity measurement using *SPSS* with the result of $r > 0.113$ and reliability measurement using *Cronbach alpha* with the result $r > 0.7$ (see the appendix of the questionnaire)

FINDINGS AND DISCUSSIONS

Demographic data from the respondents are gained based on the following category: age, gender, educational background, academic position, and teaching experiences. The dominant age of the respondents (43.5%) 122 respondents are at the age of 31-40 years old, below 30 years old is 64, 41-50 is 60, 51-60 years old is 29, and above 61 years old is 5. Indonesia lecturer's minimum education requirement is a master's degree, the data gained 18 % of the respondents 50 lecturers own doctorate and the rest (82 %) of the respondents, which is 250 lecturers own master degree. Most respondents are still in the position of lecturers 115, assistant profes-

sors 86, associate professors 17, and Professors 6. Fifty-six (20%) of them are still new lecturers who teach less than 5 years and do not have any academic position based on the ministry of higher education. (32,5 %) of the respondents have 5-10 years teaching experiences, (20 %) 11-15 years teaching experiences, 13,2 % have 16-20 years experience, and the rest 14,3 % have experienced teaching more than 21 years. The respondents are representative of English educators from more than 130 universities in55 cities around Indonesia.

ICT Literacy Levels

Figure 1 explains that most lecturers are ICT literate and able to use ICT in their daily teaching activities. The figure shows that more than (61.4 %) 172 respondents have ICT skills above adequate, which are good and excellent. The rest (36.49 %) are just adequate and only 6 respondents (less than 1 %) admitted having poor ICT skills.

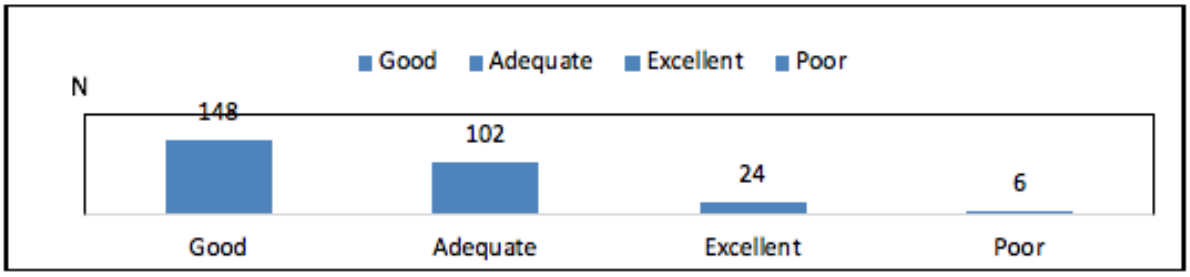

Figure 1. ICT literacy levels

The following data (table 1) describes more on teachers' knowledge of ICT in English language teaching. Less than (1%) teachers do not know how to access the internet and get some information from it. The other respondents (82.14%) are strongly agreed and (17.41%) agreed that they can access the internet and make use of the internet to find some information. (35%) of the teachers are strongly agreed and (45.71%) agreed that they have the knowledge of many various forms of ICTs tools and techniques that are accessible to be used for teaching. (15.71%) of them are neutral and only (3.57%) disagree, meaning only a few teachers do not have the knowledge of ICTs tools and techniques that can be used for teaching English. The majority of English teachers are able to make use of ICT to enhance language teaching and learning. (52.85%) teachers agree, (30.35%) strongly agree, and (40 %) teachers are not sure whether they can empower ICT to enhance language learning. less than (2%) of the respondents disagree and less than (1%) strongly disagree, only 2 respondents out of 280 feel they cannot use ICT to improve learning.

However, half of the teachers are not sure they have enough training and experiences related to the use of ICTs for instructional purposes; (31.42%) of them has neutral answers, (16.42%) of them disagree and (1.78%) strongly disagree. (13.92%) teachers strongly agree and (36.42%) teachers agree that they have enough experience and training on ICT and technology for language teaching and learning. More than half of the respondents have the competence of providing digital sources and ICT materials related to English subjects for their students, (28.21%) strongly agree and (43.21%) agree. The rest (21.78%) are not sure whether they can provide materials for their students from ICTs tools and activities. (5.35%) of the respondents, answer disagrees and (1.42%) strongly disagree.

This outcome renews previous findings by (Harendita, 2013; Kusumo et al., 2012) about the condition of Indonesian teachers who were lack of ICT skills. English teachers nowadays are proven to be more literate and willing to apply more ICT activities in teaching English. Most of the teachers know many various forms of ICTs tools and techniques that are accessible to be used for teaching. They can access internet and get some information from it, have the capacity to use technology/ICT tools to enhance language learning and teaching, provide digital sources and ICT materials related to English Language for their students, and have enough experiences and training on ICT and technology that can be used for teaching English in higher education setting.

Teachers' knowledge surely influences teachers' self-efficacy of ICT implementation in higher education settings. Teachers should equip themselves with digital literacy skills and update to the development of technology otherwise they will be left behind. In line with Parker (2010) who questions about the ideal teaching framework in the 21st-century era, how learning should be like, what literacy is, and what knowledge is.

Technology will surely change some teachers' roles in the future, therefore, teachers must be ICT literate and ready to teach in the digital era of technology.

Table 1. Knowledge of ICT

Knowledge of ICT	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
Teachers know how to access the internet and get some information from it	230 (82.14%)	48 (17.14%)	1 (0.35%)	1 (0.35%)	0 (0%)
Teachers know many various forms if ICTs tools and techniques that are accessible to be used for teaching	98 (35%)	128 (45.71%)	44 (15.71%)	10 (3.57%)	0 (0%)
Teachers know how to use technology/ICT tools to enhance language learning and teaching	85 (30.35%)	148 (52.85%)	40 (14.28%)	5 (1.78%)	2 (0.71%)
Teachers have enough experiences and training on ICT and technology for language teaching and learning	39 (13.92%)	102 (36.42%)	88 (31.42%)	46 (16.42%)	5 (1.78%)
Teachers able to provide digital sources and ICT materials related to the English Language for my students	79 (28.21%)	121 (43.21%)	61 (21.78%)	15 (5.35%)	4 (1.42%)

ICT Literacy and ICT Activities

Table 2. Correlation between ICT literacy and ICT activities frequency use

Chi-Square Tests			
	Score	db	P-Value
Pearson Chi-Square	47.489	12	.000
Likelihood Ratio	49.236	12	.000
Correlation is significant when P-value < α (0.05)			

The statistic computation shows that the P-value is below 5 %, meaning there is a significant correlation between teachers' ICT Literacy and their frequency of doing teaching activities related to ICT. The better ICT Literacy teachers have, the more frequently they use ICT in their teaching-learning activities. Teachers with excellent literacy skills always use ICT for teaching students. They make use of ICT optimally in increasing students' understanding of the lesson. A teacher with good ICT skills often uses ICT and teachers with adequate literacy skills sometimes integrate ICT in their instructional activities. (Figure 2)

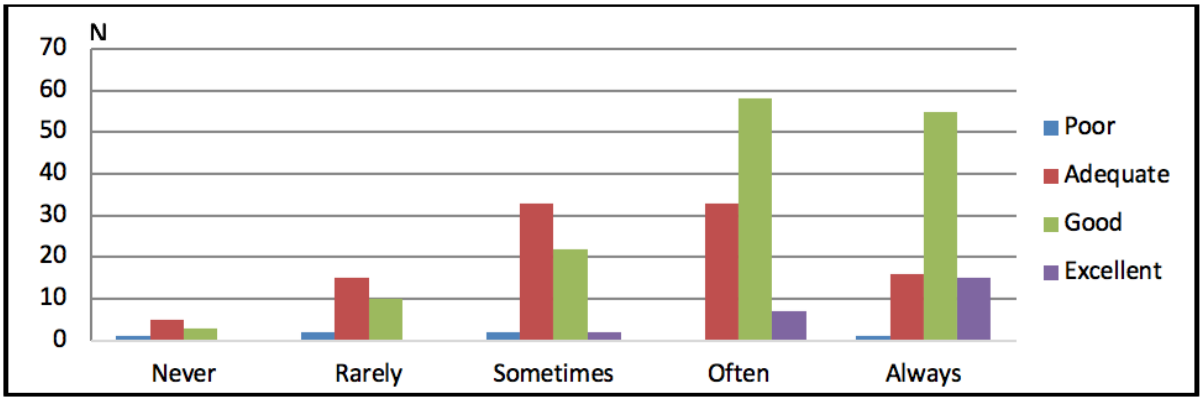

Figure 2. ICT Literacy and Frequency

Kinds of ICT Activities Use

There are fourteen kinds of ICT activities teachers use in English language teaching. (Table 2). The most frequent activity is finding material resources related to the lessons taught. It is proven already that ICT gives teachers huge access to collect, download and use materials from the internet before teaching. Teachers can find all kinds of teaching audio, printed and visual teaching materials easily through the internet. Nowadays a teacher depends on some search engines that can give them answers to any problem they have related to teaching. 60% of the respondents believe the internet can provide them many teaching materials and 53.2 % of them always do surfing activities in some search engines or worldwide websites. Other frequent ICT activities are emailing and preparing a presentation. 46.8% of respondents always use ICT in preparing teaching presentation and emailing students or colleagues related to teaching matters and tasks. In this era of eco-literacy and global warming awareness, paperless- assignments are more recommended. 45.7 % of teachers prefer to give assignments online rather than manual or printed ones. In this rapid information era, the communication system is done more through online rather than face-to-face. 36.8 % of teachers prefer to have online chatting communication, via texting in short message service with students and other colleagues related to subject matters.

Other less frequent ICT activities that sometimes used by the teachers are using Learning Management System (LMS) as online classroom learning platform (26.4 %), Educational games and application (30.4%), online discussion board (26.1%), Social media such as Youtube, whats application, Line, Instagram for teaching (27.9%). Using social media for educational purposes is not balanced with the numbers of social media users in Indonesia that 40 % of 262 million Indonesians use them. (Direktorat Jendral Pembelajaran dan Kemahasiswaan, 2018).

Video conferencing is one of the activities, which is mostly never use for teaching-learning activities in an English course. (42.5%) respondents never use video conferencing with their students. It is probably because teachers use blended learning, so there is still face to face interaction in the classroom during the course. Video conferencing is more suitable to be used for distance learning, in which teachers and students are not at the same place. (32.1 %) Respondents never use Blogging as their teaching media, though there have been several studies about the effectiveness of Blogs as media to facilitate students learning. Even though the statistic shows that 62 % of Indonesians like to do shopping online, but (38.6 %) teachers answer never do online shopping for the sake of teaching.

Many studies have shown that ICT gives more advantages to education. Integrating ICT in English language teaching improves learning and support teaching (Tallvid, 2016; Wilkinson, 2016)several one laptop per student-initiatives (1:1. It is confirmed that students have to be prepared with digital literacy skills in the modern era of teaching and learning (Tri & Nguyen, 2014)limited research has been conducted to examine the use of ICT in terms of frequency of use, purposes, perceptions, and expectations among EFL students. Thus, the purpose of the current study was to address this research problem. The research used a convenience sample of 149 English major students who were invited to respond to the questionnaire survey. The findings indicated that the participants spent more time using ICT for private purposes than for English learning purposes. Most of them showed their positive attitudes towards ICT use to study English and expected that ICT should be used more frequently in the classroom in order to maximize language learning and teaching. Gaining an understanding of the way the learners employ ICT for their non-educational purposes may help “shed light on how best to determine their educational uses” (Fujimoto, 2012, p.165. ICT improves students’ thinking and practical skills of English and helps the teacher to teach effectively (Matukhin & Zhitkova, 2015; Pun, 2013; Shyamlee & Phil, 2012). Providing students with digital or online learning materials increase students’ motivation in learning (Floris, 2014; Shishkovskaya, Sokolova, & Chernaya, 2015; Zarzycka-Piskorz, 2016). Using social media and technology improves students’ English communication (Boonyopakorn, 2016; Buran & Evseeva, 2015). The ICTs activities provide flexibility and accommodate students’ different learning styles (Kranthi, 2017) and increase students’ English proficiency (Bilgin, 2013; Shishkovskaya, Bakalo, & Grigoryev, 2015). The implementation of LMS has replaced the traditional classroom learning activities and promoted students’ autonomous learning (Averkieva, Chayka, & Glushkov, 2015; Bilgin, 2013; Fix, Kolesnikov, & Petrova, 2015; Sokolova, Rostovtseva, & Wasilewski, 2015).

More variations of ICT activities and tools need to be done to enhance language learning in higher education levels. Teachers’ capacity and attitude toward ICT determines the success of ICT integration in English

Language teaching. Teachers have important roles as the content developer and learning facilitator in implementing ICT in the education setting. Hence, teachers should maintain and improve their ICT literacy to be able to cope with the rapid development of technology used in teaching by adjusting teaching objectives, material, strategies engaged with ICT activities.

Table 3. ICT Activities Frequency

No.	ICT ACTIVITIES	FREQUENCY					
		Always	Often	Sometimes	Rarely	Never	Total
1.	Text chatting with students and other teachers on university/subject matter	103	106	50	8	13	280
		36.8%	37.9%	17.9%	2.9%	4.6%	100%
2.	E-mail and mail listing	131	92	41	14	2	280
		46.8%	32.9%	14.6%	5.0%	.7%	100%
3.	Online Classroom Learning Platform (Learning Management System)	43	71	74	38	54	280
		15.4%	25.4%	26.4%	13.6%	19.3%	100%
4.	Educational Games /Application that can be used for teaching	28	59	85	60	48	280
		10.0%	21.1%	30.4%	21.4%	17.1%	100%
5.	An online discussion board on language teaching	38	60	73	57	52	280
		13.6%	21.4%	26.1%	20.4%	18.6%	100%
6.	Social media (Youtube/Facebook/Instagram/Twitter) for language teaching	61	92	78	31	18	280
		21.8%	32.9%	27.9%	11.1%	6.4%	100%
7.	Shopping online for teaching tools and materials	16	36	52	68	108	280
		5.7%	12.9%	18.6%	24.3%	38.6%	100%
8.	Finding material resources related to lessons	168	87	21	3	1	280
		60.0%	31.1%	7.5%	1.1%	.4%	100%
9.	Preparing Presentation	131	108	31	8	2	280
		46.8%	38.6%	11.1%	2.9%	.7%	100%
10.	Giving task/assignment to students	89	128	44	13	6	280
		31.8%	45.7%	15.7%	4.6%	2.1%	100%
11.	Video conferencing and net meeting	19	30	56	56	119	280
		6.8%	10.7%	20.0%	20.0%	42.5%	100%
12.	Online Dictionaries	102	90	57	24	7	280
		36.4%	32.1%	20.4%	8.6%	2.5%	100%
13.	Blogging	32	39	65	54	90	280
		11.4%	13.9%	23.2%	19.3%	32.1%	100%
14.	World wide web surfing	149	76	30	9	16	280
		53.2%	27.1%	10.7%	3.2%	5.7%	100%

ICT Literacy and Internet Use

There is an increase in internet use frequency in 2016 only (20.4%) of Indonesians use the internet and now 132.7 million (51 %) people of Indonesians use the internet at least three hours per day. (Direktorat Jendral Pembelajaran dan Kemahasiswaan, 2018). able 3 shows that the P-value score is less than 0.05 meaning there is a strong correlation between ICT literacy and internet frequency use. The more duration teachers use the

internet, the more ICT literacy they acquire. Teachers with excellent ICT skills mostly access the internet more than 7 hours a day, 3-4 hours a day for teachers who are good at ICT, 1-2 hours a day for adequate teachers, and less than 1 hour for teachers who are poor in ICT literacy. ICT literate teachers tend to optimize the use of the internet and depend on the internet more than less ICT literate teachers.

Table 4. Correlation between ICT Literacy and Internet Frequency Use

Chi-Square test			
	Score	Db	P-value
Likelihood Ratio	42.301	15	0.000
Pearson Chi-Square	44.971	15	0.000
Correlation is significant when P-value < α (0.05)			

ICT Literacy and Training Experiences

There is a significant correlation between ICT literacy and ICT training experience. (see table 4) Numbers of teachers who are experienced in joining workshops and training related to ICT are more literate than those who never join. 5 from 6 respondents with poor ICT literacy never join any workshops about ICT application for teaching. 65 from 99 respondents with adequate ICT literacy never join ICT training either. Meanwhile, 78 of 147 respondents with good ICT skills have experienced training and workshops of ICT. 14 from 24 respondents with excellent ICT skills also join similar workshops and training before. The findings confirm the previous studies' results (Goktas et al., 2008; Hismanoglu, 2012; Kalogiannakis, 2010; Olofsson et al., 2017; Zhao et al., 2016) that training experience influences teachers ICT skills as well as their attitude toward ICT. The knowledge and experiences of applying ICT in their daily basis improve the teachers' competence of ICT literacy. The more training experiences, the more literate the teachers are in Information Communication Technology applications and the more they are challenged to apply ICT in their courses.

The study reveals kinds of ICT training and workshops experienced by the respondents, such as E-Learning, New Technologies, and Digital Learning, ITELL (Indonesia Technology-Enhanced Language Learning) workshop, TPACK (Technological Pedagogical Content Knowledge) training, CALL (Computer-Assisted Language Learning)-MALL (Mobile-Assisted Language Learning) applications training, Coursera, Augmented Reality in ELT, and LMS (Learning Management System). Some of the respondents even experienced training and short-courses related to ICT conducted by international institutions. They are ICT (Integrated Computer Technology) in ELT Course from East-West Centre, Hawaii; BINGAR Application in testing speaking and Future Learn held by Ministry of Education of Malaysia; IMOOC (Indonesia Massive Open Online Course) held by RELO, the American National Education Foundation; Online teaching workshop by University of Oregon; Coursera; and MOOC SEAMOLEC. This finding shows that there have been enough variety of ICT training and courses provided in Indonesia and more teachers are interested in joining such kind of training to enhance their ICT literacy skills.

Table 5. Correlation between ICT Literacy and Training Experiences

Chi-Square test			
	Score	Db	P-value
Likelihood Ratio	12.249	3	0.007
Pearson Chi-Square	11.913	3	0.008
Correlation is significant when P-value < α (0.05)			

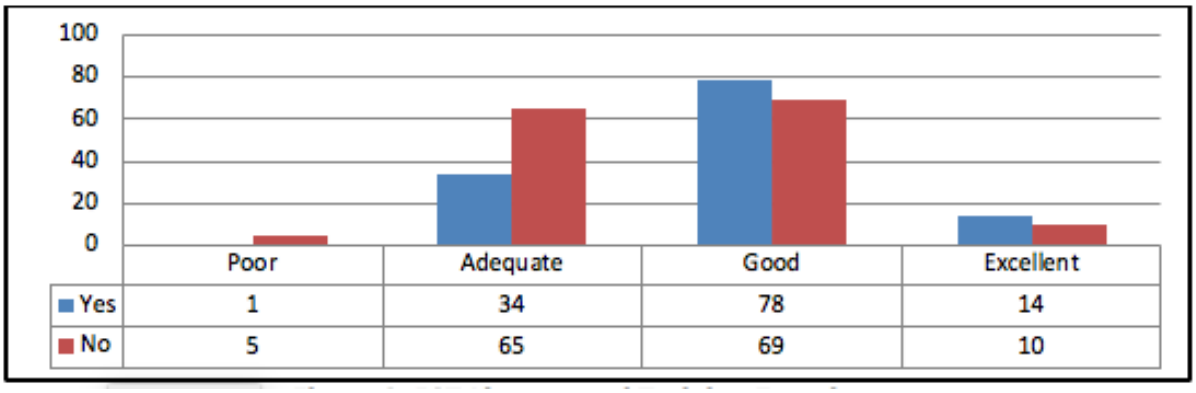

Figure 3. ICT Literacy and Training Experience

Problems in ICT Implementation

The facility of ICT that covers internet access and technological tools availability becomes the main problem teachers have in the ICT integration. (41.66 %) respondents feel they don't cater with enough facility an infrastructure that can support them to apply ICT in English language teaching. Internet connection in many different areas in Indonesia has various qualities. Internet access is quite problematic in rural areas of Indonesia. The second problem is on the teachers' ICT skills, although most of them are ICT literate but only a few of them joined the training and update their skills. Regular training of ICT integration in language teaching is needed by most teachers. (19.79%) of the teachers feel a lack of ICT skills although they are quite ICT literate. Institutional support (19.53 %). Time limitation (16.49%). (1.3 %) feels the problem is on the student's ICT literacy skills and (1.3%) have no problems in implementing ICT. Problems in ICT is mostly in technical and internet facility matter, however many studies confirm that ICT literacy skills and teachers attitude toward it determine significantly to the practice of ICT in instructional contexts. The more problems they have will discourage teachers in integrating ICT in their teaching, (Abukhattala, 2016; Dashtestani, 2014; Hashemi, 2013; Mafuraga & Moremi, 2017; Safitry et al., 2015; Silviyanti, T. M., & Yusuf, 2015). To overcome this problem it is suggested the authority increase the facility and setting particular policies to have ICT more integrated into the education setting. More organized and frequent training of ICT applications needs to be done to increase teachers' ICT skills.

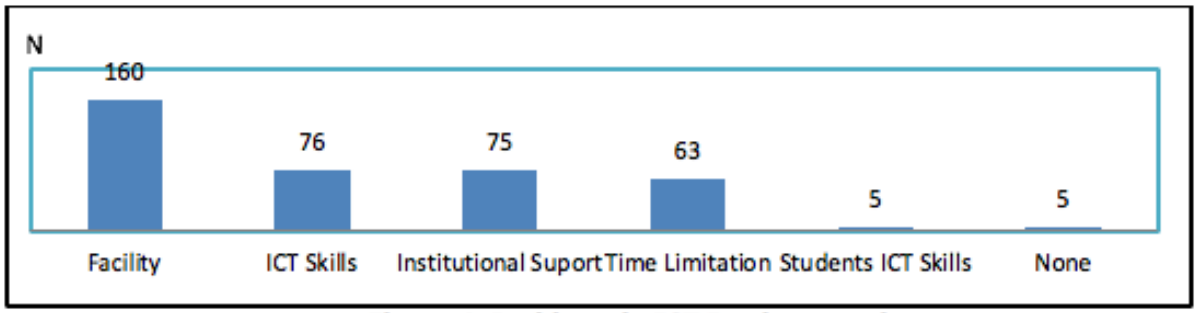

Figure 4. Problems in ICT Implementation

CONCLUSION

There is a significant correlation among teachers' ICT literacy levels with their training experiences, internet frequency usage, and ICTs integration in language teaching. The more frequent teachers implement the ICTs the more literate they will become. English educators in higher education levels in Indonesia are ICT literate and ready to implement ICT in their instructional setting. Most of them have good ICT skills and have integrated technology to enhance students' achievement and motivation in learning English. It is in hand with the government policy on the disruptive technology of the industrial revolution 4.0 that supports the use of E-learning for teaching the subjects in higher education contexts. Currently, many technological innovations take the role of teachers as; material providers, learning facilitators, assessors, and reviewers. Therefore, teachers are demanded to be ICT literate as teaching sustenance to increase their professional works quality. Hence, teachers must equip themselves with ICT skills and update to technology applications to cope with the 21st-century teaching or they will be replaced by technology itself.

The correlation between teachers' ICT literacy and ICT training and implementation is also obvious, training experiences generate teachers' ICT literacy. For that reason, the government's policy and regulation of the use of ICT should be upkeep by conducting more frequent seminars and workshops of ICT to upgrade teachers' ICT literacy levels. More operational training and stronger policy support of ICT facilities from the institution and government would be advantageous to overcome the problems of ICT and encourage greater ICT integration in education, especially in ELT. Thus, this research suggests there should be a specific design ICT in ELT course be taught as one of the compulsory subjects to pre-service teachers (English Department students) at the university level. Further researchers need to conduct an in-depth study to what extent ICT in ELT course taught in the higher education setting and how it contributes to the improvement of English language teaching quality using technology.

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FUTURE TEACHERS RESOURCE-BASED LEARNING SYSTEM: EXPERIENCE OF HIGHER EDUCATION INSTITUTIONS IN POLTAVA CITY, UKRAINE

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ABSTRACT

The article explores the problem of introducing resource-based learning (RBL) in higher education institutions as a holistic dynamic process of organizing and stimulating the independent cognitive activity of students for mastering the skills of the active transformation of the information environment, which involves the optimal use of the triad "student-teacher-librarian" of the consolidated personnel, logistical, methodological, financial and information resources. The effectiveness of the RBL system of future teachers, which consists of 5 subsystems (conceptual-target, structural-content, process-technological, motivational, diagnostic and productive) is theoretically substantiated and experimentally verified. The RBL system was implemented in the higher educational establishments of Poltava region. The organizational and pedagogical conditions of the implementation of the RBL system of future teachers as a set of interconnected circumstances, measures ensuring the purposeful management of the process of mixed learning, and the rules established in the system for ensuring high quality of professional training in higher educational establishments are identified. On the basis of pedagogical experiment was made the Implementation of future teachers in the RBL of higher educational establishments in Poltava region (Poltava V. G. Korolenko National Pedagogical University, University of Ukoopspilks "Poltava University of Economics and Trade"). Among the research methods used are: methods theoretical (analysis, comparison, generalization); methods pedagogical (pedagogical experiment, pedagogical observation); social and psychological methods (questioning), mathematical methods (mathematical calculation, ranking, regression). Poltava V. G. Korolenko National Pedagogical University, University of Ukoopspilks "Poltava University of Economics and Trade" were the basis of the empirical research. The undergraduates of the VI course of full-time and external forms of study of specialty "Secondary education", educational programs "Secondary education (natural sciences)", "Secondary education (computer science)", "Secondary education (mathematics)" (Poltava V. G. Korolenko National Pedagogical University) and undergraduate students of the 6th year of the stationary and correspondence form of study in the specialty "Educational, Pedagogical Sciences", educational program "Pedagogics of

Higher School" (University of Ukoopspilks "Poltava University of Economics and Trade") were made the sample of the study. The entire period of study in the magistracy – 1.4 years was covered by the study. It was conducted in two stages: the first (2018) – at the beginning of the experiment, before the introduction of the RBL system; the second (2019) – at the end of the experiment, after the implementation of the RBL system. Quantitative indicators of the pedagogical experiment involved 253 persons in control group (CG) and 240 persons in experimental group (EG).

Keywords: Resource-based learning, blended learning, e-learning, distance course, electronic manual, open learning environment, virtual class, electronic library

INTRODUCTION

There are intensive searches for ways of developing education as the basis of intellectual, spiritual, cultural, social, economic development of society and the state in the context of global changes and restructuring of the world, and Ukraine in particular. Modern world educational standards put new demands on higher education in Ukraine: individualization of education, use of new information and communication technologies, pedagogical innovations, strengthening of organic unity of education and self-education, transformation of the teacher's role, new role of library and librarian, creation of preconditions for organization of lifelong learning – a task to be solved by providing high-quality education, constant professional improvement and competitiveness of university graduates of Ukraine.

Teachers of many countries around the world are concerned that the current content of education, methods of its acquisition are not productive and do not sufficiently satisfy the student's need for personal use of knowledge during their studies, after graduating, in their life and professional activity. Therefore, teachers pursue productive education, in which the product's extent becomes a student with his interests, experience and educational goals. These tasks can be solved using resource-based learning (RBL), which has been long implemented in educational systems of such countries as Australia, Austria, Great Britain, Ireland, Canada, China, Germany, Norway, Singapore, the USA, Taiwan, Sweden, Switzerland, Finland, etc.

Problems of resource-based learning (RBL) are thoroughly investigated by foreign scientists M. Butler, M. Hannafin, J. Hill, C. Greenhow, S. Dexter, B. Greene, S. Land, C. Laverty, H. Niemi, E. Riedel, S. Hadjerrouit, Shu-Nu Chang, I. Sikstrom, M.-A. Westerlund and others, which clearly emphasize the importance of RBL and see the prospect of expanding educational opportunities provided full-scale transition of educational establishments to RBL.

Scientists understand under RBL:

- e-learning on the basis of modern network technologies, which contributes to the development of the scientific potential of those who study (LeoTanWeeHin, Subramaniam, 2005, Greenhow, Dexter, Riedel, 2006);
- web-based learning, the potential of which is so large, how much is the World Wide Web's educational resources (Hadjerrouit, 2010);
- learning, that promotes the creation of information and educational environment of an educational institution with the involvement of resources of libraries, scientific centers, other education institutions of the region, the country, the world education community (Hannafin, Hill, 2008);
- organic interaction of contact learning (directly "teacher-student") and the virtual one (Niemi, 2008);
- information culture development strategy (Sikstrom, Westerlund, 2011);
- active interaction of students with several learning resources with clearly defined educational goals, which implies collaboration in groups (Laverty, 2001);
- learning educational material by finding information using a variety of resources (Chang, 2007);
- a pedagogical approach, based on a project-oriented learning, in which students work with a wide range of educational resources (Greene, Land, 2000, Butler, 2011).

We agree with the above-mentioned scholars and define RBL in higher education institutions as a holistic dynamic process of organizing and stimulating the independent cognitive activity of students for mastering the skills of the active transformation of the information environment, which involves the optimal use of the triad "student-teacher-librarian" of the consolidated personnel, logistical, methodological, financial and information resources.

Under the transformation of the information environment is understood study, analytical and synthetic analysis of the content of information, regrouping and change its values and form, preparation of its new form (secondary information), convenient for future use. Note that when converting information it is expedient to use the following methods of analysis: composition, decomposition, classification, abstraction, generalization, analogy, synthesis, systematization, integration, comparison.

Based on the analysis of researches of scientists in the field of resource-oriented learning, it is found out that similar systems, the implementation mechanism of which is contact learning (directly "student-teacher" in classrooms) and virtual (distance courses, sites and other electronic resources), are implemented at training of managers, marketers, economists, lawyers, specialists in information technologies, agrarians, as it forms the ability of students to work effectively, make non-standard decisions independently, take a comprehensive approach to the evaluation results, the choice of ways of their activity (Kononets, 2016).

In general, such scholarships and practitioners are not given such attention to date, although some of its elements, such as distance learning, on-line learning, ICT applications, blended learning, are, of course, quite common. In the process of professional training of future teachers, RBL was not implemented, so we decided to develop a RBL system for future teachers and to implement it in higher education establishments.

Therefore, the task of our study is to develop, theoretically substantiate and experimentally test the effectiveness of the future teachers' RBL system; to distinguish organizational and pedagogical conditions for the implementation of the RBL system of future teachers.

THEORETICAL FRAMEWORK

Exploring the theoretical and practical aspect of RBL, our attention is drawn to the study of educators and scholars of the University of Greenwich, who introduced RBL in the course in economics. A number of activities have been implemented: delivery of educational materials (curriculum, teaching support, etc.) and assessment of students' knowledge in the disciplines using computer and information technology; open approach to evaluation; cancellation of lectures in favor of various forms and methods of teaching (Ryan, Wells, Freeman, Hallam, 1996). The introduction of the RBL at the College of Liberal and General Education, Aletheia University (Taiwan) was carried out among a community of part-time students working in business and management while "Logic course" studying. The main method of training was to identify the project method and the search for information related to each topic, basic concepts, questions and conclusions. Students prepared presentations and written reports, and were asked whether they were interested in learning under RBL, developing their own system of arguments for and against RBL. It is revealed that RBL will be successful in implementing online learning elements alongside traditional lessons (Chang, Shu-Nu, 2007). In the course of introducing RBL at Deakin University, when studying psychology, researchers stated that the systematic use of Internet resources and search tools on the Internet contributes to the learning outcomes of the practical orientation, increases the level of students' information culture, and forms their logical and critical. Conferencing services and webinars have been popular, allowing classes in virtual audiences, creating podcast libraries, holding conferences online, protecting student projects, and more (Holt, Rice, Armatas, 2002).

The similarity of the RBL process in these authors' studies is that in the educational process, information technologies and intensive independent search of information in various resources were actively used. Typically, one discipline was chosen to implement RBL. Among the students who chose the teaching profession, we did not record the fact of RBL implementation. Thus, theoretical analysis of the scientific literature, the provisions of modern approaches to the implementation of RBL showed that the pedagogical theory and practice focused on various aspects of RBL. At the same time, the problem of future teachers' RBL in Ukrainian pedagogy has not been systematically and reasonably interpreted. Therefore, our study

differs from the previous ones in that we developed a system of future teachers RBL and determined the effectiveness of students' learning activities in this system. It has been found that RBL will be successful in combining traditional and innovative forms and learning methods, although an emphasis on innovation and information technology is desirable.

The analysis of scientific works made it possible to distinguish the characteristic features of the RBL:

- *orientation* (not only for the mastering of knowledge, skills, habits, but also for training the abilities of an active and independent study of the information environment);
- *practicality* (practical application of information resources in learning, life, future professional activities);
- *potential infinity* (use for processing an unlimited spectrum of information resources in solving a certain problem task);
- *reality* (student becomes self-directed in the process of learning that corresponds to real life and prompts for constant tracking of information, its adequate interpretation and further use);
- *fundamentality* (thanks to the experience of working with information resources to form a solid basis of knowledge, skills and habits that can be used in future educational and professional situations).

In the context of the training future teachers in higher education institutions, RBL is understood as one of the powerful means of forming a teacher of a new Ukrainian school - a personality, a professional, an innovator. "The Ukrainian school will be successful if it is joined by successful teachers. They – successful teachers and professionals – will resolve a multitude of issues regarding the quality of teaching, the volume of home assignments, communication with children and school administration. Children need a leader who can lead them forward, who likes their discipline, who teaches them professionally" – noted in the Concept of New Ukrainian School (the Concept of New Ukrainian School, 2016). It is clear that such teacher can become only a motivated, competitive, socially responsible professional, able to respond promptly and adapt to the changing conditions of the informational global world, open to the creative perception of new ideas and ready to implement them in practice. So, one of the main tasks of pedagogical universities education today is to prepare teachers who should become the real "agent of change" for the better for the school of the third millennium.

On the basis of the analysis of scientific literature the system of RBL future teachers is substantiated theoretically, containing the following subsystems: conceptual-target, structural-content, process-technological, motivational, diagnostic and productive (Fig. 1).

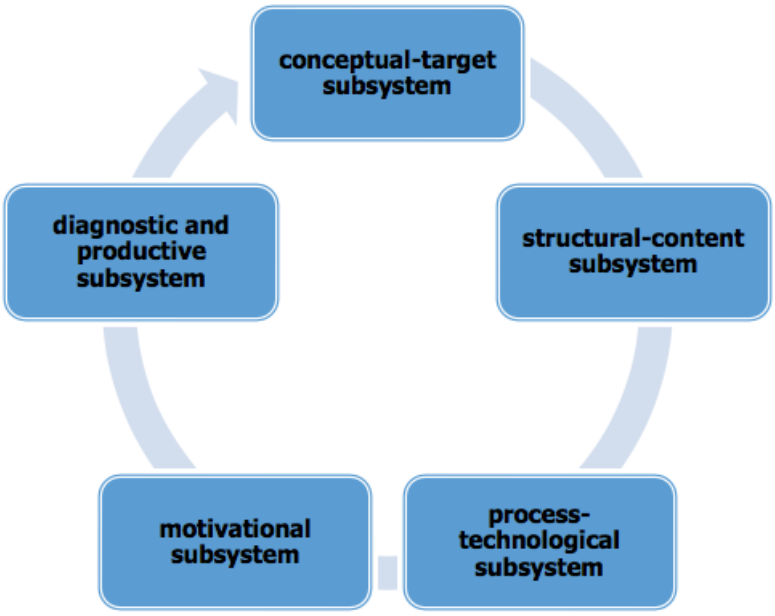

Figure 1. The RBL system of future teachers

Conceptual-target subsystem includes:

purpose of the system (computer literacy, information competence, information culture of the teacher, its orientation towards education throughout their life);

social order for highly skilled teachers;

strategy of the development of the pedagogical university (the university's vision is the integral system of training of competitive personnel of the region by creative association of modern-level professionals; the mission of the university is the development of the system of education and science through the training of highly professional specialists, the establishment of the university as a leading pedagogical institution of higher education in the region);

the concept of RBL in higher education institutions, methodological approaches (resource, acmeological, student-centered, competence, systemic, cross-cultural, cloud-oriented, design), RBL principles (universality, autonomy and controllability, freedom of choice, self-regulation, continuity, individualization, internationalization, accessibility, rationalization , informational approach);

the essence of RBL is to provide the student (future teacher) the role of the explorer of the information environment, the teacher of higher educational establishment – the role of tutor, the librarian of higher educational establishment – the role of teacher-librarian, and ensuring freedom of choice of information resources for: effective acquisition of knowledge by students, acquisition of abilities and skills, outlined in the content of each discipline; improving the quality of teaching disciplines (a qualitative indicator and absolute success); Self-regulation of educational activity (formation of students' ability to see the ultimate goal of activity, independently find ways to achieve it and seek its implementation).

Structural-content subsystem reflects the content of the education of future teachers, aimed at developing their information competence and information culture as a well-defined system of theoretical knowledge and practical skills that students must and can master for a certain time, devoted to studying the discipline "Information Technologies in Education" – a fundamental component and an applied component that envisages enriching the contents of the curriculum of the future teacher training of the information and communication component, it includes the development and implementation of programs for the development of the digital competence of a modern teacher and the study of innovative teaching methods in higher education. Digital competence is a sure but, at the same time, critical application of information and communication technologies for creating, searching, processing, exchanging information at work, in public space and in private communication; information and media literacy, basics of programming, algorithmic thinking, database work, Internet security skills and cyber security; understanding of the ethics of working with information (copyright, intellectual property, etc.) (the Concept "New Ukrainian School", 2016).

Process-technological subsystem contains the technological support of the RBL process-pedagogical technologies (web-quest technology, educational project, Web 2.0, mindmapping, cloud technologies, Kaizen technology), forms of organization of training (lecture, video tutorial, practical classes, binary classes, webinar, open lessons); methods (case-method, virtual design, interactive discussions, partial search and research methods, Cinquain method, virtual "Metaplan", visual reading, etc.), training tools (printed and electronic manuals and textbooks, clouds, Internet resources, distance learning courses , virtual classes, etc.), which are most favorable for the successful formation of information competence and informational culture of future teachers in the educational environment of the University, and positions the study of the discipline "Information Systems and Technologies in education" as a didactic project.

Motivational subsystem is allocated with the purpose of developing the motivation to study modern information and communication technologies, providing positive motivation for training and future professional activity, the process of formation of informational competence and informational culture of future teachers during the study at the university as a whole, and reflects the didactic tool, which is expedient to use in educational the process of modern university to create success situations in educational activities (pedagogy of success). The motivation subsystem is represented by educational activities, master classes, trainings, workshops, webinars devoted to modern information technologies in education, etc.

The motivation RBL subsystem of future teachers is considered in a single system of formation of stable motives of students' professional activity in general. So, as the necessary conditions for the effective implementation of this process we consider:

procedural-content: facilitation of educational activities; the introduction of personally oriented learning; individualization of educational and professional activity; observance of the correct correlation of theoretical knowledge and practical skills of educational activity; application of a competent approach; humanization and democratization of the educational process; the diversification of forms and methods of independent work of students; the corresponding style of work of the teacher and others;

didactic and educational: providing students with greater freedom to choose subjects to be studied, ways of doing business, information resources for learning; avoiding the stereotyping of conducting training sessions, using methods, forms and methods of teaching problem, interactive and research character; valuation of educational activity; distance learning and mobile learning; the structuring and differentiation of the educational material according to its importance; application of the principle of availability and use of other principles of didactics, etc.;

psychological: formation of stable interest in the profession; development of mental abilities of students, awareness of the nearest and final goals of education (close and long-term perspective), theoretical and practical significance of the acquired knowledge, professional orientation of educational activities, etc. (Ilchenko, 2017, 2018).

Diagnostic and productive subsystem provides monitoring of the effectiveness of educational activities of students (the methodology of the effectiveness of students' educational activities in the RBL system). The methodology was developed and adapted by the authors on the basis of I. Todorova's methodology (Todorova, 2011).

Methodology of Student Learning Effectiveness in the RBL System of Future Teachers

Students are invited to a questionnaire (Table 1). "Read the following sentences in the table. Read both the left and the right statement. Determine which one more accurately describes your opinion about RBL. Then circle only one digit (point), which shows the degree of certainty of this characteristic. The closer the figure to the statement, the more determined this characteristic (actualized on Webanketa https://rbl3.webnode.com.ua/on-line-anketuvannya/)".

Focus on the following scale:

1 –this characteristic prevails rather than is opposite;

2 – the characteristic is definitely defined;

3 – the characteristic is determined very strongly;

0 – hard to say.

Negative values - in contrast to positive ones.

Table 1. Questionnaire for students

"+" Characteristics of studying	Circle the necessary number	"–" Characteristics of studying
1. It is interesting to study, I am fascinated by the learning process	+3 + 2 +1 0 –1 –2 –3	1. I'm not interested in studying, I study without admiration
2. I study discipline on my own, voluntarily	+3 +2 +1 0 –1 –2 –3	2. I study discipline under external pressure, by obligation
3. I study diligently, persistently, systematically	+3 +2 +1 0 –1 –2 –3	3. I study somehow, with laziness, not systematically
4. I like to use different information resources of the Internet, work in virtual classes, use distance courses	+3 +2 +1 0 –1 –2 –3	4. I do not like to use different information resources on the Internet, work in virtual classes, use distance courses
5. I'm active at the classes, I'm curious	+3 +2 +1 0 –1 –2 –3	5. I'm passive at the classes, I'm not curious
6. The purpose, volume and algorithm of carrying out the independent work are understandable to me	+3 +2 +1 0 –1 –2 –3	6. The purpose, volume and algorithm of carrying out the independent work I don't understand
7. My marks of own work at the classes coincide with the teacher's estimates	+3 +2 +1 0 –1 –2 –3	7. My marks of own work at the classes don't coincide with the teacher's estimates
8. I can look for information, analyze it	+3 +2 +1 0 –1 –2 –3	8. I cannot look for information, analyze it
9. I can quickly and accurately process the found information	+ 3 +2 +1 0 –1 –2 –3	9. I cannot quickly and accurately process the found information
10. First of all, my thinking and imagination are working hard at the classes	+3 + 2 +1 0 –1 –2 –3	10. First of all, my memory is working hard at the classes
11. I like to learn using social networks, web-sites, to create mindmap, perform web quests, work on network projects	+3 + 2 +1 0 –1 –2 –3	11. I don't like to learn using social networks, web-sites, to create mindmap, perform web quests, work on network projects
12. I understand the concept of RBL	+3 +2 +1 0 –1 –2 –3	12. I don't understand the concept of RBL
13. Educational information is used to perform practical exercises, analysis of specific situations, close to professional ones	+3 + 2 +1 0 –1 –2 –3	13. Educational information is not used for practical exercises, analysis of specific situations close to professional ones
14. The acquired training information is stored in memory for a long time	+3 +2 +1 0 –1 –2 –3	14. The acquired training information isn't stored in memory for a long time
15 At classes the teacher uses the convenient methods and tools of RBL, and I like it	+3 +2 +1 0 –1 –2 –3	15. At classes the teacher uses the convenient methods and tools of RBL, and I don't like it
16. At classes I do not get tired, I feel cheerful after lessons, I like e-learning	+3+ 2 +1 0 –1 –2 –3	16. At classes I get tired, I feel exhausted after lessons, I don't like e-learning
17 In order to study well, I do not need constant control from the teacher	+3 +2 +1 0 –1 –2 –3	17. In order to study well, I need constant control from the teacher
18. At the classes I have a good mood, I feel confident	+3 +2 +1 0 –1 –2 –3	18. At the classes I have a bad mood, I feel uncertain
19. I feel support, respect and understanding from the teacher	+3 +2 +1 0 –1 –2 –3	19. I feel disrespect, lack of support and understanding from the teacher
20. RBL positively affects my professional training, stimulates the desire to study	+3 +2 +1 0 –1 –2 –3	20. RBL negatively affects my professional training, doesn't stimulate the desire to study

Scale for assessing the effectiveness of students' educational activity in the RBL system

The value of the coefficient	*From +3 till +1,9*	*From +1,8 till +0,6*	*From +0,5 till –0,5*	*From –0,6 till – 1,8*	*From –1,9 till –3*
Efficiency level	Very high	High	Medium	Low	Very low

Processing results. In the left column are listed statements that characterize the *effectively* organized student's educational activities, in the right - statements that characterize *inefficiently* organized learning activities. Points which close to the left column, have a "+" sign, close to the right "-". All points in the left and right numbers are based on characters. Each subsystem of educational activity is submitted by five statements. In order to calculate the coefficient of overall effectiveness of educational activities, the total amount is divided by 20 (the number of statements in the form).

$$E_{over} = \frac{\sum_{k=1}^{20} points}{20}$$, where k – the number of affirmation, E_{over} – coefficient of overall efficiency

The effectiveness of individual subsystems of educational activity is calculated by the sum of scores received by each of them.

$$E_m = \frac{\sum_{K=1}^{5} points}{5} \quad E_o = \frac{\sum_{K=6}^{10} points}{5} \quad E_i = \frac{\sum_{K=11}^{15} points}{5} \quad E_r = \frac{\sum_{K=16}^{20} points}{5}$$

E_{over} – coefficient of overall efficiency, questions №№1-20;

E_m – coefficient of efficiency of the motivation subsystem, affirmations №№1-5;

E_o – efficiency factor of the operating subsystem, affirmations №№ 6-10;

E_i – coefficient of efficiency of the information subsystem, affirmations №№11-15;

E_r – coefficient of efficiency of the regulatory subsystem, affirmations №№16-20.

METHODOLOGY AND PROCEDURES

Implementation of future teachers in the RBL of higher educational establishments in Poltava region (Poltava V. G. Korolenko National Pedagogical University, University of Ukoopspilks "Poltava University of Economics and Trade") was made within the pedagogical experiment.

Among the research methods used are: methods theoretical (analysis, comparison, generalization); methods pedagogical (pedagogical experiment, pedagogical observation); social and psychological methods (questioning), mathematical methods (mathematical calculation, ranking, regression). The basis of the empirical research was: Poltava V. G. Korolenko National Pedagogical University, University of Ukoopspilks "Poltava University of Economics and Trade"). The sample of the study was made by the undergraduates of the VI course of full-time and external forms of study of specialty "Secondary education", educational programs "Secondary education (natural sciences)", "Secondary education (computer science)", "Secondary education (mathematics)" – Poltava V. G. Korolenko National Pedagogical University; undergraduate students of the 6th year of the stationary and correspondence form of study in the specialty "Educational, Pedagogical Sciences", educational program "Pedagogics of Higher School" – University of Ukoopspilks "Poltava University of Economics and Trade".

The study covered the entire period of study in the magistracy – 1.4 years and was conducted in two stages: the first (2018) – at the beginning of the experiment, before the introduction of the RBL system; the second (2019) – at the end of the experiment, after the implementation of the RBL system. Quantitatively, a pedagogical experiment was involved 253 persons in control group (CG) and – 240 persons in experimental group (EG).

As noted above, in the course of scientific research the methodology of I. Todorova (Todorova, 2011) was used, which was adapted by the authors. The methodology for revealing the effectiveness of students' educational activity in the system of RBL future teachers was offered to the respondents in the form of a questionnaire (see Table 1). Self-government bodies were involved in organizing a comfortable, frank, and objective survey.

The survey was conducted anonymously on the basis of democracy and voluntary participation.

The results of the students' educational activity efficiency (before the introduction of the RBL system) are presented in Table 3 of the study, the results of diagnostics of the students' educational activity efficiency after the introduction of the RBL system of future teachers are shown in Table 4, the dynamics of changes in the levels of students' educational activity performance during the implementation of the RBL system are shown in Figure 7 The reliability of the results of experimental observations by the method of efficiency of students' educational activity in the RBL system services are due even regression analysis and build a trend line (see fig. 8).

Thus, the students of EG were invited to study a number of disciplines ("Pedagogy of Higher School", "Gender Approach to Pedagogy", "Teaching Methods in Higher Education Institutions", "History of Higher Education Pedagogy", "Organization of Scientific Research", "Innovative Technologies in Education", "Polycultural Education and Education in World Educational Systems", "Pedagogical Technologies of Education and Upbringing in Higher Education Institutions", "Autonomy of Higher Education Institutions", "Andragogy in the System of Pedagogical Sciences", "Management in education", "Innovative Paradigm of Education", "Sub-subject Relations between a Teacher and a Student in a Higher Education Institutions", "Persons in Historical and Pedagogical Discourse", "Information Systems in Innovation Activity") in a mixed form of learning (traditional + e-learning, integration of on-line courses from traditional classroom classes), among which the leading discipline "Information Technologies in Education" is defined.

To organize e-learning it has been developed open learning environment – OLE as an artificially formed environment, the structure and components of which contribute to the achievement of the goals of the educational process. The components of the learning environment are, first of all, the means of training (Zhuk, 2006).

OLE at RBL is a powerful tool for organizing distance education – a new organization of educational process in Ukrainian universities, based on the principle of independent student learning. Note that we are considering distance learning as a form of RBL (Kononets, 2013).

OLE – is accessible qualitative and quantitative set of information resources that are made possible for use in the educational process through distributed automated databases of data and knowledge, as well as computing resources offered and maintained in computer networks (corporate, continental, Internet), communication characteristics of these networks (Bykov, 2010).

The modern OLE of higher educational establishments that participated in the pedagogical experiment are potentially unlimited in terms of the amount of resources that can be used in the educational process, the number of users who can use its facilities and technologies, and therefore the number of students that can be jointly involved to solving a single didactic task.

In general, modern OLE for the implementation of the RBL system of future teachers consists of the following components:

- official sites of higher educational establishments;
- e-libraries;
- electronic educational resources (electronic manuals and textbooks, distance learning courses, virtual classes);
- file-servers of higher educational establishments (fig. 2).

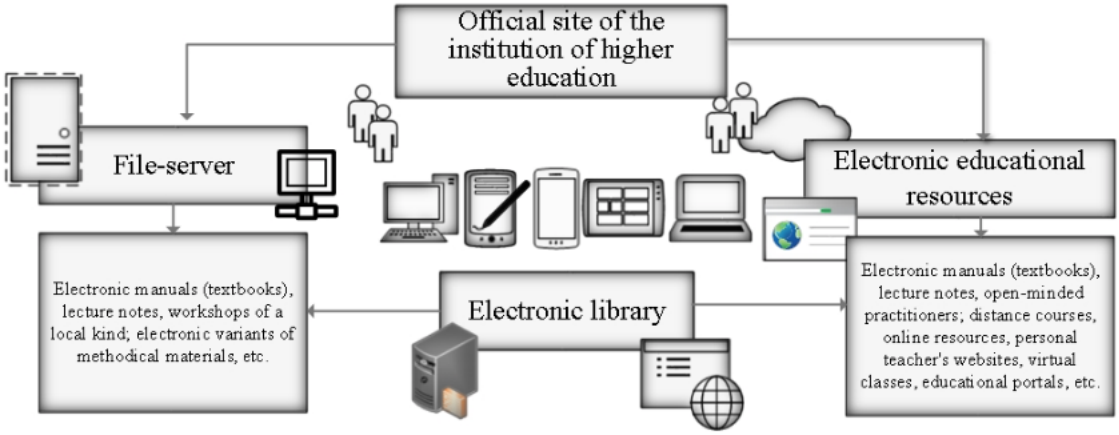

Figure 2. An open learning environment

The electronic educational resources used in the process of implementing the RBL system of future teachers are divided into 2 types: local and open.

1 type: local. The electronic educational resource (electronic tutorial, textbook, lecture notes, workshop) is necessarily a hypertext environment. Created with any program designed to develop electronic manuals (like compiled html-files of Windows) or with the help of web-editor (for example, program FrontPage). It is localized on any media (disk, flash card, computer hard drive), or a separate file can be placed on the site or in any file storage. If you are hosting on the Internet, you must download the file to your computer. In general, such electronic educational resources need to be downloaded, opened and installed (depending on the type of data). In general, such electronic educational resources are placed on the file server of the educational institution.

2 type: open. An electronic educational resource is hosted on any web-site, effectively and fully functioning in any modern browser such as Internet Explorer, Google Chrome, Opera, MozillaFirefox, Yandex Browser etc. The possibility of on-line work is available without downloading from the Internet resource (open hypertext environment, all navigation maps are available, all hyperlinks are available for work, available for viewing all the content of the learning resource, it is possible to download individual files). To this type we include distance courses, personalized teacher sites, educational portals, virtual classes, etc.

An example of a distance course "Information Systems in Innovation" as a set of educational materials and educational services created in a virtual environment for organizing distance learning based on the service https://sites.google.com/ is shown on Figure 3.

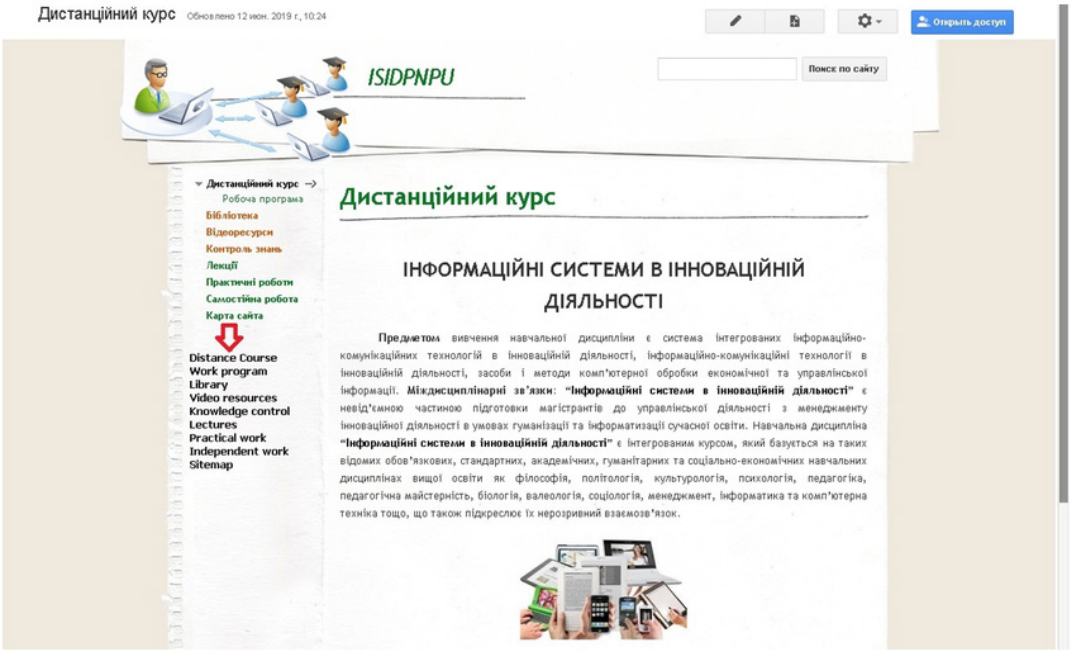

Figure 3. Distance course "Information Systems in Innovation"

E-learning of students of the EH in the process of studying a number of disciplines was carried out in the virtual classes of the Google Classroom service, which made it possible: to create a single educational space for students of all groups of students from different higher educational establishments; combine traditional and distance learning through the creation of a hybrid education system while studying the discipline; consolidate various electronic educational resources on one platform; reorient the activities of teachers to develop new electronic learning tools and enhance their creative activity, the level of digital and methodological competence.

An example of virtual class "Persons in historical and pedagogical discourse" is shown on Figure 4.

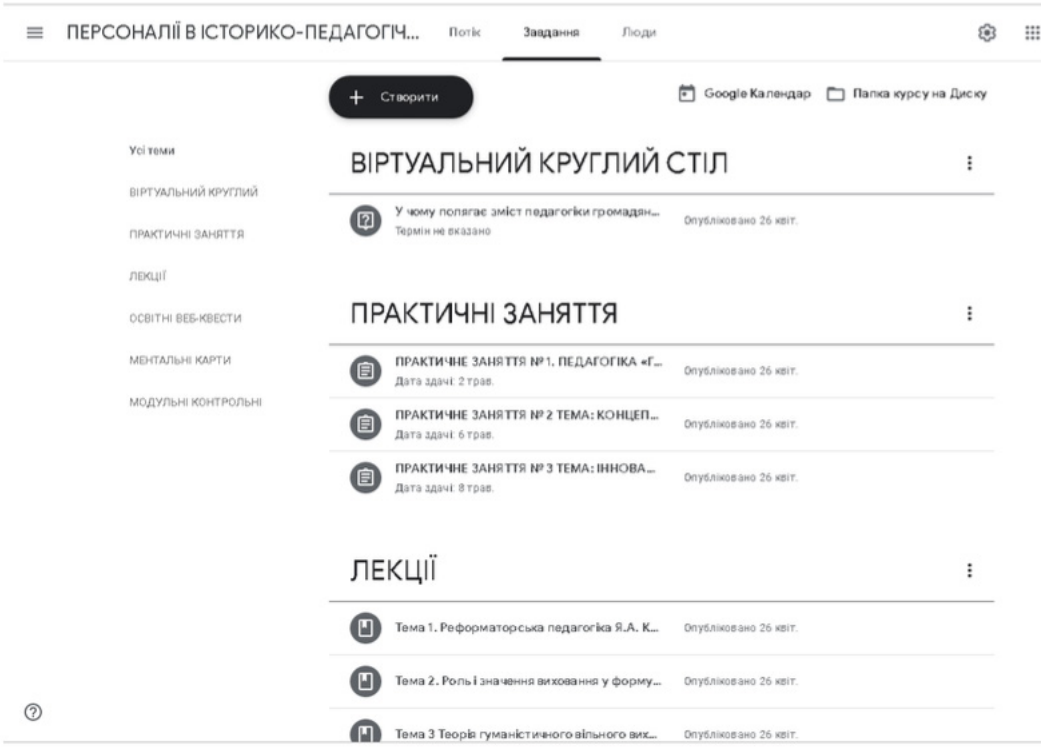

Figure 4. Virtual class "Persons in historical and pedagogical discourse" (tab "Tasks")

Let's emphasize the benefits of Google Classroom service while studying disciplines in the RBL system.

Convenience of setup. When creating a class, a code is automatically generated that students with a Google account use to join the class. This process eliminates the need to create pre-registries. Everything that is needed by the teacher is to communicate this code to the students in a convenient way or, with the student's email addresses (gmail.com), connect them independently (tab "People"), after which students receive an invitation letter to the e-mail address.

Automation. When a teacher creates a class in the Google Classroom environment, "Classroom" folder is automatically created on both its Google Drive with new attachments for each class, and on the disc of each student with separate folders for the classes they join. It allows you to organize information (documents, presentations, tables, etc.) in structured form and store it in one place, which has access from any device.

Simple interface. Work in the classroom is facilitated by a navigation system that is understandable for the instructor and the teacher. In the horizontal navigation bar, the resource contains three tabs: 'Flow', 'Tasks', 'People'. The first shows the activity of the course, the second – the tasks that are offered for execution, Google Calendar with the schedule and the course folder in Google Drive; the third contains a list of students and their email addresses, as well as information about teachers. This tab can be used to set up curricula, additional materials, etc.

The vertical navigation panel contains information on the list of topical tasks, as well as structured in separate blocks / topics educational materials, the transition to which is carried out in one click. Both the teacher and

the students can see all the tasks on the main screen of the class in the 'Flow' tab. It allows you to control activities both in a particular class and at once in several classes. In just one click a teacher can add teaching resources to a class. This may be a question (open or with options); advertisement; task (containing both one and several components - documents, presentations, videos, links to Internet resources, etc., and, if necessary, use a re-present post).

Interactive control provides the ability to plan and set timing for tasks. Any of the activity elements (tasks, questions, announcements) can be published by the teacher immediately, can be saved as a draft or scheduled for further publication on a particular day and time. Thus, a teacher can plan a course in advance, and as the course progresses, students can access specific materials. Also, when creating each task, the teacher can determine the timing of its execution. It allows both the teacher and the students to monitor their own activities, determine the pace and schedule time for the tasks.

Feedback. Thanks to the combination advertisement, created by teacher in virtual classroom, and integrated ability to comment on tasks, the teacher and student always have the ability to communicate (both synchronous and asynchronous) and track the status of each task in real time. The service also allows the creation of surveys and thematic discussions. Therefore, students have an opportunity to answer the teacher's questions and share materials with other students. It's important to note that educational interaction can take place between the teacher and the individual student, and may have a group or collective character (for example, reviewing and commenting on an individual text job or working on a collaborative project in Google-presentation, etc.).

Personalization and individualization. All tasks, work, and marks (whether performed or not, checked or not) that were assigned within the class are displayed on the individual student page. Such page is generated and automatically updated by the service to automate the progress of the learning material. Despite the fact that Google Classroom does not have a rating journal as an element, the teacher has the ability to set up a numerical grade and form the details of the learning achievements. Graded materials can be exported and uploaded to the class environment or as a Google-Table. This allows students to keep an eye on their progress from the course, as well as illustrates the topics that need to be finalized. Significantly expands the ability to implement an individual approach to each student option, which allows the teacher to assign tasks for the entire stream, and distribute individual copies for each or a particular student in the classroom.

Thus, Google Classroom service during the study of discipline provides an opportunity to implement an individualized approach to learning, interactively monitor tasks, use individualized group methods in online environment, enhance motivation for learning, and serve as a means of implementing the concept of RBL in high school. (Kononets, 2018, 2019).

During the pedagogical experiment, the students' activity in the direction of using the resources of electronic libraries of institutions of higher education has been intensified:

University of Ukoopspilks "Poltava University of Economics and Trade" – e-library website http://lib.puet.edu.ua/ (fig. 5);

Poltava V. G. Korolenko National Pedagogical University – e-library website http://lib.pnpu.edu.ua/ (fig. 6).

Figure 5. E-library of PUET

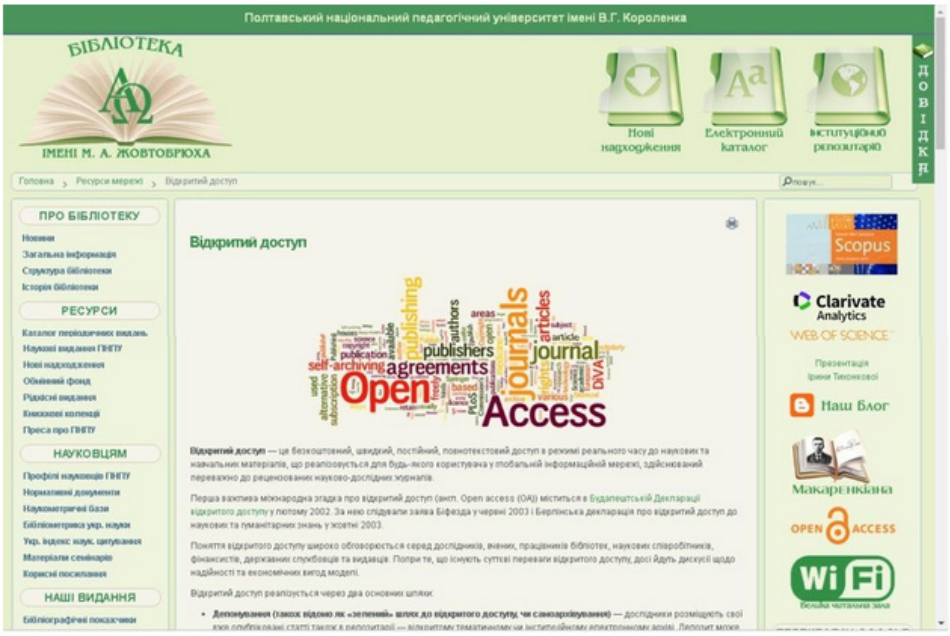

Figure 6. E-library of Pedagogical University

Our universities have become tradition of holding library classes, thematic information exhibitions, days of information, mini-seminars for students, where librarians help to get deeper into one or another topic, find relevant literature, work with catalogs, arrange a bibliography for course work, etc. The task of the librarian of the modern university is to interest the student in printed literature, to organize his independent work with the textbook and additional sources, to target independent search of information. In addition,

the librarian, as well as the teacher, should become a student guide in the process of finding information among the Internet resources, since students and the library have access to the Internet, the university has a Wi-Fi zone and students have access to electronic resources of the library and the World Wide Web in any place. The modern librarian performs the basic social function of the library – to provide comprehensive information to the maximum extent.

Students of the Pedagogical University were able to attend the PUET electronic reading room, a virtual production laboratory, use an electronic kiosk, multimedia laboratories, and distance learning rooms. Thanks to the library resources of the PUET library, students have access to a large number of electronic guides and textbooks, digitized versions of printed literature that are not available at the pedagogical university. Instead, students at PUET were given access to a wide range of psychological and pedagogical literature of the electronic library of the Pedagogical University.

On the basis of PUET reading rooms with the involvement of specialists of the Inter-branch Institute for Advanced Training and Retraining of Specialists, which is a unit of PUET, the testing of structural and content subsystem of the RBL system of future teachers was carried out by introducing for the students of the EG course "Innovative Methods of Teaching in Higher School: the Newest in European and World practice" (author S. Nestulia).

Thus, today libraries of higher educational establishments of Poltava region create a powerful information system that provides students with not only effective search for educational information, but also the production of the information needed for each individual student, which is necessary for the effective management of all its resources, the creation of information and technical environment for optimal organization of RBL in general.

The experience of higher educational establishments in Poltava region in the process of training students of PUET and pedagogical university has shown the expediency of distinguishing organizational and pedagogical conditions for the implementation of the RBL system of future teachers as a set of interconnected circumstances, measures that ensure the purposeful management of the process of mixed learning, and the rules established in the system for providing high quality professional training.

These conditions must be considered systematically. Mixed RBL training for future teachers involves:

- understanding the RBL process as a multidimensional problem;
- definition of the essence, content, functions and parameters of the system;
- establishment of the features of the RBL functioning as a specific type.

Organizational-pedagogical conditions for the implementation of the RBL system of future teachers:

- Availability of Internet communication in higher educational establishments.
- Creation of an appropriate structure for providing communication in the system of training of future teachers.
- Presence of developed electronic educational resources of local and open type.
- Identifying and testing the ways and means of communication in the RBL system of future teachers.
- Make a timetable for all activities that simulate the process of RBL future teachers.
- Taking into account the tasks of educational programs, which are the training of future teachers.
- Introducing a mixed form of student training.
- Application of various forms and methods of organizing educational activities in the RBL system of future teachers.
- Implementation of tutor's function of teacher in the process of implementing the RBL system of future teachers (the individual support of the student is to provide him with the help in achieving the best educational result; tracking the process of training and providing feedback; conducting individual and group consultations (tutors); counseling and support individual educational process).
- Activation of the work of libraries and electronic libraries of higher educational establishments.

The conditions for the implementation of the RBL system for future teachers, listed above, are closely interrelated. As our research has shown, during the implementation of the RBL system of future teachers, it

is necessary to take into account the whole range of conditions. Among the negative causes, we point out the stereotyped teaching and evaluation of educational activities in distance learning technologies.

The main task for the students of EG was the implementation of network projects on such topics as "Pedagogical technologies in Higher education institutions", "Pedagogical design in higher education institutions", "Personally oriented technologies of education and training", "Technology of Vitagene Education", "Debate Technology", "Training Technology", "Dialogue of Cultures", "Technology of Free School", "Technology of Modular Education in Higher School", "Webinar as a Form of Information Technologies in Higher Education", "Coaching Technology in Higher Education", etc. (Table 2).

The organization of mixed learning envisaged the creation of conditions comfortable for students: 1) performance of tasks not only in the classrooms of the university and the library, but also in the cafe, in the park, in the student's dormitory, in the nature thanks to the virtual classes; 2) use of any information resources; 3) organization of feedback between the teacher and the student with the help of e-mail, Viber application.

Table 2. An example of a network project

Author(s) of a project:	
Student's name and surname:	1. 2. 3. 4.
Group:	
Project Manager:	
Name of the educational institution:	
Discipline: PEDAGOGICAL TECHNOLOGIES OF EDUCATION AND TRAINING IN HIGHER SCHOOL	
Description of the project:	
Theme of the project:	MODERN PEDAGOGICAL TECHNOLOGIES AND PEDAGOGICAL DESIGNING IN HIGH SCHOOL
Key words: pedagogical technology, pedagogical design, pedagogical situation, pedagogical process, pedagogical system.	
Tasks of the project:	
1. Find out what the peculiarities of traditional learning technologies are.	
2. Outline the classification parameters of traditional education.	
3. Show the features of the methodology of traditional learning technology.	
4. Develop ways to improve teaching methods as a means of intensifying the educational process.	
5. Develop their own instructional guidelines for implementing group learning forms.	
6. Describe the classification of gaming learning technologies by H. Selevko. Suggest your own variant.	
7. Develop the technological scheme of the business training game.	
8. Prepare a platform for online group discussion on "Pedagogical technologies of higher education on the basis of humanization and democratization of pedagogical relations".	
9. Make a glossary to the topic.	
10. Find a bibliography, useful links to Internet resources to this topic.	
11. Propose recommendations on the structure of the educational project of the educational establishment.	
12. Develop draft copyright, modification or adaptive programs.	
13. Reveal the theoretical foundations of developmental training technology.	
14. Design the pedagogical situation of your choice as an object of pedagogical design.	

Brief description: *During the project, students will determine the meaning of the topic personally for themselves. Analyze the information collected, streamline and generalize it with Google services by creating a web-based project portfolio that includes:* 1. *Site of the project* https://sites.google.com/. On the site, provide a page "The authors of the project", on which to place information from the photos of each member of the group. 2. *Blog.* 3. *Bookmarks.* 4. *Calendar.* 5. *Google Drive files (Document, Presentation, Table, Form, Image).* 6. *YouTube Channel.* 7. *Online survey using Google Forms.* Programs: OC Windows (Linux), Microsoft Office package, alternative office packages (for student choice), browser *Google Chrome* . Distribution of responsibilities: 1. 2. 3. 4. Display the work plan in the calendar (indicate start date and end date): 1 .Find materials from the topic. 2. Create a site. 3. Create a blog. 4. Create bookmarks. 5. Create *Google Drive documents* (*Document, Presentation, Table, Form, Image*). 6. Create YouTube Channel. 7. Organize an online survey. 8. Present and protect the project (conference). Work schedule: hours of class lessons, 20 hours - off-class time. Materials and resources required for the project: Internet resources	
Results:	Web Portfolio: • Site (hosted files from Google Drive), blog, YouTube Channel. • Presentation of the project.

CG students did not implement network projects. They worked on conventional projects under traditional training conditions.

It should be noted that the project activity of students was carried out in small groups, there were 3-4 students involved to one project. The experience of using project methods proves its high efficiency in raising the level of professional socialization of future specialists, digital competence, as well as the level of their information culture. Joint collective work on a network project allows students to develop the following skills and abilities: to use computer technology (laptops, smartphones, etc.) for educational purposes; to cooperate, to bear responsibility; to enter a group or team and to contribute; to prove solidarity; be able to organize their work in interaction with other people; be able to collaborate and work in a group; to make decisions - to settle disagreements and conflicts; be able to negotiate; be able to design and perform various types of work.

It should be noted that the implementation of the network project was carried out within 2 months.

RESULTS AND DISCUSSIONS

Before the introduction of the RBL system of future teachers, the effectiveness of students' educational activity was determined by I. Todorova's methodology. (Todorova, 2011). The results are shown in Table 3:

Table 3. Effectiveness of students' educational activities (before the introduction of the RBL system)

Efficiency level, %	Very high	High	Average	Low	Very low
CG(253)	0	17,79	49,41	27,67	5,13
EG(240)	0	15,83	49,58	27,09	7,5

As can be seen from Table 3, the level of student performance varies from very low (CG – 5,13%, EG – 7,5%) to high (CG – 17,79%, EG – 15,83%). This is understandable, because all the same certain knowledge and ability to work independently, use of electronic educational resources, Internet resources for students is due to the IT orientation of the discipline and the knowledge acquired in computer science.

The results of diagnosing the effectiveness of student learning activities after the introduction of the RBL system of future teachers are shown in Table 4.

Table 4. Effectiveness of students' educational activities (before and after the introduction of the RBL system)

Efficiency level, %	*Very high*		*High*		*Average*		*Low*		*Very low*	
	Before	After	Before	After	Before	After	Before	After	Before	After
CG(253)	0	0	17,79	20,16	49,41	49,01	27,67	26,88	5,13	3,95
EG(240)	0	6,25	15,83	20,42	49,58	58,75	27,09	14,58	7,5	0

From Table 4, we can see that the levels of student performance in the implementation of the RBL system were distributed as follows.

Very high: in EG – 6,25%, in CG – 0% (at the beginning stage in CG and EG – 0%).

High: in EG – 20,42%, in CG – 20,16% (at the beginning stage in EG – 15,83%, in CG – 17,79%).

Average: in EG – 58,75%, in CG – 49,01% (at the beginning stage in EG – 49,58%, in CG – 49,41%).

Low: in EG – 14,58%, in CG – 26,88% (at the beginning stage in EG – 27,09%, in CG – 27,67%).

Very low: in EG – 0%, in CG – 3,95% (at the beginning stage in EG – 7,5%, in CG – 5,13%).

The dynamics of changes in the levels of students' academic performance at the introduction of the RBL system is visualized on Figure 7.

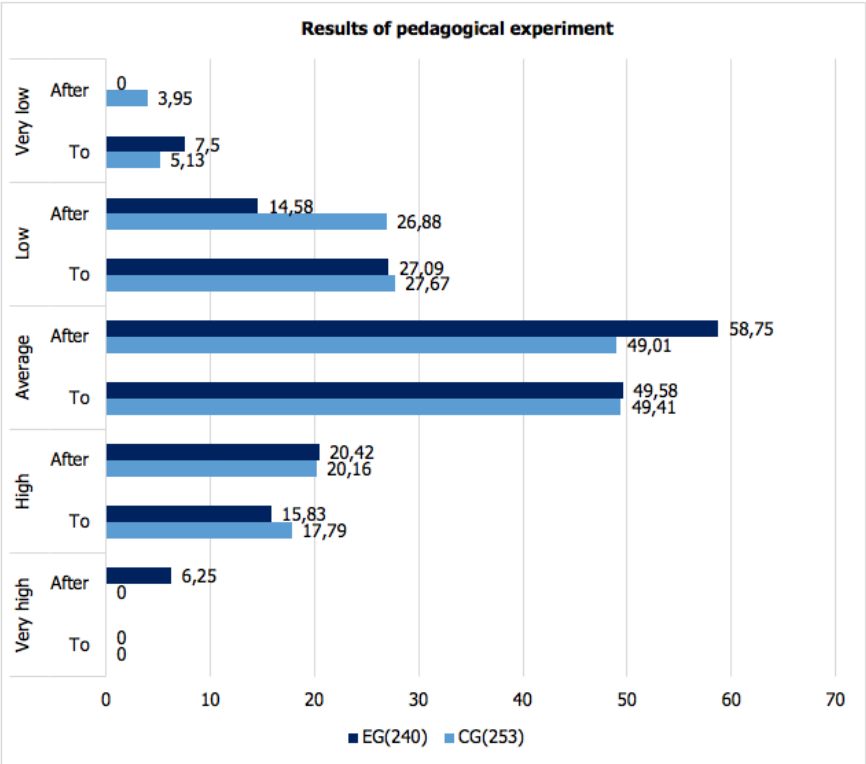

Figure 7. The dynamics of change

The reliability of the results of experimental observations on the methodology of the effectiveness of students' educational activity in the RBL system was determined using regression analysis and trend line construction. (Figure 8).

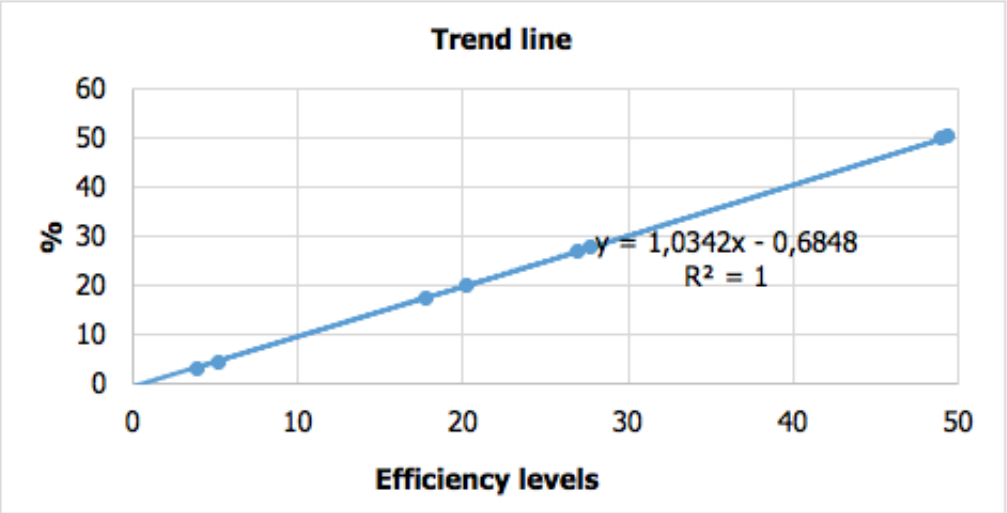

Figure 8. Analysis using the trend line

In Figure 8 "Efficiency levels" axis correspond to the following scale: 1-10 – very low level, 10-20 – low, 20-30 – average, 30-40 – high, 40-50 – very high. The constructed trend line shows that the indicators of the obtained values are stable and uniformly increasing from very low to very high. The probability of approximation is $R^2 = 1$, which means the reliability of the constructed trend line.

The positive results of the experimental work were discussed and analyzed by the teachers of General Pedagogy and Andragogy Department (Poltava V. G. Korolenko National Pedagogical University) and Department of Economic Cybernetics, Business Economics and Information Systems (University of Ukoopspilks "Poltava University of Economics and Trade") at a joint meeting of the scientific round table "Implementation of a system of resource-based learning of future teachers". It was noted the positive dynamics of changes in the levels of students' educational activity in the implementation of the RBL system, was discussed further vector of development of topics of network projects, didactic tools of motivational and procedural-technological subsystems; was proposed extension of the list of topics of network projects with emphasis on practically oriented component of training of future educators. It was also decided to develop joint distance courses, virtual classes, electronic manuals for replenishing the e-libraries of universities, as well as to create a Ukrainian OLE for teaching future teachers and wide popularization among the educational community of the RBL system and its implementation in higher education institutions, not only in higher education, but also throughout Ukraine and beyond.

CONCLUSION

The effectiveness of the RBL system of future teachers, which consists of 5 subsystems (conceptual-target, structural-content, process-technological, motivational, diagnostic and productive) is theoretically substantiated and experimentally verified. The RBL system was implemented in the higher educational establishments of Poltava region.

The organizational and pedagogical conditions of the implementation of the RBL system of future teachers as a set of interconnected circumstances, measures ensuring the purposeful management of the process of mixed learning, and the rules established in the system for ensuring high quality of professional training in higher educational establishments are identified.

The effectiveness of the RBL system for future teachers (the level of effectiveness of students' educational activity in the RBL system) indicates positive statistically significant changes. Very high level: in EG –

6,25%, in CG – 0% (at the beginning stage in CG and EG – 0%). High: in EG – 20,42%, in CG – 20,16% (at the beginning stage in EG – 15,83%, in CG – 17,79%). Average: in EG – 58,75%, in CG – 49,01% (at the beginning stage in EG – 49,58%, in CG – 49,41%). Low: in EG – 14,58%, in CG – 26,88% (at the beginning stage in EG – 27,09%, in CG – 27,67%). Very low: in EG – 0%, in CG – 3,95% (at the beginning stage in EG – 7,5%, in CG – 5,13%). The statistical verification of the results of the experiment according to this technique showed that the indicators of the obtained values are stable and evenly increased from very low to very high. The obtained probability of approximation confirmed the reliability of the obtained forecast.

The research does not exhaust all aspects of the identified problem. The obtained theoretical and practical results form the basis for further study of the problem in the aspect of identifying the specific ways of organizing effective cooperation with libraries in Ukraine and other countries, with foreign educational institutions that train future teachers, studying the directions of introduction of RBL, building up an open partnership with higher education institutions and the creation of a new generation of universities using innovative technologies.

RECOMMENDATIONS

Implementation of the RBL system for future teachers in the higher education institutions of Poltava region made it possible to formulate the following recommendations:

to establish cooperation with other higher education institutions and network cooperation for creating a common open educational environment;

to build the educational process of future teachers preparing on the base of mixed form of learning (traditional learning and e-learning);

to prepare and implement the scientific and methodological provision of the process of RBL of future teachers (textbooks, manuals, electronic educational resources, distance learning courses, etc.) in the educational practice of higher education institutions;

to intensify the activity of libraries and electronic libraries of in the educational practice of higher education institutions, to transform the role of a librarian to a teacher-librarian students and teachers to be encouraged to work in virtual classes, to use a wide range of information resources, to build an individual educational trajectory of training;

it is expedient for teachers to develop personal websites which will be their visiting card and will reflect the scientific and pedagogical activity;

to improve forms, methods and learning tools, taking into account the concept of RBL in higher education and the paradigm “lifelong learning”.

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