TOJET
The Turkish Online Journal of Educational Technology

ISSN 2146-7242

Turkish Online Journal of Educational Technology

Volume 17, Issue 2
April 2018

TOJET
01.04.2018

THE TURKISH ONLINE JOURNAL OF EDUCATIONAL TECHNOLOGY

April 2018
Volume 17 – Issue 2

ISSN: 2146 - 7242

Indexed by
Education Resources Information Center – **ERIC**
SCOPUS - ELSEVIER

Published in TURKEY

Contact Address:
Prof. Dr. Aytekin İŞMAN
TOJET, Editor in Chief
Sakarya-Turkey

Message from the Editor-in-Chief

Dear Colleagues,

TOJET welcomes you. TOJET would like to thank you for your online journal interest. The online journal system has been diffused very fast for last seventeen years. TOJET has continued to diffuse new trends in educational technology to all over the world.

TOJET is confident that readers will learn and get different aspects on educational technology. Any views expressed in this publication are the views of the authors and are not the views of the Editor and TOJET.

TOJET thanks and appreciate the guest editor Amirul Mukminin and reviewers who reviewed for one or more submissions of this issue for their valuable contributions. As always, the issue of v.17 i.2 - 2018 features contributions from many countries.

TOJET, TASET, Governor State University & Sakarya University will organize IETC-2018 (www.iet-c.net) between August 08 - 10, 2018 at School of Education, Indiana University, Blomingtoon, USA. For any suggestions and comments on the international online journal TOJET, please do not hesitate to send mail.

Call for Papers
TOJET invites you article contributions. Submitted articles should be about all aspects of educational technology. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJET. Manuscripts must be submitted in English.

TOJET is guided by TOJET's editors, guest editors and advisory boards. If you are interested in contributing to TOJET as an author, guest editor or reviewer, please send your CV to tojet.editor@gmail.com.

April 01, 2018
Prof. Dr. Aytekin ISMAN
Editor-in-Chief
Sakarya University

Editorial Board

Table of Contents

An Exploratory Study of the Factors Affecting the Perceived Usability of Algerian Educational Websites

Mohamed BENAIDA
Faculty of Computer and Information Systems, Islamic University of Madinah, SAUDI ARABIA
md.benaida@gmail.com

Abdallah NAMOUN
Faculty of Computer and Information Systems, Islamic University of Madinah, SAUDI ARABIA
a.namoun@iu.edu.sa

ABSTRACT
Nowadays universities pay considerable attention to the use of websites to enhance the education process through the delivery of important information. The general aim of a website is to attract more target users. However, a poor website leads to fewer visits, less efficiency and less satisfaction from users. The present study explores the effects of four key factors including system usefulness, interface quality, content and satisfaction of users on the perceived usability of Algerian educational websites. A total of 200 students were tasked with four interaction tasks and subsequently asked to complete a usability questionnaire, consisting of 19 usability questions. Results indicate that the website usability perceptions amongst university website users are significantly affected by all four factors. In particular, website usefulness, information quality, interface quality and overall satisfaction all require more attention for the design of effective Arabic educational websites. Improvements to speed of Internet, structure of the website and quality of website contents were also advised.

Keywords: Usability, Algerian Educational Websites, Factors, System Usefulness, Information Quality, Interface Quality, Satisfaction

INTRODUCTION
The usage of Internet by the education sector has become increasingly important nowadays ever than before. The growing of Internet around the world allows the universities to give more considerations to the use of websites during the education process. The general aim of a website is to attract more target users. Hence, a poor website leads to less visits, less efficiency and less satisfaction from the users and as a consequence, the website will fail to reach the target and the expectations of the users. Therefore, usability is the supreme solution for attracting and satisfying the targeted audience for educational website use. According to Hasan only one study investigated the evaluation of usability within Arabic educational websites. The results showed that students preferred the following area which included: navigation support, logical structure of a site, quick downloading of web pages, aesthetic design, and up-to-date (Hasan, 2014). According to our research there are no prior studies that have investigated the usability and usefulness of Algerian educational website. Therefore this study enriches the usability research landscape related to Arabic websites and enhances the understanding of the factors that encompass the concept of usability within educational websites. The contribution of this paper is thus to explore the effects of usability factors on Algerian higher education websites.

LITERATURE REVIEW
Algeria is a country situated in North Africa (Maghreb) where the majority of its residents are young people. There are more than 39 universities with 17 dispersed university campuses under the control of the minister of education. The number of Algerian Internet users has risen from 50,000 users in the beginning of 2000 to 11,000,000 in November 2015, with a proportion of 27.8% of the total population (Internet World Stats, 2015). The Internet users and especially students remain to face many barriers to gain a higher speed Internet access. The main problems which discourage the student from accessing education websites is the cause of a limited reach of AT's fixed-line network and the inflation in the cost of Internet usage, the third generation (3G) has been operating only in December 2013, despite other countries (e.g. Saudi Arabia 2011) already launched their 4G (Chaabna & Wang, 2015).

In the year 2015, there were more than 3, 36 billion users of the Internet around the world. This significant increase of Internet usage opens various opportunities for the universities around the world to benefit from this

type of technology. Many universities have a web presence which must reflect the level of services that are provided to the students and staff. Nielsen (1994) defines the usability of a website as the ability of the user in becoming familiar with the website and how errors can be reduced when using the website. The key elements for a successful website can be measured by the efficiency of the website design, the remembrance of how to navigate through the website and the overall satisfaction of the website.

In modern education websites usability is regarded as a key component for survival in the Internet world; however, the website designer must consider the users requirements and allow the users to accomplish their tasks efficiently (Nielsen, 2000; Yan, & Guo, 2010; Teo, & Liu, 2003). According to Flavian, Gurrea, and Orús (2009) usability enhances the understanding of the tasks and contents whereby tasks need to be completed with minimal errors. Usability is also notably affected by the connection of the Internet and a poor Internet connection can limit the number of website users. Furthermore, the speed of Internet from one country to another can provide various measurement scales of usability and if the users can't achieve their target in a specified time frame they will refrain from visiting the website in the future (Tractinsky, Katz, & Ikar., 2000).

Several studies have considered the usability of university websites. Sengel and Öncü (2010) investigated the usability of Uluda University website and extracted differences in the responses of females and males. Results show that the students' interpretation of web usability drastically changes between the two genders, with females have considerably higher ratings for 23% of the predefined reasons to visit the usability. The author implies that the websites audience seems to be directed at the females more than the males.

Mentes and Turan (2012) evaluated and explored the usability level of Namık Kemal University website, the findings showed that website usability perceptions is positively affected by five of the six factors (attractiveness, helpfulness, efficiency, learnability and demographics are accepted) however, controllability is rejected. Demographic factors (gender and web experience) have major effects on the on the individual user' usability perception. Adrian, Duncan, and Durrant (2015) aim of their research was to provide an assessment of the usability of the University of the West Indies and found that the challenging areas are detected in the site's navigation, user satisfaction and learnability. Caglar and Mentes (2012) investigated the usability of European university of Lefke website in regard to student utilization and discover the effects of the information age on university websites using a website analysis and measurement inventory (WAMMI) questionnaire. To examine the data the authors used non-parametric and regression methods. The results show usability problems of a EUL website, situated in Cyprus as well as discontentment.

Tuch, Presslaber, Stöcklin, Opwis, and Bargas-Avila (2012) formulated users' first impressions via examining two parameters, namely visual complexity and prototypically as design features of web pages. Two studies were conducted, for the first study using 119 screenshots of real websites, apparent aesthetics were used to rate VC (three levels included: low V, medium V and high V) and PT (low Vs high) variations. VC and PT influenced the subject aesthetics scores within 50ms of exposer to real websites. Moving on to the second study the duration of screenshot presentation was reduced (17ms, 33ms and 50ms). Results suggested even within 17ms duration PT and VS both influence aesthetic perception despite PT being less pronounced than the one of VC. The correlation between PT and VC are proportional, the outcome of PT becomes as significant as the VC effect. Furthermore, having a low and high VC was considered being unattractive whereas highly appealing web pages were seen to have low VC and high PT. Subjects have a fondness of websites with a PT and a low VC. However, aesthetic judgments are affected by both features after a short exposure time of 17ms. Subjects have a fondness of websites with a PT and a low VC. After a short exposure time of 17ms, aesthetic judgments are affected by both features PT and VC. Cyr, Head, Larios, and Pan (2009) used questionnaires, eye-tracking systems and interviews in their study. Human images with facial features on websites tend to be more appealing to the Internet users. This allows the users to perceive social trust and having warmth; In contrast with human images without facial features and images with no human image at all (where no direct relationship was observed.) High human condition was the most favorable, had greatest image appeal and social presence. Another similar research used eye-tracking method, where adjectives were used to describe high-human treatment as having higher emotional draw. By using an eye-tracker this enabled us to calculate how long the participant spent on viewing images and calculated the number of fixations too. It was found that the users spent the greatest proportion of time looking at human images without facial features and as a result it hard more fixations.

Islam and Tsuji (2011) investigated 20 Bangladeshi university websites in terms of usability. To evaluate these websites, they used a questionnaire and online automated tools (html toolbox and web page analyzer) which can be used to determine the internal features of the websites. Moreover, the design of the questionnaire was designed to fit the 23 usability criteria which were eventually classified into five categories. Thowfeek and Abdul Salam (2014) examined Shackel's usability model to determine usability features and to improve the

survey by creating a questionnaire. They studied undergraduates from the South eastern university of Sri Lanka who were in their final year of study. A selection of both experienced and non-experienced users of e-learning websites were used. The authors found that both students whom are experienced and non-experienced do not necessarily carry much connotation in this research, this is due to the theory of perception and experiences are usually at the same level. However, the usability attributes are necessary for the unprompted and natural interface with e-learning websites. Furthermore, outcomes of inexperienced users show that there's a higher expectancy concerning the features of usability of an e-learning website and new users are already wary about all the features which support them to use web pages for their own learning. In contrary, experienced users said that there's room for improving the features of the usability as the greater scales aren't influenced. Abdul Aziz, Mohd, and Nordin (2010) used a sample of 120 from higher education institution websites from the online portal of the ministry of higher education, to study the usability of Malaysian university websites. The main areas of focus were dedicated to broken links, web performance, page size and usability features. The results indicated that these websites still have some issues which need to be revised.

Al-Qeisi, Dennis, Alamanos, and Jayawardhena (2014) studied 216 users of Internet banking in their study. These users demonstrated that the technical, general satisfaction and layout dimensions of a banks website are significant to the user. The dimensions such as organization, clarity, access and loading time are associated with the usage behavior directly and in directly. Lee, Bahn, Kim, and Yun (2010) analyzed the relationship between perceived usability before actual use, time taken to complete task and the effects of design features on user preference for e-commerce web sites. The results showed a correlation between pre-use usability and task completion time was apparent; (2) the relationship between task completion time and preference was less than that of pre-use usability and preference; (3) aesthetic aspects such as color and typography did not have a significant effect on user preference like organizational structure and layout had. Papadopoulos and Xenos (2008) looked at the evaluation of the new edition of Hellenic Start School (HOU) website. They adapted the heuristic evaluation method which consists of several evaluators evaluating whether the user interface is similar to a set of performance measurement which have been adapted in generic-type application, along with a set of usability concepts. The study shows a pattern of usability errors and dissatisfaction from the users which been overlooked in the developing stages of the website. Both authors suggest that an effective way in which the website can advance to develop into an efficient, useful, effective and satisfactory to all the users is to the revealed imperfections. However, there are no studies which investigate the usability on Algerian education websites and from this point onwards it would be important for this study to fill in the gap in the field of usability research.

RESEARCH METHOD

This empirical research was introduced to analyse and improve usability for Algerian education websites which represents the initial stages of a wider study program. As mentioned before, the main goal of this research is to evaluate and measure the effects of the four factors (efficiency, learnability, web content and satisfaction) on usability of Algerian education website. In the second stage, usability guidelines for Algerian education websites were deduced from the evaluation of the data.

The top four universities in Algeria were examined in this research and they are as follows: University of Tlemcen university of science and technology Houari Boumediene (Algiers), University Kasdi Merbah of Ouargla and Université d'Alger 1 (Algiers University 1). Further details are given in the methodology section. These universities were selected based on their ranking in Algeria. The aim was to gauge user perception of students towards the best universities in Algeria and understand the potential problems they face during their interaction with education information. In this research, four research hypotheses are formulated and addressed based on the usability factors:

H1: Algerian students find their university website useful.
ISO 9241-11 defines efficiency as "the resources expended in relation to the accuracy and completeness with which users achieve goals" (Lee et al., 2010). Efficiency provides the designer a chance to examine the speed of completion of a particular task and the components of it comprise competence time and accuracy of task.

H2: Algerian students are happy with the content of their university website.
One of the most affected components of a website is the content decision which can be classified into two categories: information and design. (Rahimnia & Hassanzadeh, 2013) When the relationship between information and design are very strong, more users will be attracted to the website.
The designer must take into account information type, how to retrieve information and which information has the priority to be displayed on the website (Thakor, Leach., Gillham, & Esterman 2011; Proctor et al., 2009). The content includes font, font size, color, images, videos, text, icons, links and logos.

H3: Algerian students like the interface quality of their university website.
The interface quality factor is a key element to a successful use in the usability criteria. Interface quality can define as the feeling of users about interfaces and interactivity which include appearance, navigation, proximity, layout and compatibility (Pang, Suh, Hong, Kim, Lee, 2010).

H4: Algerian students are satisfied when using the university website.
Satisfaction is another key in usability aspect. Usually the target of any website is to meet the satisfaction needs of its users. Therefore, it is recommended to allow the users to be comfortable when navigating through the website. ISO 9241-11 defines satisfaction as "the freedom from discomfort, and positive attitudes towards the use of the product" (Lee et al., 2010).

RESEARCH METHODOLOGY

This section provides background information about the selection of Algerian university websites, participants, questionnaire development and data collection process.

Algerian University Websites

Top Four Algerian universities whom are ranked nationally in the year 2016 were chosen for this study. The top university being the University of Tlemcen followed by the University of Science and Technology Houari Boumediene (Algiers), University Kasdi Merbah of Ouargla and Université d'Alger 1 (Algiers University 1) being the fourthly ranked university. The programs and courses which are offered at these universities include: undergraduate degree and postgraduate degree across the areas of study.

These websites were examined due to them being from the top Algerian universities as well as the students' accessing them to accomplish their needs. Sample screenshots for the websites are presented in the following Figures. Through use of the existing websites, this research intends to assess the Algerian student's response to a variety of usability features on Algerian university websites.

Figure1. Algiers University 1 Home Page

Figure. 2. University Kasdi Merbah of Ouargla Home Page

Figure 3. University of Tlemcen Home Page

Figure 4. University of Science and Technology Houari Boumediene Home Page

Participants

The collected sample of this research involved a total of 200 students from the four Algerian universities, in order to assess the usability features discussed in the previous section. From each university, 50 students volunteered to participate in this study. The participants were female and male students from undergraduate and postgraduate background and came from various faculties. Each university student was given access to their university website to evaluate perceived usability features by using questionnaires and experiment tasks. Convenience sampling was used in order to reach as many participants as possible. This technique is a non-probabilistic method that allows recruiting volunteers that are easily accessible to the researcher. The only restriction in our study was that the participants would need to be students at these universities.

Pilot Study

The importance of conducting a pilot study is to eliminate any errors when evaluating usability factors and to ensure the original research will work successfully (Van Teijlingen & Hundley, 2001). A similar set of steps were followed to that which would be used in the actual research. This pilot study comprised of ten undergraduate and postgraduate students in order to refine tasks and questionnaires. However, few concerns were detected in relation to the Internet connection speed. To reduce the same problem from reoccurring in the experiment, peak times will be avoided to ensure Internet availability.

Data Collection

Certain points need to be outlined in this study before starting with data collection; such as data collection used, appropriate data collection methods and the type of stakeholders in order to identify the required data. A number of steps have been carried before the experiment took place. At the start of the study and upon arriving, the participants were provided with a brief description of the experiment and were requested to read and sign a consent form. Next, all the participants in each of the four universities were gathered in one place at their available timings. The first part of the questionnaire was completed by users asking questions in relation their

age, gender and reasons for visiting the website. Every participant is given five minutes to explore the website in case some students haven't used the site before and to ensure that the students have accessed all the levels of website. Following that, the students were handed two papers, first paper consisting of four experiment tasks (to ensure reliability and validity) and the second being a questionnaire to precisely measure usability factors.

Questionnaire

Previous research confirmed that the questionnaire mode is the most popular way to collect data on website design (Al badi, Okam, Al Roobaea., & Mayhew,2013; Cyr et al., 2009). Furthermore, questionnaires can be used to rate users satisfaction (Holzinger, 2005) and is one of the most effective way to gather users opinions about systems. One the most widely used questionnaires to measure usability is the Computer System Usability Questionnaire (CSUQ). CSUQ was developed by IBM to evaluate the computer system usability. Moreover, the questionnaire consists of 19 questions (IBM computer usability satisfaction) (Lewis, 1995), each question rated from one to seven and the scale ranging from "strongly disagree" to "strongly agree" and a "not applicable" option is present.

The questionnaire is categorized into four key factors: system usefulness (questions 1 to 8), information quality (questions 9 to 15), interface quality (16 to 18) and overall usability (questions 1 to 19).

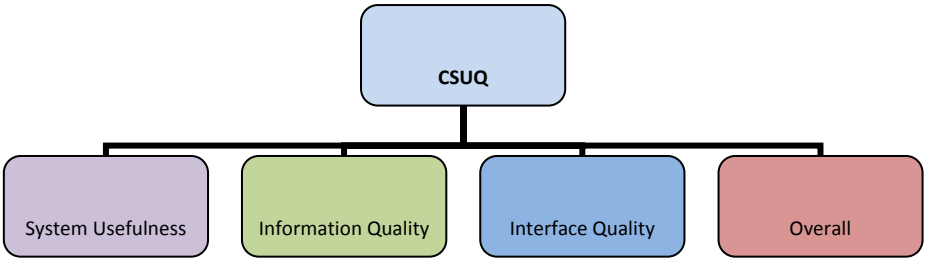


Figure 5. Components of CSUQ to evaluate key factors of usability

System usefulness questions evaluate the effectiveness, learnability, ease of completing tasks, and time completion of tasks. Information quality questions evaluate the quality of the information of the website usability, errors, and information clearness, and how satisfied are the users with it. Interface quality questions evaluate the interface quality of the website (Ozacar, 2016). At of the end of questionnaire the users can list three most negative and positive aspects of the website.

CSUQ has been chosen as a primary source of the data collection due to its high reliability score (= .95) and construct validity (Lewis, 1995; Ozacar, 2016). Moreover, the questionnaire was translated from English to Arabic language for the Algerian website users, in order to accommodate the language needs of the participants.

Data Analysis

Quantitative data were collected through CSUQ questionnaire and an additional questionnaire was used to measure the demographic information of participants as shown in table 1. Across all the examined universities (200 participant students) the female respondents were 49.5% and the male respondents were 50.5% and more than 55% of respondents have used the Internet for three years or more. Moreover, around 50% of students rarely or occasionally use the university websites. These results indicate that half of Algerian students do not use the university website regularly despite more than half of the participants having good experience in Internet use.

Table 1. Demographic data of participants

		Tlemcen university	**USTHB university**	**Ouargla university**	**Algier1 university**	**Average**
Gender	Male	52%	40%	65%	45%	50.5%
	female	48%	60%	35%	55%	49.5%
Years Using the Internet	<3	20%	20%	33%	18%	22.75%
	3-5	60%	55%	52%	54%	55.25%
	>5	20%	25%	15%	28%	22%
Usage of university website	Every day	23%	25%	30%	19%	25%
	Few times a week	20%	18%	24%	30%	23%
	Occasionally	50%	42%	40%	35%	41%
	Rarely/ never	7%	15%	6%	16%	11%

Task Performance

In this section, the performance of different tasks between the Algerian university websites has been examined using two main usability metrics: average task completion time and average number of clicks; both measuring in seconds. Statistical analysis showed that the average completion times and number of clicks for task two across the Algerian university websites were the highest (110s, 14 clicks) and users spent the least amount of time in completing task one (54, 13 clicks). Participants took 69 seconds and a total of 7 clicks to complete task three; meanwhile, participants took 77 seconds and a total of 11 clicks to complete task four.

Table 2. Average Completion Time (in seconds) and Number of User Clicks

	Average Completion (Seconds)					**Average Number of clicks**				
Task	Tlemcen Uni	USTHB Uni	Ouargla Uni	Algiers 1 Uni	Average	Tlemcen Uni	USTHB Uni	Ouargla Uni	Algiers 1 Uni	Average
One	40	62	55	60	54	13	11	7	19	12
Two	118	97	98	127	110	14	12	15	14	13
Three	60	40	100	78	69	4	7	11	4	6
Four	82	69	93	65	77	10	8	10	14	10

Qualitative data were collected from the second part of the CSUQ questionnaire, where users gave opinions and feedback on the negative and positive aspects of the Algerian university websites. On average, 408 negative comments and 145 positive comments were received (see table below). These feedbacks were categorized after undergoing a qualitative content analysis; they were then grouped in accordance to the four factors that have been described earlier in this paper (Overall satisfaction, system usefulness, information quality and interface quality).

In the USTHB website (Arabic version), users reported that there is no search engine (18). In addition, poor language usage (40) has been reported as a negative feature of a website. This pattern occurs across all four Algerian university websites where a combination of the Arabic as well as the French language has been used; for example, some of the content on the USTHB website (Arabic version) is written in French and vice versa. In particular, the Ouargla university website does not provide any other language option apart from French as their main language; despite the first language of Algeria being Arabic. Meanwhile, broken links (48) can be found in all Algerian university websites.

Furthermore, the content quality across all Algerian university websites are fairly poor (50); whilst some pages provide no information, other pages tend to overload the user with a lot of information (45). Apart from the Tlemcen University website, the remaining universities use unclear font types (35) as well as a small font size (48). Furthermore, negative feedback was reported 25 times for the image use on websites and color use was reported only 5 times across all four university websites. In terms of overall satisfaction of the websites a total of 72 have regarded the Internet and website speed as a negative aspect of using the university website.

On the other hand, very few positive aspects of the university websites were detected. Relevant information was classified as the most desirable feature on the university websites (41). The users also desired the use of social media links (30), layout (24), background color (25) and the number of available languages for accessing the university websites. No positive characteristics were provided in terms of the users with the overall satisfaction of the Algerian university websites.

Table 3. User Feedback Categorized into Negative and Positive Themes (number of occurrences between brackets)

Theme	**Negative**	**Positive**
System usefulness	language use (40), search engine (18), broken links (45)	Social media links (30), number of languages (25).
Information quality	Content (50), finding required information. (45)	Relevant information (41)
Interface quality	font size (48), font type (35), images (25), link to homepage (25), color usage (5)	Layout (24) , background color (25)
Overall satisfaction	Internet and website speed (72)	

Factor Analysis
The metric scale of the questionnaire is out of 7, any rating from the participants observed above 50% (>3.5) is an indication of a good usability system; whereas, any ratings below 50% (<3.5) from the respondents indicates a poor usability system, in accordance with CSUQ scale. The scale had good reliability, with a high Cronbach's alpha of 0.88. Furthermore, the four factors will be analyzed in this section to evaluate the effect of usability for each factor.

System Usefulness
The mean CSUQ score for system usefulness was 3.27 (46.7%) in all universities that were examined in this study. Algiers university 1 had the highest score of 3.54 (50.57%) and the lowest score was given by Ouragla university students 3.09 (44%). Meanwhile USTHB and Tlemcen university scored 3.2 (46%) and 3.25 (46%).

Information Quality
The results shown in the information quality factor in all four universities were 3.03 (43%). Once again Ouargla University had the lowest ratings for this factor 2.68 (38%); the highest score was given by Tlemcen University students for their website, 3.36 (48%). However, Algiers University 1 website had 3.2 (45%) and USTHB scored 2.89 (41%).

Interface Quality
In terms of user response, the interface quality factor assessed using CSUQ scale had an average of 2.68 (38%) across all four university websites. The lowest ratings were for USTHB website 2.37 (33%) and the highest ratings for this factor was for Tlemcen university website. Algiers 1 University and Ouargla University websites had close ratings 2.59 (37%) and 2.56 (36%).

Overall Satisfaction
In terms of overall satisfaction of the website, the average CSUQ factor score across all four Algerian university websites was 3.14 (44%) this factor had the highest score amongst all other factors. Moreover, students from Tlemcen University had the highest ratings (3.25, 46%) for their university website followed by Algiers University 1 (3.22, 46%), whilst Ouragla University website had the lowest ratings (2.96, 40%) from its users. USTHB had scores of 44% (3.14). Fig. 1 displays the average scores and sub scores for each Algerian university website.

Table 4. Average rating of usability factors across the four educational websites

Usability Factor	Tlemcen University	UATHB University	Ouargla University	Algiers 1 University	Average
System Usefulness	3.25	3.20	3.09	3.54	3.27
Information Quality	3.36	2.89	2.68	3.20	3.03
Interface Quality	3.23	2.37	2.56	2.59	2.68
Overall Satisfaction	3.25	3.14	2.96	3.22	3.14

DISCUSSION
To the best of our knowledge, this study is the first study to test the usability of Algerian websites in this field. In the results section, the four factors (system usefulness, information quality, interface quality, and overall satisfaction) of the CSUQ questionnaire were examined; as well as the written opinions and feedback from users on the Algerian university website after the completion of tasks. In this section, a detailed discussion of these results will be provided.

System Usefulness
In the CSUQ questionnaire, the first eight questions measured system usefulness. Of the three categories, system usefulness was rated below the average by the users (3.27). The overall trend for Algiers 1 University is positive (metric score > 3.5/7) in comparison with Ouargla university, Tlemcen and USTHB (metric score <3.5/7). This shows that users from Algiers 1 university are satisfied with the website in regard to the system usefulness and are able to efficiently and effectively complete their work when using these websites. Furthermore, question 7 was rated the highest (4.27) amongst other Algerian university websites in terms of system usefulness from users of university of Algiers 1. However, question 4 had the lowest ratings (2.5) from university of Ouargla website users. This indicates major problems within the Ouargla university website and shows that the users struggled to complete their work and found some difficulty in using the website. Problems such as broken links and no search engine (USTHB, Arabic version) in the website resulted in the slow navigation and ineffectiveness of task completion as shown in completion times and the number of clicks in tasks three (Average of 69.5, 6.5 clicks). Moreover, an undesirable feature which has been frequently flagged as a negative aspect of the website is the

inconsistent use of the Arabic and French language on the websites. For example, in the Tlemcen University homepage Arabic and French language is used for the content information; in addition, when a new page is opened, the user finds content in written in French only and vice versa. Such errors made by the designers discourage users from visiting the website again. Overall, Algerian students feel that the Algerian university websites were inefficient and therefore H1 is rejected.

Table 5. Average Rating of Website Usefulness Factor

Questions	**Average Rating (on a 7-point scale)**			
	Tlemcen University	USTHB University	Ouargla University	Algiers 1 University
1. I am satisfied with how easy it is to use this system	3.06	3.26	3.54	3.72
2. It was simple to use this system	3.75	3.2	3.1	3.2
3. I can effectively complete my work using this system	3.1	2.92	2.68	3.46
4. I am able to complete my work quickly using this system	3.1	3.28	2.5	3.5
5. I am able to efficiently complete my work using this system	3.56	3.06	3.2	3.12
6. I feel comfortable using this system	3.19	3.35	3.26	3.66
7. It was easy to learn to use this system	3.05	3.5	3.25	4.27
8. I believe I became productive quickly using this system	3.23	3.06	3.2	3.42
Average Website Usefulness Rating	3.25	3.20	3.09	3.54

Information Quality

The second usability metric attained from the CSUQ (questions 9-15) provides the score for the perceived information quality on the system. The information quality had an average rating of 3.03 (<3.5/7), which indicates a poor usability system of the Algerian university websites. The users are satisfied with the organization and the clarity of information found on the university website as it was rated the highest, 4.1 (Tlemcen University); followed by the effectiveness of the information in helping the user complete the tasks (Tlemcen University,3.69). In addition, the information quality score consists of an item relating to error messages, the users felt that the system didn't provide error messages which explains to them how to fix issues they were experiencing; therefore, a low score of 1.8 (Ouargla University) was given. This could reduce the time completion tasks and hence why the users considered finding required information as a negative aspect of the Algerian university websites. A total of 41 respondents suggested that relevant information implemented by the sites were a positive aspect of the Algerian university websites; whereas content information was regarded as a negative aspect by 50 users as demonstrated in tasks one (54.25s, 12.5 clicks) and task two (98s, 13.75 clicks). This is due to some universities providing the required information for the users (Algiers 1 University and Tlemcen University) and others providing no information at all (Ouargla University and USTHB) as shown in the table below (question 12). Overall, The Algerian students found that the information quality on the Algerian university websites were below average; therefore, H3 is rejected.

Table 6. Average rating of website information quality factor

Questions	**Average Rating (on a 7-point scale)**			
	Tlemcen University	USTHB University	Ouargla University	Algiers 1 University
9. The system gives error messages that clearly tell me how to fix problems.	2.56	2.1	1.8	2.68
10. Whenever I make a mistake using the system, I recover easily and quickly	2.87	2.1	2.5	2.96
11. The information (such as online help, on-screen messages, and other documentation) provided with this system is clear	3.2	3.1	2.56	3.55
12. It is easy to find the information I needed	3.62	3.26	2.48	3.46
13. The information provided for the system is easy to understand	3.49	3.36	2.86	3.25

14. The information is effective in helping me complete the tasks and scenarios	3.69	3.26	2.94	3.54
15. The organization of information on the system screens is clear	4.1	3.09	3.62	2.98
Average Website Information Quality Rating	3.36	2.89	2.68	3.20

Interface Quality

Questions 16-18 of the CSUQ questionnaire is used as a way of measuring users' satisfaction with the interface quality of the Algerian university websites. Usually website users assess the website interface instead of its functionality; therefore, Interface quality was rated the lowest (2.68) amongst other usability factors. This rating was below 3.5/7 (50%), this indicates a poor usability of the websites. The layout and the background were reported as positive features of the websites. However, users have indicated that the font size, font type, color usage and lack of images on the website were the most disliked aspects of the websites. USTHB users were dissatisfied the most with the overall interface of their website (2.37) as opposed to Tlemcen University (3.23). Overall, the users felt like the Algerian university websites did not provide all the functions and capabilities that they were expecting it to have and eventually this will cause a decline in the usage of these websites. The final results showed that Algerian students found the interface quality on the Algerian university websites were poor; therefore, H3 is rejected.

Table 7. Average rating of website interface quality factor

Questions	**Average Rating (on a 7-point scale)**			
	Tlemcen University	USTHB University	Ouargla University	Algiers 1 University
16. The interface of this system is pleasant	3.38	2.36	3.38	2.63
17. I like using the interface of this system	3.42	2.52	2.18	2.26
18. This system has all the functions and capabilities I expect it to have	2.89	2.23	2.12	2.88
Average Website Interface Quality	3.23	2.37	2.56	2.59

Overall Satisfaction

The final usability metric provides scores for the overall satisfaction of the websites from the users. Users from Tlemcen rated their university website similarly, 3.25 (43%). Meanwhile, USTHB users gave a score of 3.14 (44.8%) and Ouargla University had a score of 2.84 (40%). These scores are all below the average ratings of 3.5 (50%) which is a strong indication for the poor usability and the dissatisfaction of the Algerians users with the university websites. Users reported that low Internet and website speed was a major problem when carrying out tasks. This was reflected in the completion times as well as number of clicks in task four (100.25s, 10.5 clicks). The final results showed that Algerian students were unsatisfied with their university websites were poor; therefore, H4 is rejected.

Table 8. Average rating of website overall satisfaction factor

Questions	**Average Rating (on a 7-point scale)**			
	Tlemcen University	USTHB University	Ouargla University	Algiers 1 University
19. Overall, I am satisfied with this website	3.25	3.14	2.84	3.22

CONCLUSION

Usability is an essential factor for predicting the reaction of users when using the system. A good design and a well-structured website ensure a high level of usability and can have positive effects on the users' satisfaction (Petrie, & Bevan, 2009, Flavian, & Gurrea, 2008). Many universities adopt the use of an effective and higher quality education websites, in order to reach these goals, the designer must consider all factors of usability.

This study highlights the significance of the four factors of usability which can influence university websites from the perspective of students as users. However, Algerian students expect a well-designed, easy to use and good information quality in order to be satisfied with the website. Nevertheless, the general view of Algerian users in this study shows dissatisfaction with the university websites. Many problems on these websites have been detected in all four factors.

Interface quality is one of the major problems that has been detected, this includes broken links that can easily be found in many pages and other links cannot be used at all. In addition, the structure of some websites are very poor; this consists of color, icons, search engine, font and font size and these all should be given priority for high interface quality. This means the designer of the Algerian university websites should keep in mind that it is crucial to use the relevant design in order to keep the website more attractive for the users.

The results show that the information quality needs more attention as the given score was second lowest. One of the reasons for this finding is that there were no messages given to the user when an error occurred in the system. As a result, users will struggle to overcome such problems or to avoid it, leading the user to not being able to complete certain tasks. An example for this was during the tasks completion phase when the students were not able to find the required information. Thus, the designers must recognize the importance of the quality of information which can assist the users to complete their tasks. Hence it is essential that basic usability testing should be carried when developing the website.

Although system usefulness factor was rated the highest amongst other usability factors, areas of improvement were still needed. Broken links were reported as the most negative aspect of the Algerian university websites as well as the inconsistency in language use. These deficits make it problematic and less efficient for the users to find relevant information on the Algerian university websites, as detected in the study. Many of the errors on the websites can be solved fairly simply; our results reinforce the need for accurate and precise planning during the development stage where one language must be consistently used throughout the website with no disruption of other languages.

Furthermore, the overall satisfaction of the users reflected the usability features of the Algerian university websites. Slower websites have been anticipated to be less interesting for the Algerian users; usually, user experience doesn't depend only on the performance of the websites but also the connectivity of it. However, in this study, Internet speed had a large impact on the performance and completion of tasks, as the results of task four shows. This pattern is noticeable across the Algerian websites where there's an overuse of unnecessary large images which can hamper website loading. The larger the image files, the longer the site will take to load. Therefore, designers must compress and resize images without affecting the quality and most importantly use only images which are relevant to the site. Adapting these methods together ensures a better-performing, efficient and for more pleasant and effective website for the users.

In conclusion, Algerian university websites need significant amendments and enhancements by taking into account the four usability factors (system usefulness, information quality, interface quality and overall satisfaction). The designers of Algerian university websites ought to test the system before launching to disregard any errors and must also integrate the users' needs to retain users towards the site.

REFERENCES

Abdul Aziz, M., Mohd, I., & Nordin, N. (2010). Assessing the accessibility and usability of Malaysia Higher Education Website. *International Conference on User Science and Engineering*, pp. 203-208.

Adrian, S., Duncan, P., & Durrant, F. (2015). An assessment of the usability of the University of the West Indies (Mona, Jamaica) Main Library's website. *The Electronic Library*,Vol.33, No.3, pp. 590- 599.

Al badi,A., Okam,M., Al Roobaea., & Mayhew,P. (2013). mproving Usability of Social Networking Systems: A Case Study of LinkedIn, *Journal of Internet Social Networking & Virtual Communitie.*

Al-Qeisi, K., Dennis ,C., Alamanos, E., & Jayawardhena, C. (2014). Website design quality and usage behaviour: Unified Theory of Acceptance and Use of Technology, *Journal of Business Research*, pp. 2282–2290.

Caglar, E., & Mentes, S. A. (2012). The Usability of University Websites: A Study on European University of Lefke, *International Journal of Business Information Systems*.

Chaabna, S., & Wang, H. (2015). Analysis of the State of E-commerce in Algeria, *International Journal of Marketing Studies*.

Cyr, D., Head, M., Larios,H.,& Pan,B. (2009). Exploring human images in website design: a multi-method approach, *MIS Quarterly*,Vol. 33, No.3, pp. 539–566.

Flavian, C., & Gurrea, R. (2008). Reading newspapers on the internet: the influence of websites. *Internet Research journal*, Vol.18, No.1, pp. 26-45.

Flavian, C., Gurrea, R., & Orús, C. (2009). Web design: a key factor for the website success, *Journal of Systems and Information Technology*, Vol.11, No. 2, pp. 168 – 184.

Hasan, L. (2014).The Website of the University of Jordan: Usability Evaluation, *International Arab Journal of e-Technology.*

InternetWorldStat. (2017). Retrieved from: http://www.Internetworldstats.com/stats.htm

Islam, A., & Tsuji, K. (2011). Evaluation of usage of university websites in Bangladesh, DESIDOC, *Journal of Library and Information Technology*, Vol.31, No.6, pp. 469-479.

Lee, C., Bahn, S., Kim, G. W., & Yun, M. H. (2010). Performance Comparison of Manual and Touch Interface using Video-based Behavior Analysis, *Journal of the Ergonomics Society of Korea*, Vol.29, No.4, pp. 655-659.

Lewis, R. (1995).IBM computer usability satisfaction questionnaires: Psychometric evaluation and instructions for use, *International Journal of Human–Computer Interaction*, Vol.7, No.1, pp. 57-78.

Mentes, A., & Turan, A. (2012a). Assissing the usabililty of university websites an empirical study TOJET, *The Turkish Online Journal of Educational Technology*.

Mentes, A., & Turan, A. (2012b). Assessing the usability of university websites an empirical study On Namik Kemal University, *The Turkish Online Journal of Educational Technology*.

Nielsen, J. (1994). Usability Inspection Methods, *ConferenceCompanion CHI'940 Boston,Massachusetts, USA*.

Nielsen, J. (2000). *Designing web usability.* Indianapolis, IN: New Riders Publishing.

Pang,M.,Suh,W., Hong,J.,Kim,J., & Lee,H. (2010). *A new web site quality assessment model for the Web 2.0 Era. In: Murugesan, S. (Ed.)*, Handbook of Research on Web 2.0, 3.0, and X. 0: Technologies, Business, and Social Applications, IGI Global, Hershey. pp. 387-410.

Papadopoulos, T.; & Xenox M. (2008). Quality Evaluation of Educational Websites Using Heuristic and Laboratory Methods. *In the Proceedings of 2nd Panhellenic Scientific Student Conference on Informatics*.

Petrie, H., &Bevan, N. (2009). *The evaluation of accessibility, usability and user experience*. In: Stepanidis, C. (ed.) The Universal Access Handbook, CRC Press, New York . pp. 10–20.

Proctor, R.; WNajjar, L.; Vu, K. L.; Reeves, L.; Salvendy,G.; Rudorfer, A.; & Zhu, W. (2009). Content Preparation and Management for Web Design: Eliciting, Structuring, Searching, and Displaying Information. *International Journal of Human–Computer Interaction*.

Rahimnia, F., & Hassanzadeh, J. F. (2013).The impact of website content dimension and e-trust on e-marketing effectiveness: The case of Iranian commercial saffron corporations, *Information & Management journal* Vol.50, pp. 240–24.

Sengel, E., & Öncü, S. (2010). Conducting preliminary steps to usability testing: investigating the website of Uludag University, *Procedia Social and Behavioral Science, 2,* (pp. 890–894).

Van Teijlingen, E., & Hundley, V. (2001). The importance of pilot studies, *Social Research Update,* Vol. 35.

Teo, H., & Liu,C. (2003). An empirical study of the effects of interactivity on web user attitude, *International Journal of Human-Computer Studies*, Vol.58, No. 3, pp. 281-306.

Thakor,V., Leach,M., Gillham,D., & Esterman,A. (2011). The quality of information on websites selling St. John's wort, *Complementary therapies in medicine*, Vol.19, No. 3 pp.155—160

Thowfeek, M.; & Abdul Salam, M. (2014.Students' Assessment on the Usability of E-learning Websites, *Social and Behavioral Sciences*,Vol. 141, pp. 916 – 922.

Tractinsky, N., Katz, A. S., & Ikar, D. (2000). What is beautiful is usable, *Interacting with Computers*, Vol.13, No2, pp. 127-145.

Tuch, A., Presslaber, E., Stöcklin, M., Opwis, K., & Bargas-Avila, J. (2012b).The role of visual complexity and prototypically regarding first impression of websites: Working towards understanding aesthetic judgments, *International Journal Human-Computer Studies* Vol.70, pp. 794–811.

Yan, P., & Guo, J. (2010). The research of web usability design, *The 2nd international conference on Computer and Automation Engineering*, Vol.4, No. 1, pp, 480-483.

Zerari, F. (2011). Experience of Algeria in Developing Libraries, White Paper submitted for the Digital Library for the Maghreb Workshop. Online version available through: www.FulbrightAcademy.org.

Case Study: A Learning-Centered Continuous Ph.D. Advance Course Redesign Process

Mahmoud Al Ahmad
Electrical Engineering Department, College of Engineering, UAE University
m.alahmad@uaeu.ac.ae

ABSTRACT
In this case study,the results and recommendation following the redesignprocess ofan advanced engineering course for Doctor of Philosophy (Ph.D.) studentsis presented.Three Ph.D. students from the college of electrical engineering in United Arab Emirates university enrolled in the courseduring one academic semester. The Ph.D. supervisor for the three students was the course instructor.The aim of the study was to examine the possibility of aligningthe university Ph.D. course design guidelines, students diverseresearch and knowledge needs and instructor requirements, experience, and skills in one advancedcourse.Furthermore,proposed herein is a continuouscourse formation and redesignprocess to cope up with the ever-changing nature ofresearch and knowledgeadvancement in this information age.Supporting the student's learning process, knowledge acquisition and assessment was a straightforward process in the newly designed course. The major challenge was inmeetingthe needs of students from relatively different academic backgrounds and having diverse research requirements. Furthermore,the validity of the recommended courseredesign process was established bystudents' marks and grades, success in meeting requirementsand student feedback gathered at the end of the academic semester.The resultssupport the validity of the advocatedcourseredesign process and proved its effectiveness at least for similar context.

Keywords: Ph.D.course redesign, Syllabus creating**,** Assessment tools**,** Class interaction

INTRODUCTION

The number of students enrolled in higher education programs is increasing dramatically.In 2010, the Association of Universities and Colleges of Canada reported that 1.2 million students are enrolled in degree programs on Canadian universities, 755,000 of which are undergraduates and 143,400 are graduate(The Association of Universities and Colleges of Canada, n.d.).In the United Arab Emirates, the Centre for Higher Education Data and Statistics announced a 6% increase in students enrolment between 2010 and 2011(Centre for Higher Education Data and Statistics, 2012). They also reported that 10.4% of the enrolled studentsare pursuing Master degree and 0.3% are Ph.D. students. In 1900, the rate of knowledge doubling was every 100 years. By the end of 1945, knowledge was doubling every 25 years("Knowledge Doubling Every 12 Months, Soon to be Every 12 Hours - Industry Tap," n.d.). Nowadays, knowledge doubles every 13 months and soon it will be doubling every 12 hours. This ever-increasing demand for a postgraduate degree and the fast pace rate by which information is doubling calls for drastic change in curriculum formation and course design process especially at Ph.D. level. Moreover, the internet, information and communication technology, and mobile devices are reforming and transforming research and education workplace radically(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). Designing and implementing advance Ph.D. course has always been a challenging task. The challenge of this task stems from the diver's needs and requirements that must be met at the university, student,and instructional level. This task becomes even more puzzling when you consider the current volatile work and marketplaces with the latest technological advancements and researchbreakthroughs.

In this paper,a framework for continuously redesigning advancePh.D. coursesis presented. The premise of the concept advocated herein is that PhD. is a research-focused degree and with the rapid advancement in the different research fields, keeping the same syllabus and course-design will not be beneficial for students' growth and development in the long run. Whatis called for herein is notcontinuous content update and material refurbishing. Whatis calledhere is anongoing pedagogical coursesredesign and reformation process. A process that will impart knowledge beyond the traditional borders of teaching and learning. The article first briefly describes teacher-centered vs. learning-centeredpedagogyand the implication associated with adopting each one, then outlines the research foundations from which the proposed framework is rooted, and in conclusion, provides a practical illustration of the framework-in-action.

The rest of the paper is organized as follows. Section 2 outlines research effort in the field. In Section 3, method and concept details are illustrated. Results and discussion are presented in Section 4. Section 5 concludes the paper and discusseslimitation and possible future research directions.

LITERATURE REVIEW

There is a growing body of research into learning-centeredpedagogy. As Whetten(Whetten, 2007)stated, "we are in the midst of an unfolding paradigm shift in higher education, from focusing on teaching to focusing on learning". Traditionally, lecturers act as the principal information-distributor and assessor, while the studentspassivelyreceiveinformation, hence the name, teacher-centered educational process (Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006).There are manyimplications of this traditional pedagogy. First, students are considered the only learners, therefore,teachers are not required to learn and improve their knowledge and practice.Second, teacher-centeredpedagogy, reinforce the predominant philosophy of recitation, rather thanknowledgeapplication.Still,ifknowledge application is considered at all,the undertaken believeis that students autonomouslywill find a practical use of the knowledge transferred to them by instructors(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006).Furthermore, knowledge transfer is one-wayand one-direction which explain the rigidity of this traditional pedagogy. Moreover, students are assumed to have comparable learning ability and learning styles, which can be conveyed as"one size fit all". Quite the contraryis "learning-centered" or "student-centered" educational philosophy. At the heart of learning-centered education is that educators and students are both learners, working in a great harmony toadvance students' abilities(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). Table 1 below summarized the main difference between the two pedagogies.

Table 1: Comparison between teacher-centered and learning-centeredpedagogy

Aspect	Teacher-centred	Learning-centered
Knowledge source	teacher	teacher, students, class interaction
knowledge presentation	one size fits all	different learningstyles(Cassidy *, 2004)
Knowledge direction	one direction from teacher to student	Multi-directionalcommunication and knowledge sharing
Knowledge Assessment	Instructor assess the student	Faculty, self, peer, and external assessments (Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006)
Learners	The students	The teacher and the students
Focus	knowledge recitation	Knowledge application

The designingof a learning-centeredcourseis one aspect of the issue,accommodatingfor the exponential knowledgeandtechnological advancement in the design processis another aspect that must be taken into consideration.As stated by the National League for Nursing (NLN), the majority of nursing coursesare neglecting the fluctuating needs of the healthcare environment nowadays(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). The issue is not particular to medical programs, engineering education and coursesup to now;rely onoutdatedpedagogies for technical instruction and problem solving(Mason, Shuman, & Cook, 2013). This issue cannot be solved simply by updating course material or as Bevis and Watson (Sarvimäki, 1992) indicated "switch, swap, and slide content around".Course redesign is a promising solution to this issue.Recently, the concept of course redesign process has found its way to the new educationalphilosophiesand it has gained popularity over the years.Ariovich and Walker (Ariovich & Walker, 2014)discussed a newly adopted math course redesign approach ina large community college in which principles are separated into modules and suppliedovera computer software.Both instructors and students found the redesign processuseful but from a different facet. Instructors viewed the redesign process as an excellent opportunityfortailoring the material to suit students'level, needs,and skills, while students embraced and appreciated the redesign to control the amount and the time by which information is delivered to them(Ariovich & Walker, 2014).Anothercourse redesign case is an educational model called the flipped classroom(McLaughlin et al., 2014). Researchers at the UNC Eshelman School of Pharmacy adopted flipped classroom course redesign for required first-year pharmaceutics course. They uploaded all the coursevideotapedlectures online; the goal was giving students greater opportunity to control the pace of content delivery.Class time was used to involve students in active learning assignment. Student's opinion was recorded before and after the course redesign process. Before the course redesign, results were infavor of the traditional coursestructurespecifically 70% of the students selected the traditional course. After the course redesign process, 84.6% preferred the flipped classroom course redesign.The examples and casestudies that describe the concepts and benefits of course redesign at the undergraduate level in higher education are many(Ariovich & Walker, 2014). Yet, there is scariness of resources for courses redesign at the graduate level and more specifically at Ph.D. level. Moreover,the nature of Ph.D.course and students enrolled in them call for specific design requirements. Requirements that will take into account the recent accelerated knowledge generationand technological advancement.Weare notadvocating a

specific courseredesign process, in this context.Weare proposing a generic framework for consciously redesign Ph.D. level advanced courses to cope up with rapid changes and challenges in today'sworld and to graduatewell-qualifiedprofessionals for ourglobaleconomy.

METHOD

Our proposed method has been influenced by workspresentedindiversebut related disciplines.Precisely, it is fortified by three theoretical perceptions:

1.Winn and Gree (1997) “Universal endorsement” Concept
2.Libarkin (2008). “Concept Inventories” (CIs)
3. Fink (2005) “content-centered approach”

First, and before diving in myrecommendedcontinues redesign process for Ph.D. level advanced courses. Let us first take a closer look at the traditional orwemaysay typical course design process.

Traditional Course-design Process

Kathleen(Graves, 1996) describe course design process as a seven steps framework. Figure 1 better illustrate her proposed framework. The framework is general and allows a constrained room for modification and alteration within each step. The optimal adaptationof this model is for designing schools’curriculum and undergraduate introductory courses. Yet, the main problem with this model is the fact that it follows the well-known waterfall model which makes adapting it for Ph.D. courses in general and advanced one in particular impractical. Water-fall modelsare well-structured but rigid. The central idea of the waterfall model is that one shouldn’ttake the next step before completing and perfecting the current one.

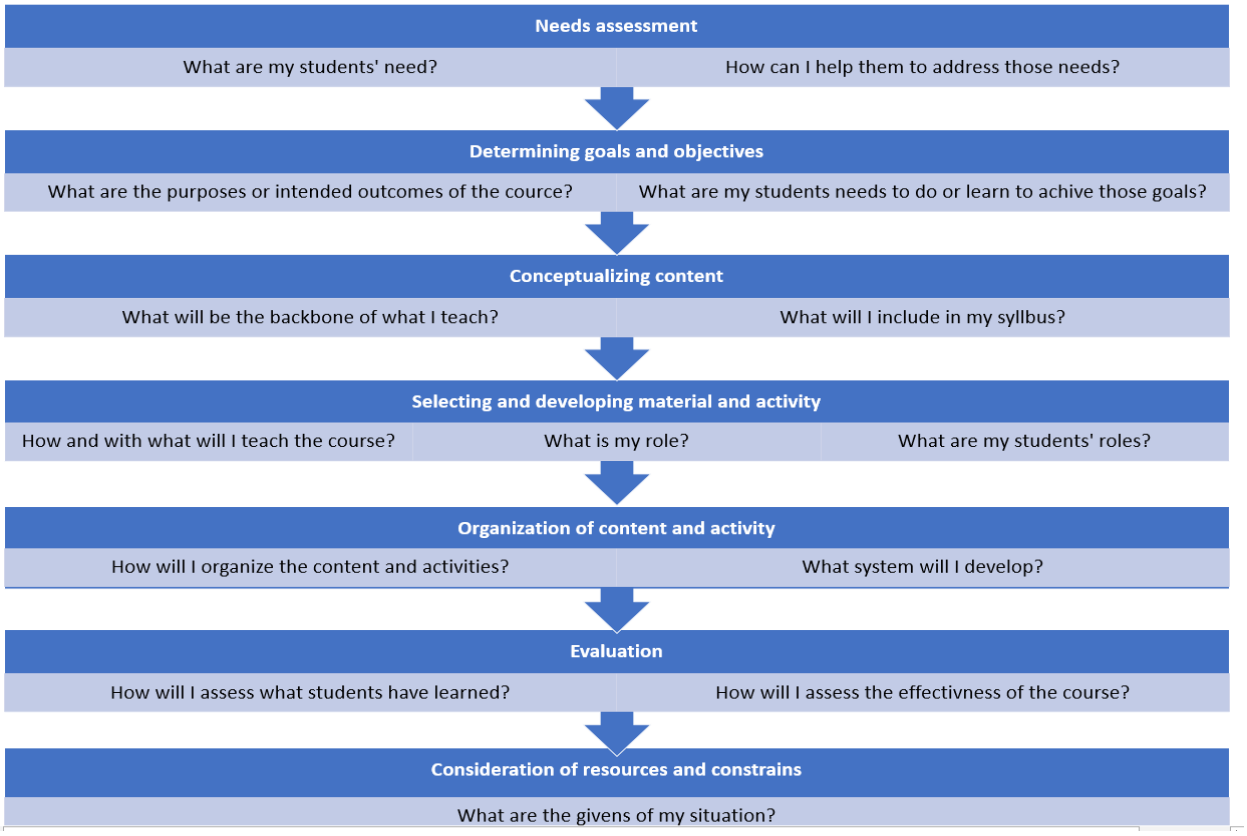


Figure 1. Typical course design framework. This figure illustrates steps followed for course design as proposedby Kathleen (Graves, 1996).

As we move up in the educational ladder, the knowledge we need to acquire becomes more specific and less steady.

Proposed continuous redesign process for advanced Ph.D.courses

At Ph.D.level, information and knowledge become extremely specialized but at the same time more volatile and wavy.Specifically, atthis level you are not studying facts and proven theories and foundations, you are dealing

with experimental concepts and proven hypotheses. Therefore,Ph.D. courses need continuousupdates and improvements to incorporatelatest development and innovations in the congruentresearchdomains.

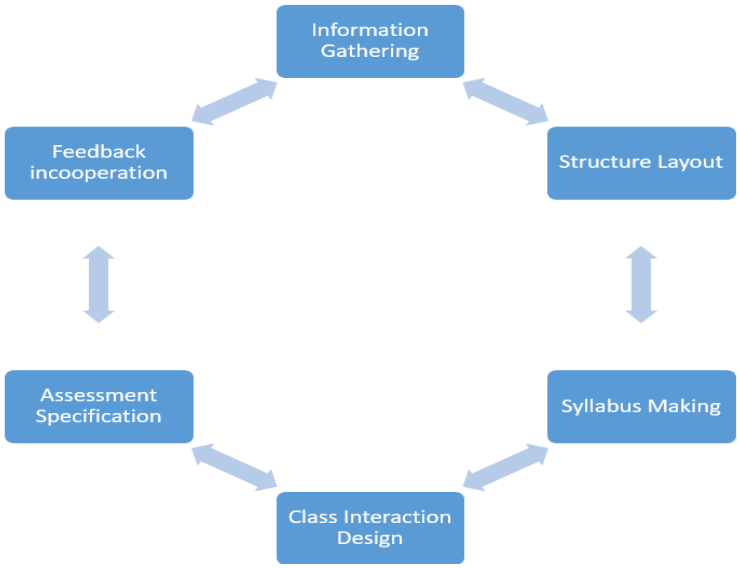


*Figure 2.*The proposedcontinuouscourseredesigningframework. This figure illustrates steps followed for continuousredesigning process intended for advanced Ph.D. courses.

Figure 2 illustrates my recommended six-phases framework for continuously redesigning advanced Ph.D. courses. As can be seen in the figure there is flexibility between the different phases; information can flow in both direction between consecutive phases. This makes a room for modification and improvement that can take place promptly.

This whole process we are proposing needs continuous support from all parties involved in order to ensure successful execution. When endorsing or suggesting new changes, an important aspect that must be considered is the "universal endorsement" (Winn & Gree, 1997). Precisely, all stockholders should be consulted and involved; and consensus among them should be researched before applying the proposed change. Therefore, before reform an advanced Ph.D. course, the course redesigned should confer with involved students, once consensus reached. Formal approvals from administrative personals regarding the amendments in the course, completed at later stages.

InformationGathering.

Students' opinions and thoughts arefundamentalto thecontinuation of the process. *Figure 3* shows the various means of information collection.The instructorcan hold meetings, group discussions or brainstorming sessions to see what students are thinking and what they are expecting from the course.In addition to that, questionnaires(Wijnveen& Driel, 2015) are very effective measuring tools that are globally used to valuable data regarding on certain topic. Hence, using such tool will produce practical and dependableresults for course designer. Before, getting students' view, it is essential to encourage their interaction with senior Ph.D. scholars, lab engineers, post-doctoral fellows and other related individuals that they might need in their support for conducting research.Besides, the instructor needs to ensure that students understand the importanceof this step and get the maximum support from the consulted individuals during the whole process of course redesign.

From the discussions, the instructorcan identifyweakness and strength of each student.Knowing suggestions and students' weakness and strength, the instructor can decide what suggestions to incorporate and endorse; which ones should be ignored and discarded and which should be included in the next courseredesign iteration for the next batch of students. Because it is impossible to authorizeevery suggestion and fulfill all requirements.

Another substantial source of input for this process is "concept inventories" (CIs) (Libarkin, 2008). According to Julie Libarkin, CIs are multiple-choice assessment,specificallyfocused and designed for the learner. These tests aredesigned in a way that can measure the students' existing conceptual understanding. The instructor can use CIs results to determine areas that students' knowledge is lacking. The output of these CIs can be used as a solid reference in selecting the topics for the course-designing. Moreover, suggestions from students' research team are alsoa useful source of information.Apart from the students and instructor involved in the course, suggestions from other teaching faculties, post-doctoral scholars, and lab engineers can be considered as well.

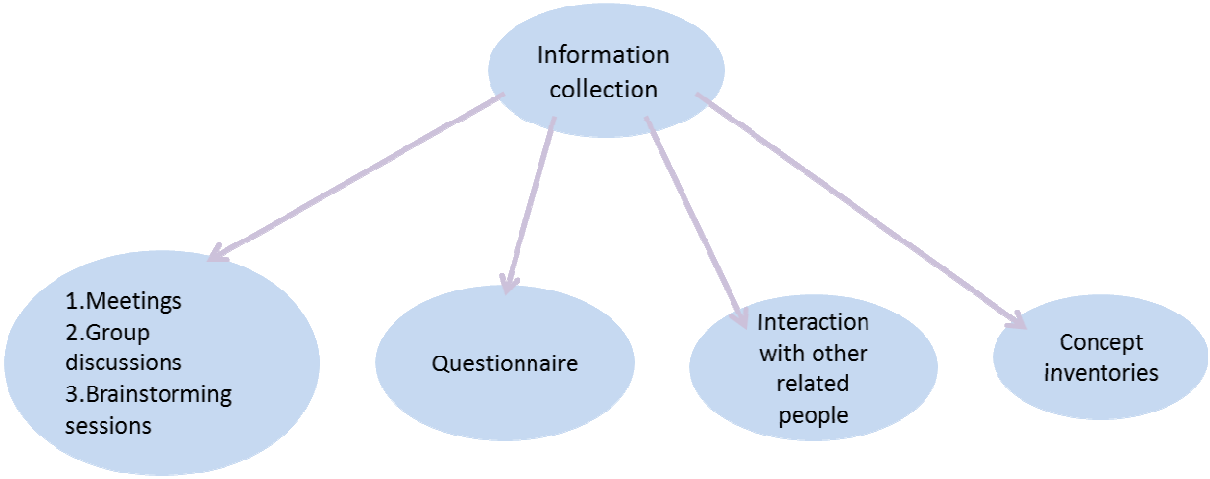


*Figure 3.*Information Gathering techniques. The figure illustrates the Various methods of information collection that can be used in the first step.

Structure Layout

The course structure designing starts with the catalog definition that is provided by the university.The catalogshould contain a list of keywords to be covered in the course but theemphasis at this phase is given to students required keywords and topic rather than the one provided by the university which might be outdated.

Designing the course structure orwemay say backbone can follow diverse ways and approaches. According to L.Dee Fink, the most common approach is the "content-centeredapproach"(Fink, 2005)or sometimes called "Listof Topics" approach. This approach is based on a proposed list of different topics the instructor prepared after studying and searching.The main advantage of this approach is that the requiredsources and information for the covered topics are within the instructor's reach.However, some questions need to be answered before composing a list of topics. Theanswers to these questions will affect the listcontent significantly. The questions are as follow:

- What do Ineed my students to learn? (outcomes)
- How willI deliver the information? (procedure)
- How doI know that the information is well received? (feedback)

Answering these questions will definitely play a major role in preparing the list of topics. Outcomes are the objectives of the course. The procedure is the method and toolsI will use to reach my objectives. The feedback implies two related but different things. From one hand, feedback implies the result of assessing my students' knowledge. On the other hand, students' feedback,and their results can be used as a corrective mechanism to enhance the next course redesign iteration. As shown in *Figure 4*, course structure designing is a circular process. The course objectives must be well mapped with other coursesand the overall educationalobjectives as well.

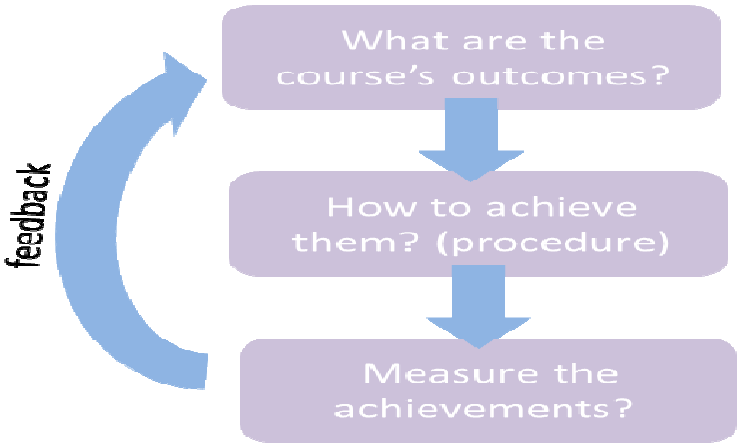


*Figure 4.*Course structure designing process

Syllabus Making

Once the course content is ready, you can move to the next step which is creating a syllabus. Basically,the syllabus is like a contract between the instructors and their students, and a well-written syllabus should provide you with a clear idea about the course, it can tell you clearly everything you need to know about the course.It can be considered as the students' guide through the semester. The syllabus should answer several questions, for instance,

- What is expected from the students and from the instructor?
- How many tests will beconducted?
- What is the weight of assessments and homework?
- Which reference books will be utilized?

The criteria to be met in structuring a syllabus is shown in *Figure 5*

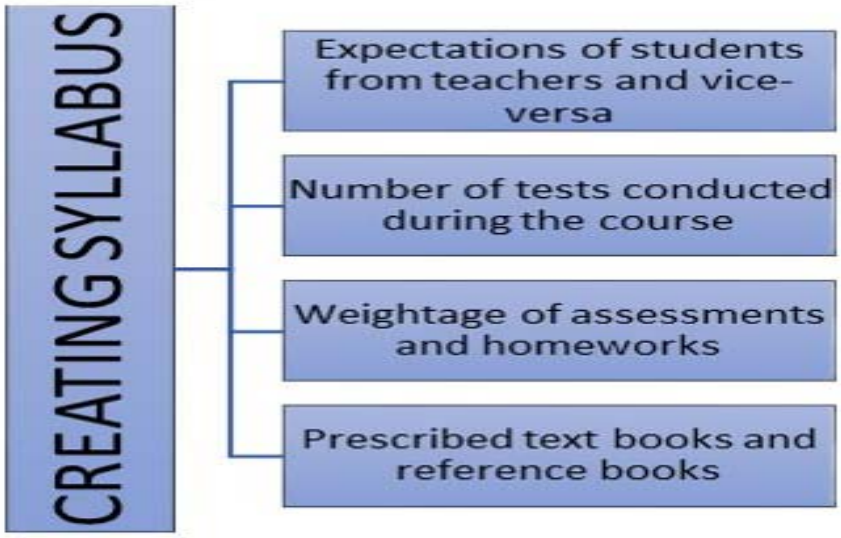


*Figure 5.*Syllabus elements. Criteria to meet while creating a syllabus

When preparing a syllabus, it should includes:clear, well-defined course objectives and they should be in harmony with the main educational program objectives. In the syllabus, the following points are to be mentioned:

I. Instructor Information:The instructor can introduce himself briefly to the students by giving some personal information like his name,contact number, email, office location, specialization, qualification,courses he taught previously, etc.

II. Course Description: A general overview of the course is needed to give the students an overall idea of what the course is all about and what should they expect to learn in the course. This may include course number, course title, credit hours, and so on.

III. Course Objectives: Course objectives should be in agreement with college and educational process objectives. The course objectives need to be well defined in the syllabus so the students will know why they are studying this specific course with these specific topics. If any Prerequisite is required, it should be mentioned in the syllabus.

IV. Course Outcomes and Related Program Outcomes:After completion of the course, students will be proficient in certain topics as mentioned in the syllabus. Knowing the outcomes before starting the course is a key element for impressive results.

V. Students Evaluation/Grading System: It is very important to provide the students with the marking policy and weight of all assessments and homework so that they can distribute their efforts and time wisely. Details about marking tests and assessments, like quiz, mid-terms, final-terms need to be mentioned as well.

VI. Course Topics: topics covered during the course timeshould be declared.

VII. Teaching and Learning Methods:There can be many ways to deliver lectures such as the use of smart-board, power-pointslides,animations, videos… etc. Sometimes the class discussion material will be written on a whiteboard during the class.

VIII. Course Timeline: A precise timeline is absolutely required. Class schedule and topics to be coveredmust be mentioned on a class basis or weekly basis.

IX. Assignments, Homework and Exams Schedule: A detailed schedule of all the planned tasks will help the students to put their study plan ahead of the semester and keep themselves prepared for their tasks ahead of time which can definitely guarantee better performance.

X. Required Textbooks:Mentioning reference books and recommended study material is utmost crucial.

XI. OfficeHours:time apart from the scheduled class hours devoted todiscussingcourse-related problems. The lecturetime is not enough to clear all the doubts.

XII. Course Policies, Rules and Regulations: Well defined clear rules and regulations can make the class environment good for everyone. Both students and instructor will be relaxed following certain rules. These rules may include code of conduct, university laws along with few inside class rules like a number of allowed absence from the class; allowable times when students can come late to the class; whether students should use mobile phones during class; materials required in class like textbooks, calculator, tablet, laptops, etc.

In addition to all of the above, the syllabus must be flexible and updatableto new changes and policies, at the same time, it should have a solid design andwell-defined structure.

Class Interaction Design.

According to the learning theory (Bandura, 1977), the social environment of the classroom can considerably influence the growth of students.Furthermore, the social environment of the classroom is largelyaffected by the way instructors interact with their students. The classroom atmosphere is a combination of elements including student-instructor social interactions, behavioral and academic expectations, as well as the physical environment of the classroom (Freiberg,1999; Mainhard, Brekelmans, Brok,&Wubbels,2011). As *Figure 6* demonstrates thefoundation of a prosperous student-instructor relationship is a common understanding of expectations and responsibilities. Thisunderstanding lays the framework for the relationship.The common understanding is established in the early and frequent meetings with students. Even modest involvement and communication between the students and the instructorin those meetings can yield great results. Sharing critical situations such as deadlines, research outcomes, experiment difficulties, etc. can helps in strengthening the bond between the instructor and the students and make them familiar with each other thoughts and way of thinking.

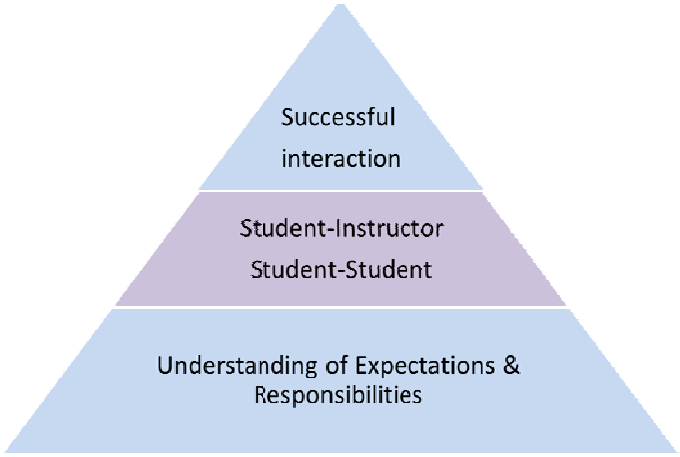


*Figure 6.*Successful interaction process. The foundation of successful class interaction processes.

Moreover, utilizing new and diverseteaching methods will provide the class with the required diversity which willsupport and enhance the student's research work.For instance,blendedlearning (Chen, 2009) or hybrid learning methodthat merges between face-to-face pedagogyand online learning can enrich the class and the students' learning experience. Moving from informationreceiving-mode to information searching-mode is very effective and can be viewed as a concentration boosting tactic for students.In addition to that, involving students in the course by not only reading and writing the receivedinformation but also applying this information is the best way, to measure their understanding and comprehension. Student-student interaction helps in enhancing confidence levels; it facilitates ideas interchanging among students, which is a crucial step of learning. Why? Because individual students havecontrasting perspectiveswhich makes them approach problems from different angles and as a result expand their learning boundaries.

It is crucial to establish strong communication channels between the students and the instructor. This cannot be established unless the connection is built on trust. Fallowfield and Jenkins (1999)stated that if a patient decides to go through a clinical trial he must trust his doctor.Similarly, students have to trust and put their faith in their instructor to guarantee the effectiveness of communication between them.

Assessment Specification

Assessment is known to be the process of evaluatingstudents' performance and measuring the attainment level of the educationalprocess outcomes(Jabbarifar, 2009). Effective measuring tools are required to keep track of the progressmade by students.

Basically, any well-designed assessment process starts by defining and writing down the expected outcomes, this is followed by selecting and establishing needed measuring tools. After that, applying these tools and collecting the output data. Finally, studying and evaluating the collected data to utilize for future improvements. This process can be outlined as follows:

- *Defining educational process outcomes:*writing down all the expected and needed outputs generally about the process and specifically for the students.
- *Selecting measuring tools:*deciding on whether director quantitative assessments like quizzes and exams or indirect qualitative assessments like surveys.
- *Studying and evaluating:*collected data (answers) need to be studied closely to extract and conclude results.
- *Improvingand updating:*All the collected data will now be used for making future modifications in the process and to enhance the outcomes.

Course assessment tools vary widely, there are countless tools that can be used to evaluate students' performance. However, as Figure 7.Illustrates, they can be divided into two main categories as follow:

*Quantitative tools:*measurescourse results

- Quizzes
- Midterm and final exams
- Homeworks
- Assignments
- Projects
- Term reports
- Lab work

*Qualitative tools:*measurestudents and instructor performance

- Self-report measures like surveys
- Self-assessment

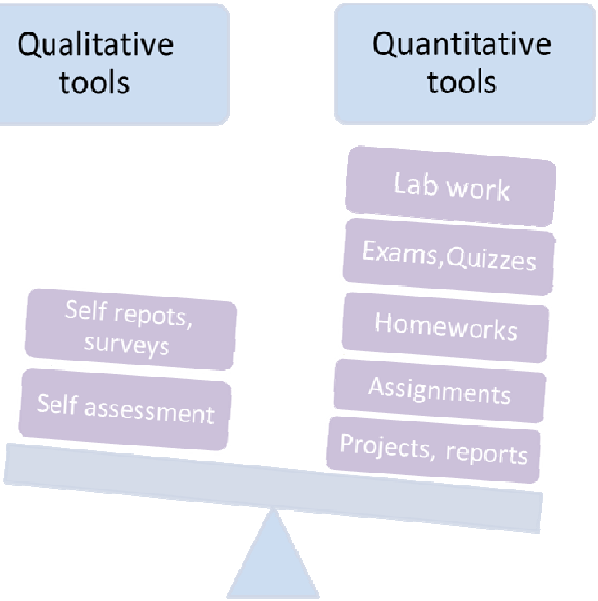


*Figure 7.*Assessment tools. The two type of assessment tools:qualitative and quantitative.

Feedback Incorporation

The assessment results, students'informalcriticism,and instructor observations all can act as an active direct feedback mechanism. They will help highlight weaknesses and suggest a solution to overcome those weaknesses in the next iteration of course redesign process. Another feedback procedure but with an indirect influence is the courseselectronic files (e-files). Saving a soft copy and hard copy from the course files such asthe course's syllabus, student's grades, exams, assignment, assessments and other files serve two purposes. First, it acts as supportive evidence for the educational process.Second, it can be used as a reference for future course redesign

process. Therefore, creating and designing a systematic hierarchical structure to facilitate accessing those files will be of a great help for all those who are involved in the future course redesign process.

RESULTS & DISCUSSION

In this section, the results and recommendation following the implementation of the proposed continuous course redesign process for advanced Ph.D. courses will be discussed in details. The redesigned course title was "Advanced topic for Electrical Engineering". Three Ph.D. students were enrolled in this course and the instructor was their Ph.D. supervisor. In the first step, information was gathered through focus groups and meeting with the Ph.D. students. The meetingswere quite informing; students discussed their research interest, dissertation focus, the subject knowledge they would like to gain, software tools they want to learn and research skills they striving to acquire. Since the 3 students' dissertation focus is mainly pertaining to biomedical engineering, they requested that the course cover the basic knowledge in this field. They also requested covering the latest research direction in this field. The students also requested addressing the basics of electrical characterization of the material, modeling,and simulation. The instructor decided that MATLAB software and its various tool-boxes be used for statistical data analysis, simulation coding and implementation. A good command and knowledge of MATLAB and its tool-boxes are crucial for Ph.D. students in the engineering field.The instructor also decided to coverthe concept of "Equivalent circuit generation"since it will serve the three students in their Ph.D. research project. The instructor and the students agreed that class activity covering the basics and the implementation details of "Equivalent circuit generation"will be carried out instead of the regular lectures on the fundamental concepts. Students should study the fundamental concepts individually and class time is for practical activities.

After communicating with the students and understanding their perceptions, the list of topics to be covered in the course wasmade. The catalog definition for this course was designed according to the students'needs and interest. Nevertheless, the emphasis was on the frontiers in electrical engineering.The redesigned course focused on the synthesis of linear networks. Moreover, classical realization techniques such as Foster-I, Foster-II, Cauer-I, Cauer-II and their synthesiswas covered in depth. The knowledge of those classic techniques is essential for understanding the synthesis of anRL, RC and LC networks. These networks are more relevant to the students' research projects. During the course the students were asked to write a MATLAB code for network synthesis, this gives students a solid foundation in the fundamentals of circuits. They were also asked to use Prony Toolbox in MATLAB to manipulate numerical data and acquire various parameters like mode, amplitude, damping, frequency, energy,squared error, poles, and residues, mean squared error (MSE). Overall, the outcome of this course will be the foundation for the research in developing the equivalent circuit. Furthermore, the course outcomes have been mapped with the corresponding graduate program perspectives. As a result, a systematic assessment procedure can be conducted to provide insight intothe continuous improvement of the course.

The class interaction and atmosphere was very friendly. During the class, students used to share their personal experiences and discuss the problems relatingto the application of the theoretical concepts in their research projects.
Homeworkwas given to aid the studentsin exploring the content related to the class material. Quizzes were conducted to assess the students' attainment level of the fundamental concepts covered. Projects developed as part of the coursehelped to develop the students' practical research skill and critical thinking ability.

Students' Feedback.

After the completion of the course, all Ph.D. students' feedback has been taken which shows their overall experience and their learning in the whole process. This section summarizes students' perceptions ofthe designed course after attending it for the whole semester.

1) First Student:
"Advanced courses basically help students who may have studied at different institutions with a different set of courses, spent years abroad or studied a different study program for their degree, to get a better understanding of the subject and to acquire various research domains. This course includes the basic and advanced level of the topics, which helps in improving fundamental knowledge and its application at a higher level. The Network Synthesis course whichI studied as Advance Topic of Electrical Engineering-1 helped to revisethe fundamental knowledge and made me implement that for my thesis work.I studied fundamentals of Network Theory; Synthesis of One port and Two-Port Networks; Prony's Analysis; Realization of Equivalent Circuits; which all includes: realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms. As per my thesis, The Electrical Characterization of Urine,Iused Prony's Analysis for my experiments, which were based on real-time exponentially decaying function.IlearnedProny Toolbox with MATLAB, its coding and implementation.westudied its various parameters

like Mode, Amplitude, Damping, Frequency,and Energy along with their analysis by Squared Error, Poles, Residues, Mean Squared Error (MSE).wedeveloped the foundation of my research to work on. Teamwork and mentor's help proved to be good starting of my Ph.D. work. Ihave good hopes forthe advanced topics of electrical engineering-2."

2) Second Student:
"The course was designed in such a way that it is merged with our research. The material was well organized and sturdily presented.Iwas extremely eager to learn more due to the connectedness of the course's topics to our theses.I studied how to model an electric circuit from a time domain of a response. The course covered Foster and Cauer forms of synthesis R-L, R-C, and R-L-C circuits. Prony's Analysis is also involved in the course plan. Most importantly,Iwas introduced to a toolbox in the Matlab for using Prony's Analysis. Furthermore,Iwrote a script in Matlab for synthesizing an electrical circuit from an Input Impedance. Engaging with the Matlab software in the coursework enhanced my skills in programming and designing. This thesis work comprises the characterization and modeling of piezoelectric sensors. The material embedded in the course will be beneficial for me when modeling the equivalent circuit of the piezoelectric sensor that I'm working on. The output signal of the piezoelectric harvester is generated from ambient vibration. This signal could be analyzed to model an electrical circuit that emulates harvester operation. The course covers all this deeply and expanded my perception ofthe choices of modeling methods and the software that helps to perform it."

3) Third Student:
"My thesis which is "Electrical Equivalent Circuit of Microfluidic Channel with Biological Suspension" is very much related to the course Network Synthesis. For obtaining the electrical equivalent circuit, a deep understanding of various electrical parameters such as lumped elements (resistors, inductors,and capacitors) and their response for an electrical signal, to say, current or voltage signal is definitely needed. The analysis of the transfer function of a system plays a prominent role in synthesizing the equivalent circuit. These concepts are applied for bringing an analogy between non-electrical systems, such as Microfluidic channels. The subject, Advanced Topic in Electrical Engineering deals with the synthesis of linear networks. The synthesis techniques studied in the subject follow a well-defined pattern, called classical pattern. Classical realization techniques, such as Foster-I, Foster-II, Cauer -I, Cauer-II are dealt in great depths so that synthesis of an RL, RC and LC networks can be carried out systematically and easily. These techniques will result in networks that have a minimal number of lumped elements and hence called canonical networks. The MATLAB code developed for network synthesis give good insight into the fundamentals of Control systems also. In nutshell, network synthesis techniques are made lucid through this subject and it forms the fundamental for understanding "Advanced topics in Electrical Engineering -2" thatI can study in the future semester. Hence, the subject opened the door for getting a better view of the generation of equivalent circuits."

The above-mentioned feedbacks showcase that the successful implementation of the proposed redesign process. All three Ph.D. students got 'A' in the course. They also mentioned how they were doubting the process before conducting the course redesign process and they were doubting the benefit of such practice to a certain extent. One student stated that the outcome was better than what she expected. The results reached signals the importance of involving students in the redesign process especially at the Ph.D. level, where students have enough subject knowledge and ability to assess what they need and what is lacking.

The course material and files soft and hard copy were saved for future reference and for the next redesign iteration. The students' feedback was also recorded and saved for further class iteration.

CONCLUSION

In this paper, a continuous advanced Ph.D. course formation and redesign process wereproposed. The aim of the proposed method issurvivingand striving in the ever-changing nature of research and knowledge advancement in this information age. The method aim is designing and planning advanced Ph.D. course in a way that guarantees remarkable resultswhile supporting students in their thesis research. Advising several Ph.D. students at the same time is an excitingbuthard task. Instructors are under a constant pressure to deliver the best to theirstudents. The proposition of this methodisthat at Ph.D. level students needs advance coursesto serve their research work while following the university guidelines. Involving the students in the design process and understanding their needs and requirements is the only way to accomplish this.

The main limitation of the study is the fact that it was conducted for one academic semester on a small number of students. The problem is that the number of students enrolled in Ph.D. studies is relatively smaller than the number master and bachelor students. This is a double-edged sword. One can argue that the smaller number of students ensure the successful execution of the proposed course redesign process, since having few numbers of

students mean fewer requirements to fulfill and reaching consciences among them will be easier. On the other hand, this will help us establish the validity of the proposed process and prove its adaptability for bigger classes as well especially that the number of enrolled Ph.D. students is growing drastically recently.

Another limitation of the case study is that the course instructor was the Ph.D. supervisor of the three students. Thus, one might argue that the proposed method will only work in a similar scenario and its success was mainly due to this reason. This can be a valid argument and the current case study cannot serve in defending the generality of the proposed course redesign method. Therefore, in future, we are planning to conduct another case study where the course instructor is not the Ph.D. supervisor for the students enrolled in the course.

Besides, adopting such procedure need flexibility in rules and policies from the university side. It is not enough that the course designer is open to change and suggestion. Students are flexible and open-minded. To really reap the benefits of such process all involved parties should have the flexibility in mind and procedures to embrace such radical change.

REFERENCES

Anand A. et al. (2014) Designing Engineering Curricula Based on Phenomenographic Results.doi:10.1109/T4E.2014.18

Ariovich, L., & Walker, S. A. (2014). Assessing course redesign: The case of developmental math. Research & Practice in Assessment, 9, 45–57.

Bandura A.(1977) Social learning theory. Englewood Cliffs, NJ: Prentice-Hall

Candela, Lori; Dalley, Karla; Benzel-Lindley, J. (2006). A case for learning-centered curricula. Journal of Nursing Education, 45(2).

Cassidy *, S. (2004). Learning Styles: An overview of theories, models, and measures. Educational Psychology, 24(4), 419–444. https://doi.org/10.1080/0144341042000228834

Center for Higher Education Data and Statistics. (2012). Indicators of the UAE Higher Education Sector. Retrieved from http://www.cheds.ae/Reports.aspx

Chang J.K., et al. (2016) Curriculum Design – A Data Driven Approach, 5thIIAI International Congress on Advanced Applied Informatics.doi: 10.1109/IIAI-AAI2016.163.

Chen W., (2009) A Study of Using Blended Learning in Teaching and Learning Modern Educational Technology. doi: 10.1007/978-3-642-03697-2_28

Freiberg HJ. School (1999) climate: Measuring, improving and sustaining healthy learning environments.Philadelphia, PA: Taylor & Francis.

Graves, K. (1996). Teachers as Course Developers. Cambridge University Press.

Hoe D., (2013) Development of a Concept Inventory for Microelectronics Courses.doi: 10.1109/FIE.2013.6684993

Jabbarifar, T. (2009). The importance of classroom assessment and evaluation in educational system. In Proceedings of the 2nd International Conference of Teaching and Learning. Retrieved from https://my.laureate.net/Faculty/docs/Faculty Documents/INTI Conferences/Parallel Sessions 4/4C/4C-03-P142 (Iran).pdf

Ji L., Yu L., (2015) Learning through Participation: Partnership in Undergraduate Curriculum Design and Assessment in Chinese Higher Education. doi: 10.1109/ICCSE.2015.7250275.

Knowledge Doubling Every 12 Months, Soon to be Every 12 Hours - Industry Tap. (n.d.). Retrieved March 21, 2018, from http://www.industrytap.com/knowledge-doubling-every-12-months-soon-to-be-every-12-hours/3950

L. Dee Fink,(2005) Integrated Course Desgin, Kansas, Manhattan, The Idea Center.

L. Fallowfield, V. Jenkins, (1999) Effective Communication Skills are the Key to Good Cancer Care.European Journal of Cancer, Vol 35, No. 11, PP. 1592-1597.

Libarkin J.,(2008) Concept Inventories in Higher Education Science, manuscript prepared for the National Research Council.

Longstreet C., Cooper K., (2014), Curriculum Design Factors for Constructing Serious Educational Game: a Learning Objective Centric Approach. doi: 10.1109/CGames.2014.6934156.

Mainhard MT, Brekelmans M, Brok P, Wubbels T. (2011) The development of the classroom social climate during the first months of the school year. Contemporary Educational Psychology. ;36:190–200.

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the Effectiveness of an Inverted Classroom to a Traditional Classroom in an Upper-Division Engineering Course. IEEE Transactions on Education, 56(4), 430–435. https://doi.org/10.1109/TE.2013.2249066

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., … Mumper, R. J. (2014). The Flipped Classroom: A Course Redesign to Foster Learning and Engagement in a Health Professions School. Academic Medicine, 89(2), 236–243.

https://doi.org/10.1097/ACM.0000000000000086
Pankin J., Roberts J. Savio M. (2012) Blended Learning at MIT.
Ruayruay E. et al. (2016) Three Essential of Curriculum Design for Developing Competent Food Engineering Graduate Students (for Problem-solving in Food Industry) via Work-integrated Learning Mechanism. doi: 10.1109/TALE.2016.7851835.
Sarvimäki, A. (1992). Toward a caring curriculum: A new pedagogy for nursing. Scandinavian Journal of Caring Sciences, 6(1), 22–22. https://doi.org/10.1111/j.1471-6712.1992.tb00118.x
Sehgal U., Gokhale S., (2015) Designing Curriculum to Optimize the Paradigms in Engineering Education in India. doi: 10.1109/MITE.2015.7375348.
Starodubtseva D., et al. (2015), Curriculum design and development of master's educational programs in IT area (through the example of international development of master programs "Applied computing" and "Product life cycle technological process efficiency' of TEMPUS SUCCESS and ACES projects. doi: 10.1109/ICL.2015.7318060.
The Association of Universities and Colleges of Canada. (n.d.). Trends in Higher Education. Retrieved from https://www.univcan.ca/wp-content/uploads/2015/11/trends-vol1-enrolment-june-2011.pdf
Tjong Y., Warnars H. L. H. S., Adi S. (2016), Designing Knowledge Management Model For Curriculum Development Process: A Case Study in Bina Nusantara University. doi: 10.1109/ICIMTech.2016.7930295.
Visser-Wijnveen G.,Rijst R.,Driel J.,(2015) A Questionnaire to capture students' perceptions of research integration in their courses. doi: 10.1007/s10734-015-9918-2.
Weiwei CH, et al. (2015), Curriculum Design for Computational thinking Training Based on Concept Map. Doi: 10.1109/ITME.2015.58.
Whetten, D. A. (2007). Principles of Effective Course Design: What I Wish I Had Known About Learning-Centered Teaching 30 Years Ago. Journal of Management Education, 31(3), 339–357. https://doi.org/10.1177/1052562906298445
Winn R., Green R.,(1998) Applying Total Quality Management to the educational process.Int. Engng Ed. Vol. 14, No.1, p. 24-29.
Zea C., Rodriguez A., Bueno N., (2014), An Innovation Model in Curriculum Design for Teaching Engineering at Universidad EAFIT.doi: 10.1109/FIE.2014.7044386.

Defining e-Portofolio Factor for Competency Certification using Fuzzy Delphi Method

Dana Indra SENSUSE
Faculty of Computer Science, Universitas Indonesia.
dana@cs.ui.ac.id

Betty PURWANDARI
Faculty of Computer Science, Universitas Indonesia.
bettyp@cs.ui.ac.id

Puji RAHAYU
Faculty of Computer Science, Universitas Indonesia.
puji.rahayu41@ui.ac.id

ABSTRACT
This study is introducing the e-Portfolio function as a storage, workspace and showcase to support Competency Certification in Indonesia. Thus, the mix-method approach was implemented on determining important elements of e-Portfolio as a storage, workspace and showcase for competency assesment context. The research implemented thematic analysis and Fuzzy Delphi Method to obtain the result. Therefore, 20 experts in certification competency domain were participated in the process. As resulted, this study highlighted the basic role of e-Portfolio consists; workspace, storage and showcase.

INTRODUCTION
Indonesia as the country with the largest population in the ASEAN region, should be ready to face the free flow of labor both at regional (Economic ASEAN Community) and global (China-Asian Free Trade Agreement) levels (The ASEAN Secretariat, 2015), but the condition of Indonesian workers still showed relatively low competitiveness compared to the ASEAN member countries (Biro Pusat Statistik, 2015; The ASEAN Secretariat, 2015). To raise the competitiveness, Indonesia's government try to improve quality of human resources in Indonesia (Republik Indonesia, 2003, 2012, 2007). The Government set up some policies in objective to improving the quality of Indonesian human resources in national development, set up the system, the structure, organization and guidelines for integrating education and job training and work experience in order job competence recognition awards. ("PerMenakertrans no. 14 tahun 2015," n.d.; Republik Indonesia, 2006, 2014)
In line with the process of increasing the competence of labor in the process of obtaining certification of professional competence in Indonesia, previously performed Portfolio assessment process conducted by the Board of Certification of Profession Competency (Republik Indonesia, 2004) assisted by the Certification Body (Republik Indonesia, 2004), an assessment methods against someone based on those documents. The document is evidence that the professional has had a competency. To ensure that the portfolio held information is correct, then the assessor may verify the portfolio related to documents filed with the competency test participants using four criteria rules of evidence (Valid, First, Latest, Sufficient) ("PerMenakertrans no. 14 tahun 2015," n.d.) (Republik Indonesia, 2004). However, the assessment portfolio process has a weakness, the portfolio is in paper form, the time for inspection the portfolio required a long time, there is no standard guidence to determine which one evidence must be submitted, it cannot be used to test a unit in an integrated, cannot render the evidence is not written, the reference list or index of the portfolio proposed to be set in advance, the evidence indicated must be current and valid and the election and an explanation of the evidence submitted by the participants competency tests may have an impact the expected results.

Based on the issues, e-portfolios can be the one way to solve it, where e-Portfolio as a professional profile in digital form can capture and compare the information on the level of skills and professional competence, potential for development, and career prospects (JISC, 2009; Smith, 1996; Woodbury, Addams, and Neal 2009). Besides e-Portfolio also have broad implications for public tool used by the government where they can be used to describe the services provided by the government, which is a service that is more transparent and more accountable pursuant to Presidential Instruction No. 3 of 2003, O'Brien et al, (O'Brien, Osbaldiston, & Kendall, 2014) stated e-Portfolio is a form of e-government implementation in the development of an entrepreneurial society independently.

Therefore, the functions of E-portfolio is required for develop e-portfolio model (Albert, 2006; DiMarco, 2006; Young & Morriss, 2007). This study was conducted to applying Fuzzy Delphi method to gain expert consensus for e-portfolio functions especially for competence certification in Indonesia.

THE LITERATURE STUDY

1. Certification of Competence

The key elements of professionalism are defined by Walrad in three elements, i.e. public obligation, personal integrity, responsibility, accountability and competence (Walrad, 2017). One of the elements, competence, is used as the well-accepted standards to find the professions with the good understanding of their activities (Walrad, 2017). To find those competence professions, an organization use the certification of competence through an assessment test. Certification helps to evaluate an individual's skills, knowledge and abilities to know the current level of expertise (Davies, Randall, & West, 2015). Competence is not only assessed by a certification test but also it can be evaluated by the related documents, called portfolio.

2. E-Portfolio Function

One of e-Government implementation is e-portfolio (O'Brien et al., 2014). E-Portfolio is a workforce assessment data collection to present the individual's competence in the specific field using electronic or technology devices (Rahayu, Indra, Purwandari, Budi, & Zulkarnaim, 2016). It can be used as a solution to process the certification of individual's competence by capturing and comparing the information on e-portfolio system (Jose, 2017). It supports the government services more accountable and transparent. According to David Jose, there are five key features to reach of e-Portfolio objectives, including electronic storage, personalization, showcasing, reflection and feedback, and assessment (I Balaban, Divjak, & Mu, 2011).

Table 1: The Mapping Definition and Type of e-Portfolio, source: (Rahayu et al., 2016)

NO	AUTHOR / YEAR	DEFINITION	TYPE
1	NLII (Morrison, 2003)	A diverse collection of evidence is authentic and represents what the individual or organization to learn from time to time including the self-evaluation process and is designed to be represented by a particular purpose	Collection (storage), Showcase
2	Siemens, 2004	Products made of students shaped collection of digital artifacts to demonstrate experience, achievement and learning, where there is a process of planning, synthesis, share, discuss, evaluation, and responding to feedback.	Collection (storage), Self-development (workspace)
3	Abrami & Barrett, 2005	Set the goal of student work that tells the story of the business, student progress and / or achievements in one or more areas	Showcase, recognation
4	P Butler, 2006	A collection of evidence gathered together to show one's learning journey from time to time and to demonstrate their ability	Collection (storage)
5	European Institute For E-Learning (Haig et al., 2007)	Digital collection of personal information that describes and illustrates one's learning, career, experience and achievements	Collection (storage), showcase
6	JISC (Cambridge, 2008; Gray, 2008)	A diverse collection of evidence container, digital learning materials designed to manage learning and achievement to show the development of the self with different goals	Collection (storage)
7	NET Plan (Peters & Araya, 2010)	Products made of students shaped collection of digital artifacts to demonstrate experience, achievement and learning, where there is a process of planning, synthesis, share, discuss, evaluation, and responding to feedback.	Recognation (workspace), Showcase
8	Barrett, 2011	A virtual platform (showcase) in the form of narrative can be seen (public / private) for a variety of needs (varying permission) that supports (workspace) process or Archive Collection Digital Repository Artifact Personal Information, journals self-evaluation	Recognation (workspace), Self-Development (workspace)
9	Class, 2012	Collection of electronic evidence that shows learning from time to time with the room dynamic learning where they can capture their learning, their ideas, access to their collection of their work, reflect on their learning, share their learning, set goals, seek feedback and showcase learning and their achievements.	Recognation (workspace), Self-Development (workspace)
10	Igor Balaban, Mu,	A digital personal records that support formal learning, informal	Recognation

	& Divjak, 2013b	and non-formal and contains evidence of individual achievement in the form of artifacts and self-evaluation that can be given to whom the owner has chosen to give permission	(workspace), Showcase
11	Kim,P.,Ng,C.,&Lim ,G., 2010	an ePortfolio system design based on Private-Public (PrPl) data index system, which integrates cloud computing applications and storages with Semantic Web architecture, making semantic web-based visualisation and advanced intelligent search possible.	Recognation (workspace), Showcase

3. Fuzzy Delphi Method

The disadvantages of traditional Delphi Method (DM), including the possibility of losing the key information and time-consuming in exploration, is underlying the improvement of new method called Fuzzy Delphi Method (Saffie, Amirah, Shukor, Rasmani, & Sembilan, 2016). Combined by classic Delphi Method and Fuzzy Set Theory, FDM covers the ambiguity and repeatation technique on the old method in achieving the acceptable standard (Chen, Chen, Wang, & Tai, 2016). It is used to collect and classify the qualified expert knowledge in natural language using questionnaires with the feedback and review from them (Sayari, Yaghoobi, & Ghanaatpishe, 2014). FDM ensure the validity and verify the elements through expert opinion and consensus (Mohamad, Embi, & Nordin, 2015). Therefore, FDM is widely utilized in many fields, such as humanities, business and management, physical science and engineering including information system (Saffie, Shukor, & Rasmani, 2016).

The difference of FDM and old DM is the use of probability theory instead of mathematical concepts to address the fuzziness of natural language in the decision making (Saffie, Shukor, et al., 2016). It means that DM uses absolute numbers in addressing the expert judgement.

FDM is initialized by Murray et al. to resolve the ambiguity in DM (Murray, Pipino, & Gigch, 1985). Then it is improved by many studies, including Ishikawa et al. who developed FDM algorithm using the implementation of the Max-Min Fuzzy Delphi Method and the new DM through Fuzzy Integration (Ishikawa et al., 1993). The improvement version proposes the weighted intuitionistic FDM to achieve the better conclusions (Garai et al., 2013).

METHODOLOGY

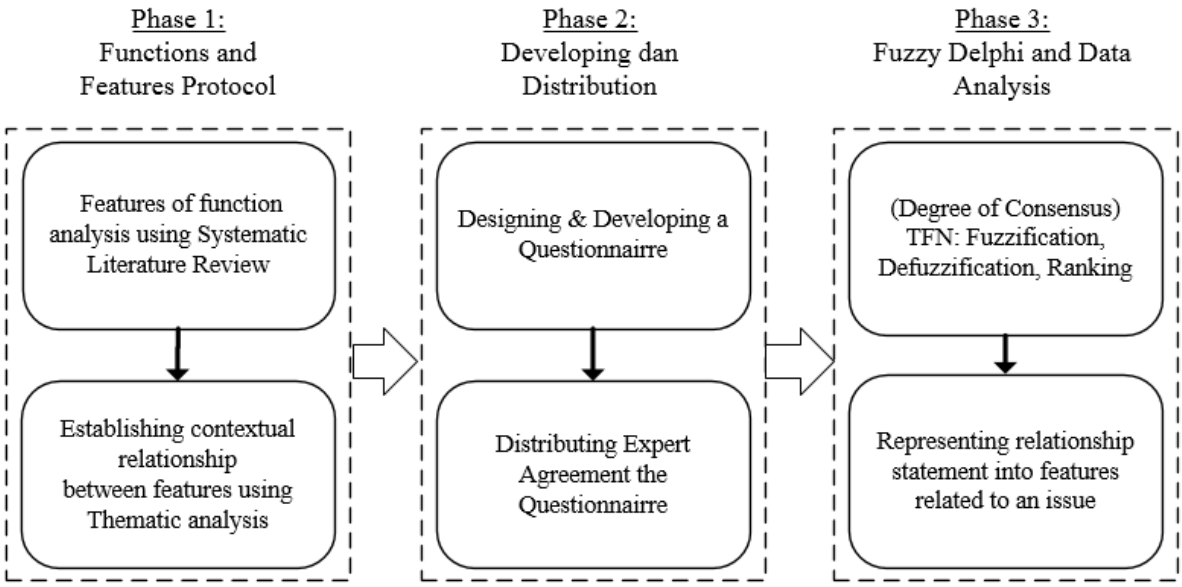


Figure 1

1. Phase 1:

The first phase of data collection involves semi-structured interviews with e-Portfolio experts from BNSP, LSP and government agencies. The thematic analysis is implemented to validate the functionality in e-portfolio obtained from the literature review. In conducting the analysis, the researcher adopted the thematic analysis

methods by Barun & Clarke (Braun & Clarke, 2006) which have proposed six steps in. The stages are shown in Figure 2.

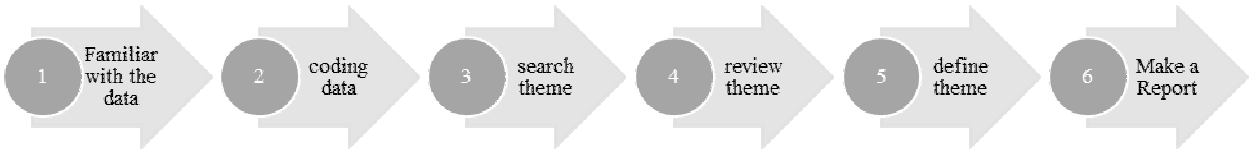


Figure 2. Thematic Analysis Stages

The interview process is conducted in the form of open questions to get expert judgement. The statements in the form of interview transcripts are processed using NVivo11 tools, to obtain themes and sub themes, so that interconnection and inter-theme relationships are obtained. The result of the thematic analysis from the 7 experts is shown in Figure 2

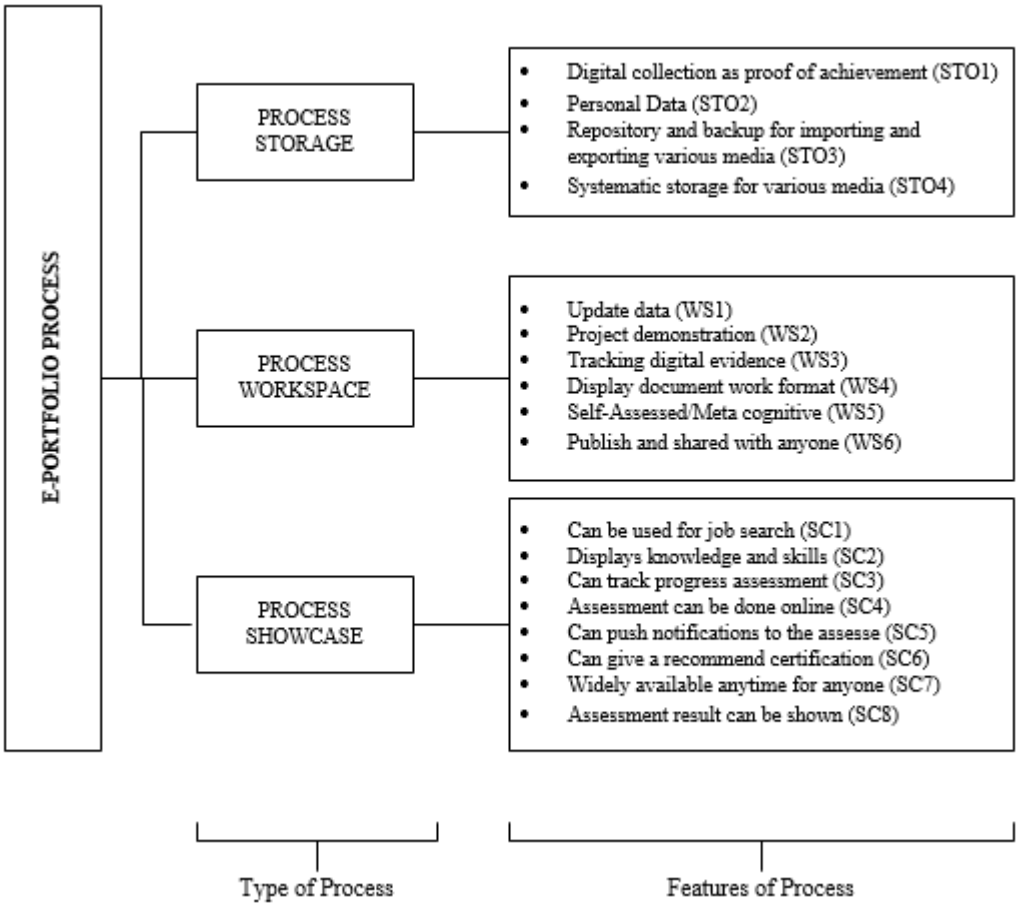


Figure 3. Theme and Sub-theme

2. Phase 2:

The FDM questionnaire was designed and administered to 25 experts. The experts came from 3 sectors: academia, government, and industry (Community of Practice). Furthermore, they had at least 5 years of working experience related to competency certification, ICT, Competen. A total of 25 copies were distributed to experts, but 20 valid copies were returned.

Table 2: Fuzzy Delphi Technique

Phase	**Total Expert**	**Instrument Design**
First step (Establishment of survey instrument)	6 Experts	Structured Interviewed (open questions)
Second step (Obtain consensus)	20 Experts	Survey Instruments

3. Phase 3: Fuzzy Delphi and Step-By-Step Data Analysis

Step 1: Determining the experts. Twenty Ex8 or Table 3? perts are invited to answer a list of questions, to decide the importance of the evaluation criteria and the ratings of alternatives with respect to various criteria using variables (Table 1).

Table 8: Variable for the importance weight of criteria

No	Variables	Scale Fuzzy		
1	Strongly agree	0.6	0.8	1
2	Disagree	0.4	0.6	0.8
3	Not Sure	0.2	0.4	0.6
4	Agree	0	0.2	0.4
5	Strongly Agree	0	0	0.2

Step 2: Experts determine the importance weight of criteria.

The researchers chose five variables for importance weight of criteria ranging from 'Strongly Agree', 'Agree', 'Not sure', 'Disgree', 'Strongly Disagree'.

Step 3: Get an average rating.

The average value is determined accordingly the formula specified. Here is the formula used to get the average value:

Step 4: Specifies the value of 'd' (Threshold value).

If the value d is d <0.2, then all experts have reached a consensus agreement

If the value of d is d> 0.2, the researchers have to repeat the procedure.

Step 5: Gain 75% consensus.

At this point, researchers have come to a decision or agreement on a group of experts is known as a consensus group. Past decided that a 75% consensus would occur should show agreement among expert. If the consensus is less than 75%, researchers should repeat the procedure to ensure there is at least 75% consensus among the experts.

Step 6: Conduct a Fuzzy evaluation.

Evaluation is one of the most reliable methods of ranking. In its implementation This process is quite difficult because it involves complex numbering and alternative methods using mathematical formulas to rank.

Step 7: Defuzzified (process to determine the weights).

Three formulas can be used in the defuzzification process to rank / print items:

1. Amax = 1/3 * (a1 + am + a2)
2. Amax = 1/4 * (a1 + a2 + 2am)
3. Amax = 1/6 * (4am + a1 + a2)

For this study, researchers chose formula 1: Amax = 1/3 * (a1 + am + a2)

FINDINGS

In the development of e-portfolio model, there is a questionnaire that constructed using ANT methodology and Institutional Theory. These questionnaires are composed by a few components which are Internal ANT, Internal and External. Then, each component contains significant factors that construct the e-portfolio model, which uses ANT methodology and Institutional Theory. Factors will be explained individually in the following section.

This section is constructed using the Institutional Theory methodology. This internal section has 3 factors, which are storage, workspace, and showcase. Analysis of each factor will be explained in the subsequent sub-sections.

1) Storage

Storage Process have 4 features,description of each feature and rank in the Storage Process as shown in Table 7.

According to the table 7, “Digital collection as proof of achievement” is the highest rank in the storage factor, while “Systematic storage for various media” is in the lowest ranking. Next, the storage factor has the threshold values (d), expert consensus percentage and defuzzification from each item show in Table 8.

Table 8: Features Description and Rank of Storage Process

Description	Rank
Digital collection as proof of achievement	1
Personal data	2
Repository and backup for importing and exporting various media	2
Systematic storage for various media	4

In the storage process, all features have the threshold value (d) ≤ 0.2 and the percentage of the expert consensus is 80%. So, in general, Storage Process has achieved the consensus with the percentage more than 75%. Defuzzification value from storage factor also shows that each item has exceeded the α-cut value which is 0.5.

Table 8: Threshold Values (d), Expert Consensus Percentage and Defuzzification of Storage Factor

Features	STO1	STO2	STO3	STO4
Features d≤0.2	0.15	0.13	0.10	0.13
Construct d≤0.2	0.13			
% Features d≤0.2	100	70	80	70
Expert Group Consensus Percentage %d≤0.2 (80%)				
Defuzzification	0.72	0.74	0.76	0.74

2) Workspace

Table 9 contains the items description and rank from the workspace function that contains 6 features.

Table 9: Items Description and Rank of Workspace Factor

Description	Rank
Update data	1
Project demonstration	2
Digital document display	3
Display digital work format	4
Self-Assessed/Meta cognitive	5
Publish and shared with anyone	6

The highest rank in the workspace function is "Update data" and "published and shared with anyone" is at sitting at the lowest rank. While the threshold values (d), expert consensus percentage and defuzzification from each of the item in workspace factor can be seen in Table 10.

Table 10: Threshold Values (d), Expert Consensus Percentage and Defuzzification of Workspace Factor

Features	WS1	WS2	WS3	WS4	WS5	WS6
Features d≤0.2	0.183	0.171	0.153	0.122	0.147	0.147
Construct d≤0.2	0.13					
% Features d≤0.2	90	50	100	60	60	100
Expert Group Consensus Percentage %d≤0.2 (77%)						
Defuzzification	0.68	0.66	0.7	0.6	0.64	0.72

The threshold values (d) in the workspace factor has the value of ≤ 0.2 for all of the items. While the expert consensus got the value of 77%. So, the workspace factor has reached the expert's consensus because it exceeds 75%. Other than that, defuzzification values from workspace factor also shows that each item has exceeds the α-cut value which is 0.5.

3) Showcase

In the showcase factor, there are 8 items. Description of each items and rank can be seen at Table 11.

Table 11: Features Description and Rank of Showcase Process

Description	Rank
Can be used for job search	1
Displays knowledge and skills	2
Can track progress assessment	2
Assessment can be done online	4
Can push notifications to the assesse	4
Can give a recommend certification	6
Widely available anytime for anyone	7
Assessment result can be shown	7

In the showcase process, the feature "Can be used for job search" had the highest expert consensus and "assessment result can be shown" had the lowest score. Meanwhile, the threshold values (d), expert consensus percentage and defuzzification from each item from the showcase factor can be seen in Table 12.

Table 12: Threshold Values (d), Expert Consensus Percentage and Defuzzification of Showcase Factor

Features	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
Features d≤0.2	0.25	0.10	0.00	0.13	0.25	0.10	0.13	0.18
Construct d≤0.2	0.14							
% Features d≤0.2	90	80	100	70	90	80	70	90
Expert Group Consensus Percentage %d≤0.2 (84%)								
Defuzzification	0.69	0.76	0.8	0.74	0.69	0.76	0.74	0.7

In the showcase process, there are 6 out of 8 items that have the threshold values (d) ≤ 0.2, which is 2, 3, 4 and 6-8. Item 1 and 5 have the threshold value (d) that exceeds 0.2 ((d) =0.2). Expert consensus result from the showcase process is 84%, hence making the showcase process passed the expert consensus test. Then, the defuzzification value from the showcase process also shows that each item reached above α-cut value which is 0.5.

DISCUSSION
CONCLUSIONS

The findings indicate that there are 3 functions and 18 features of e-portfolio that are needed by competency assessment in certification competency in Indonesia based on the consensus of expert jugdement. Motivation is the basic element and the first choice of the experts. This study has enabled the identification features of the assessment competency. This information will help competency body and assessor

prepare activities that are suitable for assese in effectively and efficiently with an eye towards meeting the needs of industry. This study also provides a clear picture for institutions of competency body that are required to prepare develop e-portfolio model for competency certification .

Information and feedback from industry can help in the preparation of a model e-portfolio for certification competency. Feedback from the ministry (government agencies) on the measures and the functions that need improvement will also help to assese who are ready to take their place in industry, thus reducing the unemployment rate among manpower in Indonesia.

REFERENCES

Abrami, P., & Barrett, H. (2005). Directions for research and development on electronic portfolios. *Canadian Journal of Learning and Technology/La Revue Canadienne de L'apprentissage et de La Technologie*, *31*(3).

Balaban, I., Divjak, B., & Mu, E. (2011). Meta-Model of EPortfolio Usage in Different Environments, *6*(3), 35–41.

Balaban, I., Mu, E., & Divjak, B. (2013). Development of an electronic Portfolio system success model: An information systems approach. *Computers & Education*, *60*(1), 396–411. https://doi.org/10.1016/j.compedu.2012.06.013

Barrett, H. C. (2011). Balancing the two faces of e-portfolios. *Education for a Digital World 2.0: Innovations in Education, Vol 2*, *3*(1), 289–307. Retrieved from http://openschool.bc.ca/info/edu/7540006133_2.pdf

Biro Pusat Statistik. (2015). Keadaan Angkatan Kerja Indonesia Agustus 2015. *Jakarta: BPS*.
Braun, V., & Clarke, V. (2006). Full-Text. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
Butler, P. (2006). A Review of the Literature on Portfolios and Electronic Portfolios. eCDF ePortfolio Project, Massey University College of Education, Palmerston North, New Zealand. *Palmerston North, New Zealand*.
Cambridge, D. (2008). Audience, integrity, and the living document: eFolio Minnesota and lifelong and lifewide learning with ePortfolios. *Computers & Education*, *51*(3), 1227–1246. https://doi.org/10.1016/j.compedu.2007.11.010
Chen, J., Chen, F., Wang, J., & Tai, D. W. (2016). Applying Fuzzy Delphi Method to Construct Digital Literacy Competences for Senior High School Students, 277–280. https://doi.org/10.1109/IIAI-AAI.2016.68
Class, C. B. (2012). Bridging cultural differences in teaching computer ethics: an example using personal portfolios. *ACM SIGCAS Computers and Society*, *42*(2), 5–14. Retrieved from http://dl.acm.org/citation.cfm?id=2422510
Davies, R., Randall, D., & West, R. E. (2015). Using Open Badges to Certify Practicing Evaluators. *American Journal of Evaluation*, *36*(2), 151–163. https://doi.org/10.1177/1098214014565505
Garai, A., Mahavidyalaya, S., Kumar, T., Science, P., Universit, T., T-set, I. F., & Garai, A. (2013). WEIGHTED INTUITIONISTIC FUZZY DELPHI. *Journal of Global Research In Computer Science*, *4*(7), 38–42.
Gray, L. (2008). Effective Practice with e-Portfolios. Supporting 21st century learning. *JISC Innovation Group*.
Haig, A., Beggs, K., Cadzow, A., Colthart, I., Hesketh, A., Peacock, H., & Tochel, C. (2007). Efficiency of e-portfolios: a systematic review of the evidence In: ePortfolio European Institute for E-Learning Conference Maastrict pdf# page= 20. http://www. eife-l. org/publications/eportfolio/proceedings2/ep2007/proceedings-pdf-doc/eportfolio-2007.
Ishikawa, A., Amagasa, M., Shiga, T., Tomizawa, G., Tatsuta, R., & Mieno, H. (1993). The max-min Delphi method and fuzzy Delphi method via fuzzy integration. *Fuzzy Sets and Systems*, *55*(3), 241–253. https://doi.org/http://dx.doi.org/10.1016/0165-0114(93)90251-C
Jose, D. L. S. (2017). Evaluating , Comparing , and Best Practice in Electronic Portfolio System Use. *Journal of Educational Technology Systems*, *45*(4), 476–498. https://doi.org/10.1177/0047239516672049
Mohamad, S. N. A., Embi, M. A., & Nordin, N. Determining e-Portfolio Elements in Learning Process Using Fuzzy Delphi Analysis, 8 International Education Studies § (2015). https://doi.org/10.5539/ies.v8n9p171
Morrison, J. L. (2003). The national learning infrastructure initiative (NLII): An interview with EDUCAUSE's Carol Barone. *The Technology Source. Retrieved June*.
Murray, T. J., Pipino, L. L., & Gigch, J. P. Van. (1985). A Pilot Study of fuzzy set modification of Delphi. *Human System Management*, *5*, 76–80.
O'Brien, P., Osbaldiston, N., & Kendall, G. (2014). ePortfolios and eGovernment: From technology to the entrepreneurial self. *Educational Philosophy and Theory*, *46*, 284–295. https://doi.org/10.1111/j.1469-5812.2011.00826.x
PerMenakertrans no. 14 tahun 2015. (n.d.).
Peters, M. A., & Araya, D. (2010). Transforming American Education: Learning powered by technology. *E-Learning and Digital Media*, *8*(2), 102–105. https://doi.org/10.2304/elea.2011.8.2.102
Rahayu, P., Indra, D., Purwandari, B., Budi, I., & Zulkarnaim, N. (2016). Review on e-Portofolio Definition , Model , Type and System.
Republik Indonesia. (2003). Undang-Undang Nomor 13 Tahun 2003 Tentang Ketenagakerjaan.
Republik Indonesia. (2004). PP No. 23 Tahun 2004.
Republik Indonesia. (2006). Peraturan Pemerintah Nomor 31 Tahun 2006. *Sistem Pelatihan Kerja Nasional*. Retrieved from http://www.setneg.go.id/
Republik Indonesia. (2012). Peraturan Presiden No 8 tahun 2012 tentang Kerangka Kualifikasi Nasional Indonesia.
Republik Indonesia. Peraturan Menteri Ketenagakerjaan no. 21 Tahun 2014 tentang Pedoman Penerapan KKNI (2014).
Republik Indonesia, U. N. (2007). Undang-Undang No 7 Tahun 2007 tentang Rencana Pembangunan Jangka Panjang Tahun 2005-2025, 1–13.
Saffie, N. A. M., Amirah, N., Shukor, M., Rasmani, K. A., & Sembilan, N. (2016). Fuzzy Delphi Method : Issues and Challenges.
Saffie, N. A. M., Shukor, N. M., & Rasmani, K. A. (2016). Fuzzy delphi method: Issues and challenges. *2016 International Conference on Logistics, Informatics and Service Sciences (LISS)*, 1–7. https://doi.org/10.1109/LISS.2016.7854490
Sayari, E., Yaghoobi, M., & Ghanaatpishe, M. (2014). Using fuzzy Delphi method in risk management (Case study: Implementation of fuzzy Delphi method to identify credit risks in convert financial and credit

institutions into the bank). *World Applied Sciences Journal*, *31*(5), 759–766. https://doi.org/10.5829/idosi.wasj.2014.31.05.1650

Siemens, G. (2004). Connectivism: A learning Theory for the Digital Age. *Elearnspace*. Retrieved from http://devrijeruimte.org/content/artikelen/Connectivism.pdf

The ASEAN Secretariat. (2015). *The ASEAN Economic Community 2015: Progress and Key Achievements*. Retrieved from http://www.asean.org/images/2015/November/media-summary-ABIS/AEC 2015 Progress and Key Achievements_04.11.2015.pdf

Walrad, C. (2017). Standards for the Enterprise IT Profession. *IEEE Journals and Magazines*.

Exploring Teachers Perspectives towards Using Gamification Techniques in Online Learning

Daniah Alabbasi, ED.D
King Saud University, College of Education, Instructional Technology Department
dalabbasi@ksu.edu.sa

ABSTRACT
Teachers are the disseminators of information and hence important in promoting the success of innovations such as gamified learning management systems. While studies have revealed that students have a positive perception of the use of gamification in online learning (Boeker et al., 2013; Buckley & Doyle, 2014; Nevin et al., 2013; Urh et al., 2015; Woo, 2014), there are few studies conducted from the teachers' perspectives. It is necessary to have research that shows the perception of teachers regarding the incorporation of gamification to enhance knowledge through online platforms with unique features. The purpose of this study was to explore teachers' perspectives toward the use of gamification techniques in online learning. The study used an exploratory research design. It collected data from forty-seven (47) in-service and pre-service teacher, who were involved in a graduate instructional technology program. A three section survey guided by a five-point Likert scale was used to collect information. The average percentage for each survey section was used in the data analysis. The results of the study indicated a positive perception toward the use of gamification tools in online learning among in-service and pre-service teachers together with online course design features. Some teachers felt that gamification affected students negatively. Limitations of the study are outlined, which dictate that further research is required.

Keywords: Gamification, online, learning, teacher, perspective.

INTRODUCTION
Online learning is becoming the conventional approach of teaching students in universities. Technology has changed the education systems, which are nowadays focusing on learning through new technological methods as opposed to traditional methods. Most students in todays' learning circles are the Generation Y (Millennials), and accordingly have accepted online learning (Song, 2010; Al-Adwan, Al-Adwan, & Smedley, 2013). Online learning is offered through the internet either partially or entirely, and studies have supported the idea that millennial learners have fully embraced it at the social and academic level (Greenhow, Walker, & Seongdok, 2009)

The implementation of gamification in the learning process has been documented in several studies. Students have been found to have a positive attitude and perception about gamification in learning (Buckley & Doyle, 2014; Dicheva et al., 2014; Cheong, Filippou, & Cheong, 2014; Franco-Mariscal, Oliva-Martinez, & Gil, 2015; Armier Jr., Shepherd, & Skrabut, 2016). Online learning incorporating gamification has also been found to receive a positive perception from students. Nevin et al. (2013) showed that students had accepted the use of gamification because it helped them in the retention of knowledge. Woo (2014) revealed that game-based learning improves the students' motivation, cognitive abilities, and performance. Considerably, students are major stakeholders of a successful learning process and, therefore, their perception and acceptance of gamification techniques is crucial for effective completion of the course requirements.

Initially, traditional methods of learning were used and compared with gamified online learning. Boeker, Andel, Vach, & Frankenschmidt (2013) found that the latter made students have better intellectual knowledge. Comparatively, gamified learning is effective in motivating students than traditional approaches. Game-based learning enables students to enjoy and have fun while learning (Boeker et al., 2013). According to Laskaris (2014), gamified learning is more visual than oral and students have been found to remember twice what they see than what they read. Therefore, incorporating gamification in verbal learning has an overall better outcome.

Teachers are the disseminators of information and hence important in promoting the success of innovation such as gamified learning management systems. Teachers realize the need for motivating students and engaging them in collaborative learning as well as in conventional teaching settings (Noraddin, 2015). Accordingly, educators have proposed the introduction of game elements in learning in an attempt to enhance motivation, collaboration,

and conventional teaching (Katmada, Mavridis, & Tsiatsos, 2014). According to literature cited in Noraddin (2015), gamified learning help students to better understand the course taught. Collectively, these benefits become the stepping stone of embracing and accepting the use of gamification in education.

The perception of teachers towards gamification is important in the implementation of its techniques in learning. Several studies have been conducted to investigate teachers' attitude and perception of game-based learning. Noraddin (2015) examined the opinion of teachers concerning the use of digital games in learning. Using university teachers in Malaysia, Noraddin (2015) found that teachers have a positive perception towards the use of digital games in learning.

Kopcha et al. (2016) performed a survey to examine the perception of teachers towards gamified teaching methods. Using practicing teachers, who were students at the time of the study, Kopcha et al. (2016) found that the surveyed teachers had a positive experience of gamified learning methods. Brom, Sisler & Slavik (2009) examined the implementation of digital game-based learning, its success and acceptance by teachers and students. Using an augmented learning environment framework, they realized that teachers have fully accepted Europe 2045, a digital learning game-based learning (Brom, Sisler & Slavik, 2009).

In an empirical study, Ajayi (2009) explored asynchronous discussion board (ADB) from the teachers' perspective. ADB is a technological (computer) controlled discussion boards done in the form of a game. Using pre-service teachers, the author realized positive views of ADB as a tool of learning to teach (Ajayi, 2009). Teachers perceive ADB as a tool that offers more learning opportunities (Ajayi, 2009). For instance, teachers think that ADB does not only promote socialization among students, but also diversify their learning experience (Ajayi, 2009). Also, they view ADB as an active storage board because it enables easy retrieval of previous discussions as well as enabling the performance of multiple tasks at the same time (Ajayi, 2009).

Lee and Hammer (2011) found that teachers view gamification as an important tool that enables them to guide and reward students. Moreover, they suggested that gamified learning makes students realize their maximum potentials (Lee & Hammer, 2011). Sandford, Ulicsak, Facer, & Rudd (2006) conducted a one-year project to investigate the attitude of teachers and students on the use of computer games in the learning process. From the teachers' point of view, games have a motivating effect on learning (Sandford et al., 2006). Also, teachers perceive games to increase the involvement, interaction, and engagement of students in the course (Sandford et al., 2006).

Moreover, the use of games was based on the perception that it enhances the cognitive and higher order thinking skills (Sandford et al., 2006). Negatively, the study by Sandford et al. (2006) found that teachers thought of games as an aid in the development of antisocial behavior as well as stereotypical notions of other students or teachers (Sandford et al., 2006). In a study investigating the acceptance of game-based learning in secondary school teachers, Bourgonjon et al. (2013) found mixed feelings and realized the existence of complex beliefs of incorporating game features in learning.

In online learning, designing courses with appropriate features is important. The performance and successful implementation of gamification is somewhat dependent on the online course design. Studies indicate that the student learning outcomes in courses are influenced by online course design features. Jaggars & Xu (2016) recently examined the link between online course design features and students performance. In this attempt, the authors realized that online courses, having an instructor-student interaction, uses modalities to invite students into questions, and have features of instant feedback help students to be committed in courses (Jaggars & Xu, 2016). Noticeably, these features reveal that incorporating game elements in such online course will positively affect the learning process.

Joyner, Fuller, Holzweiss, Henderson, & Young (2014) examine the importance of designing online courses that encourage student-instructor relationship. They found that courses, having the presence of instructors are effective in enhancing the student-teacher interaction and guidance (Joyner et al., 2014). Students feel that this feature enables teachers to frequently notify and clarify them on key components of the course (Joyner et al., 2014). Supportively, Driscoll et al. (2012) found that online courses with teacher-oriented features, i.e., the courses having features guided by instructors and pedagogy, provide effective learning environments. They examined three hundred and sixty eight students through a quasi-experiment. They concluded that online courses designed with features such as instructor interaction have a positive impact on learning (Driscoll et al., 2012). The argument derived from the above findings is that appropriate pedagogy incorporated into online courses increases students' level of enjoyment as well as help to create a smooth relationship with their instructors (Driscoll et al., 2012). As such, the use of game elements in these online courses will probably promote a

successful learning process because they may satisfy a partial need of instant feedback that students long for in online learning.

The difficulty level of any learning content should match the target group for whom the learning materials are created. In gamified online platforms, designing content with gradual difficulty is imperative for the successful implementation of those tools. This is because the use of such tools as incentives for overcoming challenging tasks would make sense to students as well as give them a sense of pride and joy as a result of reaching their goals. Therefore, the design of online courses content shouldn't be too simple; otherwise an attempt to incorporate motivating strategies, such as gamification, will be pointless (Hinterberger, 2009). Moreover, online courses should not be too simple to compromise the quality of teaching and learning and not too difficult that discourages students from learning (Hinterberger, 2009). A study conducted by Dobbs, Waid, & del Carmen (2009) indicated that a small percentage of students who participated in their study perceived online courses to be intellectually thought-provoking and difficult, which made them to learn more than what is taught in classroom courses. Dominguez et al. (2013) argued that courses with any level of difficulty have positive and negative effects on gamified learning. On one hand, it increases the positive emotions and feelings of success upon overcoming difficult tasks (Dominguez et al., 2013). Supportively, Jatnika (2015), examining SPSS as a difficult course task, indicated that difficulties in a course improves the cognitive aspects of students. However, if the task appears to be too difficult, it increases anxiety and frustrations, which adversely leads to demotivation of learners (Dominguez et al., 2013). Vatterott (2010) viewed students to be discouraged by assignments that they cannot complete individually. Difficult assignments that possibly demand external assistance do not make students feel competent, but rather frustrated because of their inability to complete the task (Vatterott, 2010).

Problem Statement

According to Thomas and Brown (2011) cited in McGrath and Bayerlein (2013), gamification is in its preliminary stages of implementation in the education systems. Its' incorporation in online learning is a challenging task, which requires the input of all involved individuals, particularly students and teachers. Embracing and accepting the gamified learning systems is crucial for its success. While studies have revealed that students have a positive perception of the use of gamification in online learning (Boeker et al., 2013; Buckley & Doyle, 2014; Nevin et al., 2013; Urh et al., 2015; Woo, 2014), there are few studies from the teachers' perspective. The few identified studies concentrate on classroom learning rather than online learning. Since education systems are transforming technologically, it is necessary to have research that shows the perception of teachers regarding the incorporation of gamification to enhance knowledge through online platforms. As such, it is difficult to anticipate the outcome of incorporating game elements in online learning and consequently cause challenges to recommend it in education. Online instructors and designers need to have knowledge on how teachers view gamification in the process of using it in online learning. The limitation of studies on the topic highlights the need for more research to increase and support existing literature. The purpose of this study was to explore teachers' perspectives toward the use of gamification techniques in online learning.

METHODOLOGY

Research design

The study used an exploratory research design. Due to the high levels of uncertainty about the teachers' perspective of gamification in online learning, the researcher identified exploratory research as the most suitable and significant design to use (van Wyk, 2012). The reviewed literature has suggested the existence of a little understanding of the subject matter. According to literature cited in Mabuda Potgieter & Alberts (2008), exploratory research is done for the purpose of "new insights, new ideas and enhancing knowledge" (p. 13). The strengths of an exploratory study design is the high level of flexibility and an informal structure, which allows an in-depth exploration of an issue (van Wyk, 2012). It offers the chance to classify problems and identify variables that enable formally structured research (van Wyk, 2012).

Study participants and data collection strategy

The study enrolled forty-seven (47) in-service and pre-service teachers who were involved in a graduate instructional technology program. They had an average age of twenty-nine years that ranged between 25-33 years old. The forty-seven participants were assigned to ten different online courses. Each course was taught and managed by a group of 4-5 teachers. The online courses were hosted in a learning management system that supports gamification (TalentLMS). Each group was asked to design the online course based on specific guidelines, and manage the course by monitoring students' progress in assignments and in the discussion board. The guidelines were related to the minimum number of modules and assignments in the course and the difficulty level of the selected units.

Teachers were asked to create at least three modules of gradual difficulty accompanied by gradual difficulty assignments. The time allocated for students to complete the course was four weeks, which implied that the course content fitted that time frame giving the students enough time to go through the materials and complete the assignments, including the discussion task. At the end of the four weeks period, participants were asked to respond independently to the survey. The online courses design guidelines indicated that each course should have the following: 1) the content should be studied in no more than four weeks period and should have learning objectives. As depicted by Pollock (2013), effective online courses should be designed with an end in mind. 2) There should be a minimum of three modules of increased difficulty. Pollock (2013) argued that online courses need to engage students, and therefore requires some level of difficulty. 3) There should be assignments that match learning objectives. Such a process will ensure that the actions of students in the course are geared toward the achievement of course goals (Pollock, 2013). 4) Courses should have a discussion activity and 5) there should be a final assessment.

Data collection

The data collection instrument was a survey tool created by the researcher. The survey had three sections, including 1) positive effects of incorporating game elements (points, badges, and leaderboards) in learning management systems (12 items). 2) Positive effects of online course design features in courses that employ game elements (5 items). 3) Negative effects of incorporating game elements (points, badges, and leaderboards) in learning management systems (5 items). These three sections had the items (statements) which the respondents were supposed to indicate their level of agreement. Each item was measured using a five-point Likert scale with a range of strongly agree to strongly disagree. The participating teachers were supposed to tick or cross the level they think was appropriate (see appendix A). Cronbach's alpha was used to measure the scale reliability and the survey was found to be highly reliable (22 items; $\alpha = 0.87$).

Data analysis

Responses to the survey were analyzed based on total percentages to each item on every point on the five-point Likert scale. The average percentage was calculated for each survey section. To visualize the perception of teachers, the five levels of agreement were categorized into three groups (agree, neutral, and disagree). The percentages of all responses were summarized in a table as well as individual graphical representations. Pie charts were used to support the results.

RESULTS

The results showed a positive perception toward the use of gamification tools in online learning among in-service and pre-service teachers. The table below shows the detailed percentages of participants' responses to each Likert scale point. The three areas of inquiry were 1) the perceived positive effects of incorporating game elements (points, badges, and leaderboards) in learning management systems. 2) The perceived positive effects of online course design features in courses that employ game elements. 3) The perceived possible negative effects of incorporating game elements (points, badges, and leaderboards) in learning management systems. The percentages were averages of all the responses of the 47 teachers.

Areas	Total	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Positive Effects of Incorporating Game Elements (points, badges, and leaderboards) in Learning Managements Systems	47	43%	43%	11%	3%	0%
Positive Effects of Online Course Design Features in Courses that Employ Game Elements	47	50%	44%	4%	2%	0%
Negative Effects of Incorporating Game Elements (points, badges, and leaderboards) in Learning Managements Systems	47	7%	14%	25%	27%	26%

The results of the first construct (the perceived positive effects of incorporating game elements (points, badges, and leaderboards) in learning management systems) showed an 86% total percentage of agreement among in-service and pre-service teachers. 11% had a neutral level of agreement and the smallest (3%) total percentage disagreed with the idea that there are positive effects of incorporating game elements in learning management system (Figure 1). The results for the second construct (the perceived positive effects of online course design features in courses that employ game elements) showed a 94% total percentage of agreement among in-service

and pre-service teachers. 4% of the responses did not either disagree or agree while 2% disagreed with the statements that there exist positive effects of gamified online course design features (Figure 2). The results of the third construct (the perceived possible negative effects of incorporating game elements (points, badges, and leaderboards) in learning management systems) showed a 22% total percentage of agreement, 25% neutral responses, and the highest (53%) total percentage of disagreement (Figure 3).

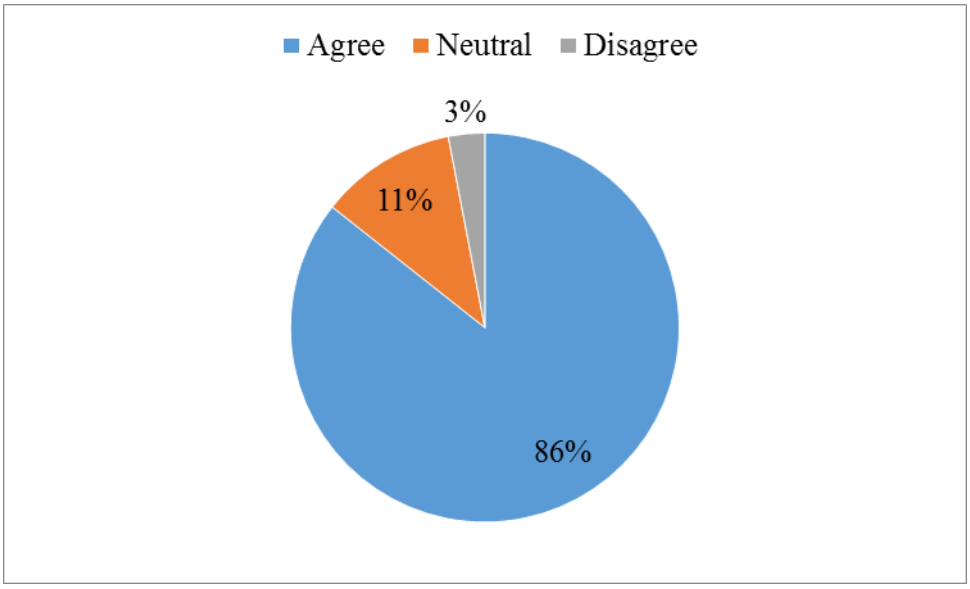


Figure 1. Percentage level of agreement with the positive effects of incorporating game elements (points, badges, and leaderboards) in learning management systems

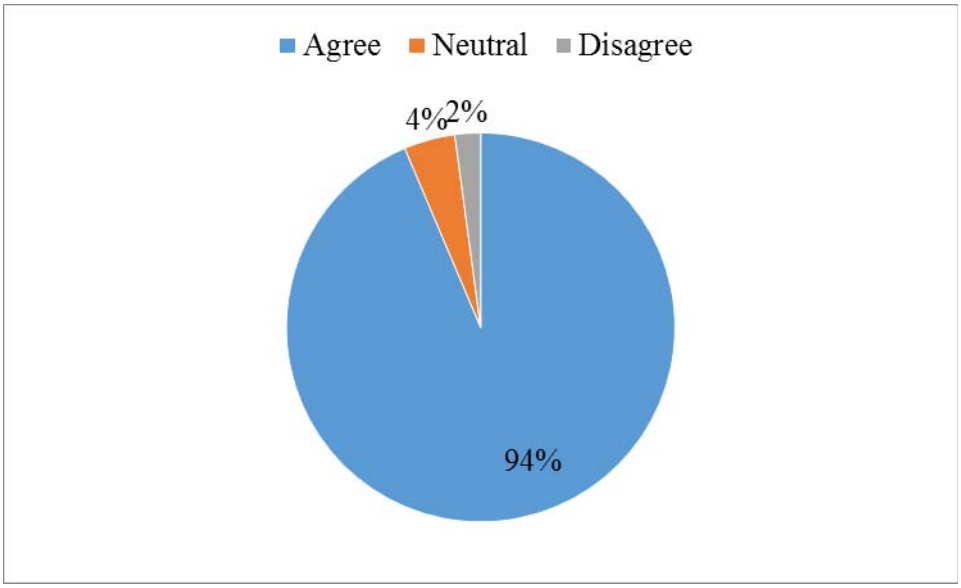


Figure 2. The percentage levels of agreement with positive effects online course design features in courses that employ game elements.

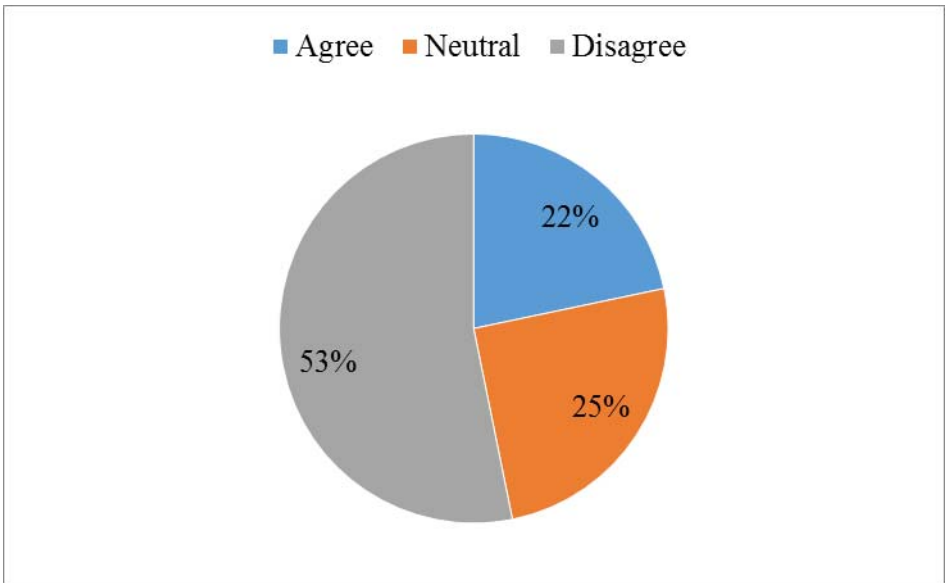


Figure 3. The percentage levels of agreement with negative effects of incorporating game elements (points, badges, and leaderboards) in learning management systems

DISCUSSION

This study aimed at exploring teachers' perspectives towards using gamification techniques in online learning. The realization of its objectives was based on an exploratory survey that had three sections, including positive effects of incorporating game elements in learning management systems, positive effects of online courses design features in courses using game elements, and negative effects of incorporating game elements in learning management systems. As revealed by the results, there was an overall positive perception toward the use of gamification tools in online learning among in-service and pre-service teachers. Similar to the perception of students (Buckley & Doyle, 2014; Dicheva et al., 2014; Cheong, Filippou, & Cheong, 2014; Armier Jr., Shepherd, & Skrabut, 2016), teachers feel gamification is contributing in a positive way in the learning process of their students. In this section, we discuss the three statements that guided the scope of the survey with a detailed examination of the item variables.

Positive effects of incorporating game elements (points, badge, and leaderboard) in learning management systems.

The results of the current study have revealed that most of the surveyed teachers have a positive perception toward the incorporation of game elements in learning management systems. Supportive of Noraddin (2015), the study realized that teachers had a positive attitude because they thought that game elements increased their students' motivation. Noraddin (2015) and Sandford et al. (2006) argued that teachers believed that students have an added motivation as a result of digital game-based learning. Teachers agreed that game elements improved the students' attention to various parts of the course. These results are similar to the survey by Noraddin (2015) who asserted that game features in teaching increase the attention and focus of students towards learning.

The results, according to the survey on the positive effects of incorporating game elements, also revealed that teachers perceived game elements to increase students' curiosity of deep exploration of the learning management systems. Also, teachers believe that gamified learning systems increase the students' satisfaction of online learning, give them a sense of autonomy, enable them to enjoy the learning experience, have fun, and participate in discussions. These results are consistent with the findings of Ajayi (2009), who showed that teachers believed the asynchronous discussion board promoted the socialization of students in the learning process. Also, the results agree with Noraddin (2015) that teachers view digital games as contributors of fun and enjoyment in learning.

The incorporation of game elements in learning has the benefit of making students earn points upon the completion of a task. This form of appreciation and reward is a motivator for students to perform beyond the expectation of the teachers and the course requirements. Moreover, game elements are connected with the students' autonomous feeling since they allow for direct involvement in seeing the outcomes of ones' effort and actions. These findings are consistent with Lee and Hammer (2011) that teachers view gamification as an important tool that helps them to guide and reward students. Also, these authors found that gamified learning enables students to realize their maximum potentials (Lee & Hammer, 2011). Consequently, they develop a

sense of being competent and as such students are more cautious not to make mistakes in tests, although they are more relaxed because gamified online learning offers the chance to redo the task and regain the lost points.

Positive Effects of Online Course Design Features in Courses that Employ Game Elements

The world and precisely the education systems are transforming technologically, which has encouraged a move towards online learning (Greenhow, Walker, & Seongdok, 2009). The results of the study have revealed that teachers have a positive perception of online course features in courses that employ game elements. Specifically, the positivity showed teachers found online courses that provided challenging tasks with the incorporation of game elements make students' have a feeling of competence, accomplishment, and joy. Moreover, teachers believe that the difficulties of online course tasks make students feel they possess abilities beyond their capacity and gain more than the course requires. According to Dominquez et al. (2013), game elements bring about challenging tasks that test students' level of competence. Dobbs et al. (2009), Dominguez et al. (2013), and Jatnika (2015) realized that difficulties in assignments increase the student competence and accomplishment. The study results also realized that teachers perceived online course design features as promoters of confidence in students in their desire to succeed in online courses. Moreover, teachers perceived instant feedback as a designed feature of online courses effectively motivates students to perform better. Jaggars & Xu (2016) argued that online course features such as instructor-student interaction, modalities, and instant feedback increase the students' commitment in online learning. Also, Joyner et al. (2014) and Driscoll et al. (2012) support these claims by suggesting that online course design features encourages discussion as teachers notify and clarify key components to students about the course.

Gamification encourages students to participate more in the discussion board (Ajayi, 2009; Cheong et al., 2011). This is because when students see that they are being rewarded by the system with more points every time they participate, they will be motivated to participate more often (Lee & Hammer, 2011). Also, when students see that they are getting more rewards, for example badges for completing complex activities, they will also be willing to continue and do more (Dobbs et al., 2009). Discussions offer students the chance to receive immediate feedback from other learners or the instructors, hence helping to gauge the performance of their learning (Bruff et al., 2013). The instant feedback motivates students to do better because it enables them to measure their level of understanding of the course and apply changes wherever necessary (Bruff et al., 2013). Overall, the advantages of discussions and instant feedback made available via gamification as well as online course design features and the gradual increase of the difficulty level when designing online courses may increase students' engagement, motivation, confidence, competence, and accomplishment in online learning.

Negative Effects of Incorporating Game Elements (points, badges, and leaderboards) in Learning Management Systems

The results of the study showed that the majority of the teachers disagreed with the negative statements of incorporating game elements in learning management systems. Ideally, some teachers did not view game elements as a factor that can induce negative feelings to students, discourage the formation of strong relationships, or lower their motivation to complete the online courses. Moreover, teachers did not perceive the incorporation of game elements in online learning as either making the students anxious or study for the purpose of gaining points rather than effective understanding of the course. These results are not consistent with several previous studies. For instance, Sandford et al. (2006) found that teachers believe that the use of games in education increases the anti-social behavior in students. Moreover, according to Sandford et al. (2006) teachers view games as platforms for the development of stereotypes about other students and instructors.

On the other hand, the findings of this study indicated that a small but significant proportion of teachers perceived game elements as encouraging negative traits in students. The study found that a quarter of the included teachers agreed that there are negative effects of game elements in learning management systems. These participants believed that students develop negative feelings, build poor relationships with other students, become demotivated, and anxious because of incorporating game elements in online learning. According to this few agreeing participants, the use of game elements make students focus on gaining points rather than effectively understand the course. Considerably, these findings are consistent with Sandford et al. (2006). Examining from a student perspective, Hanus and Fox (2015) supported these results by realizing that leaderboards demotivate students because of the immediate view of the one effort, whether good or bad.

The negativity of incorporating game elements in online learning is brought about by the competitive nature of the platform. Charles et al. (2011) found that game elements create competition, which is dissatisfying to students. In contradiction, studies have realized that game elements encourage discussions among students, hence promoting socialization (Ajayi, 2009; Cheong et al., 2011). Game elements make the students develop poor learning habits (Lister, 2015). The results of the study suggested that some teachers feel that the

incorporation of game elements in online learning makes students learn for the sake of getting points rather that effectively learning the materials. Lister (2015) is supportive of these findings by suggesting that game elements cause an interruption for the overall objective of the learning process.

It is noticed that almost a quarter of the participants had a neutral perception of the negative effects of incorporating game elements in learning management systems. Such participants feel a balanced level of gauging game elements since as reported by Ajayi (2009) and Noraddin (2015) the use of game elements is fun and enjoyable. Through research, it has been realized that gamification has the benefits of "engagement, loyalty, influence, and fun" (Muntean, 2011, 326). According to Kopcha et al. (2006), teachers view gamification as a tool that ease their teaching process as well as the learning of students. Therefore, while participants might have some negative perceptions as indicated above, the more justifiable positive effects may discourage them from admitting the negativity.

Generally, the study has revealed that teachers perceive gamification as an important tool in online learning. According to them its incorporation in the learning management systems supported by effective online course design is positively impacting the students. Moreover, the majority of the teachers believe that it does not induce negativity in learning. Due to the transition in the education systems, especially the use of technology, the results are a positive outcome for online course designers. Noticeably, some teachers and supportive literature feel that gamified online learning can have a negative impact on the student learning process. Such results indicate a negative attitude and perception of game elements, which can affect the attempt to implement gamified learning systems in education institutions.

Limitations

The study has several limitations. Gamification is a new concept and therefore, the first identifiable limitation is the lack of many supporting literature of the results found. Other than the few identified studies (Sandford et al., 2006; Ajayi, 2009; Lee & Hammer, 2011), the other studies are from the student rather than the teachers' perspective. It is hard to conceptualize the achievement of the research regarding either the supports or critics. Therefore, it is challenging to validate the realized findings and recommend the incorporation of game elements in online learning. The other limitation is the use of a small sample size. A sample of forty-seven participants is small in quantitative research because it limits the generalization of the findings.

Another limitation is the examination of teachers from a particular graduate instructional technology program. It would be more valid to examine diverse programs from different institutions. Finally, the study is based on results from a specific point in time, which challenges the attempts to predict the outcome of gamification at its later stages in online learning. The limitations above suggest further investigation on the issue. Precisely, the lack of studies highlights that more research should be conducted to offer the foundation of literature on the subject. Future research should use a larger sample size that is a good representation of teachers for effective generalization. Moreover, a longitudinal approach should be used in future research to obtain the long-term effects of gamification on online learning. Despite the limitations, the study used a valid and reliable data collection tool (survey), which strengthens its results.

CONCLUSION

The results of the study have shown that teachers have a positive perception of incorporating gamification into online learning. Specifically, the research has revealed that teachers perceive game elements as improving the motivation of students towards the course goals. It increases the attention and curiosity to navigate multiple elements in the learning management system. Moreover, it increases the students' level of satisfaction and the urge to do more than the course requires. Teachers believe that the incorporation of game elements give students a level of autonomy, giving them the feeling of being in control of their learning process. It is, therefore, clear that gamification is a highly accepted technique that improves the performance of students.

According to teachers, the use of online courses designed with increased difficulty increases the students' level of competence, enables them to have fun and enjoyment while learning, and become more engaged in course discussions. Therefore, the incorporation of game elements in such online course will promote an effective online learning environment. Teachers view gamification as tools that increase carefulness and reducing recklessness while helping the students to be relaxed in their online learning experience. It can be deduced that students do not appreciate pressure, but prefer challenging tasks that are enjoyable and encourage strong relationships. It can be noticed that gamification promotes good learning habits, which assist students' to accomplish the learning goals.

Most of the teachers do not view gamification to impact students negatively. However, some believe that the competitive nature of gamified learning demotivate students. They also view game elements as causing antisocial behavior, increasing anxiety, and leading to poor learning behavior. The negativity of gamification is noticeable, and although a small proportion of the study participants reveal this outcome, it is clear that gamification is not all about positivity in the learning process.

The research has been able to address its purpose. The implications of the study are that online course designers can implement gamification in learning systems with the approval of the teachers. It also motivates researchers to conduct more studies on the topic, especially on the negative effects of game elements in online learning. In conclusion, gamification is important, and education systems should consider incorporating it in online learning. There are limitations in the study, highlighting that more research should be conducted on the subject.

REFERENCES

Ajayi, L. (2009). An Exploration of Pre-Service Teachers' Perceptions of Learning to Teach while Using Asynchronous Discussion Board. *Educational Technology & Society, 12* (2), 86–100.

Armier Jr., D. D., Shepherd, C. E., & Skrabut, S. (2016). Using game elements to increase student engagement in course assignments. *College Teaching, 64* (2), 64-72. DOI:10.1080/87567555.2015.1094439

Boeker, M., Andel, P., Vach, W., Frankenschmidt, A. (2013). Game-Based e-learning is more effective than a conventional instructional method: a randomized controlled trial with third-year medical students. *PLOS ONE.* http://dx.doi.org/10.1371/journal.pone.0082328

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke, M. (2013). Acceptance of game-based learning by secondary school teachers. *Computer and Education, 67*, 21-35

Brom, C., Šisle, V., Slavík, R. (2009). Implementing digital game-based learning in schools: augmented learning environment of 'Europe 2045'. *Multimedia Systems, 16* (1), 23-41.

Bruff, D., Fisher, D., McEwen, K., & Smith, B. (2013). Wrapping a MOOC: Student perceptions of an experiment in blended learning. *Journal of Online Learning and Teaching, 9* (2). http://jolt.merlot.org/vol9no2/bruff_0613.htm

Buckley, P., & Doyle, E. (2014). Gamification and student motivation. *Interactive Learning Environments,* DOI: 10.1080/10494820.2014.964263

Charles, D., Charles, T., McNeill, M., Bustard, D., & Black, M. (2011). Game-based feedback for educational multi-user virtual environments. *British Journal of Educational Technology, 42* (4), 638-654. doi:10.1111/j.1467-8535.2010.01068.x

Cheong, C., Filippou, J., & Cheong, F. (2014). Towards the gamification of learning: investigating student perceptions of game elements. *Journal of Information Systems Education, 25* (3), 233-244.

Dicheva, D., Dichev C., Agre G., & Angelova G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society, 18* (3), 75–88

Dobbs, R., Waid, C., & del Carmen, A. (2009). Students' perceptions of online courses: The effect of online course experience. *Quarterly Review of Distance Education, 10* (1), 9-26.

Driscoll, A., Jicha, K., Hunt, A. N., Tichavsky, L., & Thompson, G. (2012). Can online courses deliver in-class results? A comparison of student performance and satisfaction in an online versus a face-to-face introductory sociology course. *Teaching Sociology, 40* (4) 312 –331. DOI: 10.1177/0092055X12446624

Franco-Mariscal, A. J., Oliva-Martínez, J. M., & Gil, M. L. A. (2015). Students' perceptions about the use of educational games as a tool for teaching the periodic table of elements at the high school level. *Journal of Chemical Education, 92* (2), 278-285.

Greenhow, C., Walker, J. D. & Kim, S. (2009). Millennial Learners and Net-Savvy Teens? Examining Internet Use among Low-Income Students. *Journal of Computing in Teacher Education, 26* (2), 63-68.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. *Paper presented at the 2014 47th Hawaii International Conference on System Sciences,* 3025-3034. DOI:10.1109/HICSS.2014.377

Hanus, M., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80* (0), 152 – 161.

Hinterberger, H. (2009). E-learning: Make it simple as possible, but not simpler. *ATDF Journal, 4* (2), 11-18.

Jaggars, S. S., & Xu, D. (2016). How do online course design features influence student performance? *Computers & Education, 95,* 270-284.

Jatnika, R. (2015). The Effect of SPSS Course to Students Attitudes toward Statistics and Achievement in Statistics. *International Journal of Information and Education Technology, 5* (11), 818-821.

Joyner, S. A., Fuller, M. B., Holzweiss, P. C., Henderson, S., & Young, R. (2014). The Importance of Student-Instructor Connections in Graduate Level Online Courses. *MERLOT Journal of Online Learning and Teaching, 10* (3), 436-445.

Katmada, A., Mavridis, A. & Tsiatsos, T. (2014). Implementing a Game for Supporting Learning in Mathematics. *The Electronic Journal of e-Learning, 12* (3), 230-242.
Kopcha, T. J., Ding, L., Neumann, K. L., et al. (2016). Teaching Technology Integration to K-12 Educators: A 'Gamified' Approach. *TechTrends, 60* (1), 62-69. doi: 10.1007/s11528-015-0018-z
Laskaris, J. (2014, July 30). *30 facts about gamification in e-learning.* Retrieved from eLearning Industry http://elearningindustry.com/30-facts-gamification-in-elearning
Lee, J. J., & Hammer, J. (2011). Gamification in Education: What, how, why bother? *Academic Exchange Quarterly,* 15 (2), 1-5.
Mabuda, B.T., Potgieter, E., Alberts, U.U. (2008). Student nurses' experiences during clinical practice in the Limpopo Province. *Curationis, 31* (1), 19-27.
McGrath, N., & Bayerlein, L. (2013, December 1). *Engaging online students through the gamification of learning materials: The present and the future.* Retrieved from http://www.ascilite.org/conferences/sydney13/program/papers/McGrath.pdf
Muntean, C. I. (2011). Raising engagement in e-learning through gamification. *In The 6th International Conference on Virtual Learning ICVL 2012* (pp. 323–329).
Nevin, C. R., Westfall, A. O., Rodriguez, J. M., Dempsey, D. M., Cherrington, A. (2013). Gamification as a tool for enhancing graduate medical education. *Postgraduate Medical Journal*. doi: 10.1136/postgradmedj-2013-132486
Noraddin, E. (2015). Three Learning Potentials in Digital Games: Perception of Malaysian University Teachers. *The Online Journal of Distance Education and e-Learning, 3* (3), 78-89.
Pollock, D. L. (2013, April). *Designing and Teaching Online Courses.* Retrieved from http://fsweb.bainbridge.edu/QEP/Docs/DesigningandTeachingOnlineCourses.pdf
Reiter, B. (2013). *The epistemology and methodology of exploratory social science research: Crossing popper with Marcuse.* Retrieved July 3, 2016, from http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1099&context=gia_facpub
Sandford, R., Ulicsak, M., Facer, K., & Rudd, T. (2006). *Teaching with Games: Using commercial off-the-shelf computer games in formal education.* Retrieved from https://www.nfer.ac.uk/publications/FUTL49/FUTL49.pdf
van Wyk, B. (2012). *Research design and methods: Part I.* Retrieved from http://www.uwc.ac.za/Students/Postgraduate/Documents/Research_and_Design_I.pdf
Vatterott, C. (2010). Five hallmarks of good homework. *Educational Leadership, 68* (1), 10-15.
Woo, J.-C. (2014). Digital Game-Based Learning Supports Student Motivation, Cognitive Success, and Performance Outcomes. *Educational Technology & Society, 17* (3), 291–307.

Acknowledgments: This is a research project that was supported by a grant from the Research Center for the Humanities, Deanship of Scientific Research at King Saud University.

Appendix A. Gamification in online Learning Survey: Teachers' Perspectives

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Positive Effects of Incorporating Game Elements (points, badges, and leaderboards) in Learning Managements Systems					
1. Incorporating game elements in online learning increased my students' motivation.	☐	☐	☐	☐	☐
2. Incorporating game elements in online learning Drew my students' attention to the various parts of the course.	☐	☐	☐	☐	☐
3. Incorporating game elements in online learning increased my students' curiosity to navigate and explore all the various elements of the LMS.	☐	☐	☐	☐	☐
4. Incorporating game elements in online learning increased my students' satisfaction about the learning experience in the e-learning course.	☐	☐	☐	☐	☐
5. Earning points for task completion motivated my students to do more than what they were required to do in the course.	☐	☐	☐	☐	☐
6. Incorporating game elements in online learning gave my students a sense of autonomy that increases their feeling of being in control over their learning.	☐	☐	☐	☐	☐
7. Game elements gave my students a sense of autonomy that helped them to directly see the outcome of their actions in the e-learning course.	☐	☐	☐	☐	☐
8. Passing successfully the predesigned challenges and seeing that directly through the use of game elements increased in my students a feeling of competence.	☐	☐	☐	☐	☐
9. My students expressed a sense of enjoyment while working on the course.	☐	☐	☐	☐	☐
10. My students were motivated to participate more often in the discussion board in order to earn more points.	☐	☐	☐	☐	☐
11. My students were more careful not to make any mistakes in the final test so they don't lose any points.	☐	☐	☐	☐	☐
12. My students were more relaxed with making mistakes when completing the course tasks because they can redo the tasks and regain the lost points.	☐	☐	☐	☐	☐
Positive Effects of Online Course Design Features that Employ Game Elements					
13. Designing the learning materials of the e-learning course in a way that challenges the students within their competence level and support that with the utilization of game elements gave my students a feeling of **competence.**	☐	☐	☐	☐	☐
14. Designing the learning materials of the e-learning course in a way that challenges the students within their competence level and support that with the utilization of game elements gave my students a feeling of **accomplishment.**	☐	☐	☐	☐	☐
15. Designing the learning materials of the e-learning course in a way that challenges the students within their competence level and support that with the utilization of game elements gave my students a feeling of **joy.**	☐	☐	☐	☐	☐
16. Sharing success criteria with my students in the e-learning course increased their confidence level about succeeding in the course.	☐	☐	☐	☐	☐
17. The instant feedback made available through game elements motivated my students to do better in the course.	☐	☐	☐	☐	☐

Negative Effects of Incorporating Game Elements (points, badges, and leaderboards) in Learning Managements Systems					
18. Incorporating game elements in online learning created negative feelings in my students due to the adverse effects of competition.	☐	☐	☐	☐	☐
19. Incorporating game elements in online learning discouraged the formation of strong relationships between students.	☐	☐	☐	☐	☐
20. Utilizing game elements in online learning lowered my students' motivation to complete the course.	☐	☐	☐	☐	☐
21. Utilizing game elements in online learning made my students anxious.	☐	☐	☐	☐	☐
22. My students were more concerned about collecting points than effectively learning the materials.	☐	☐	☐	☐	☐

From Teacher-Oriented to Student-Centred Learning: Developing an ICT-Supported Learning Approach at the Eduardo Mondlane University, Mozambique

Xavier Muianga
Department of Computer and Systems Sciences (DSV), Stockholm University, Stockholm, Sweden
xmuianga@dsv.su.se

Tina Klomsri
Department of Computer and Systems Sciences (DSV), Stockholm University, Stockholm, Sweden
tinaklomsri@gmail.com

Matti Tedre
Department of Computer and Systems Sciences (DSV), Stockholm University, Stockholm, Sweden
matti.tedre@acm.org

Inocente Mutimucuio
Faculty of Education, Eduardo Mondlane University, Maputo, Mozambique
inocente.mutimucuio@uem.mz

ABSTRACT
Eduardo Mondlane University (UEM) is in the process of modernising its teaching and learning approaches. As one of the pedagogical reform projects, student-centred learning (SCL) in combination with Web 2.0 tools was introduced as a pilot in the course 'ICT in Environmental Education' in the Faculty of Education. This study explored—using action research strategy—to what extent the new pedagogical approach contributed to students' competency development. Twenty-nine students were involved in the course. Eight semi-structured interviews with students were combined with sixteen classroom observations to see how students used the Learning Management System (LMS) and Web 2.0 tools over eight weeks. Content analysis was used for interviews and information produced by students. The results showed that collaboratively e-learning supported the development of students' information management and problem-solving skills and their use of metacognitive strategies for self-regulated learning. Information and Communication Technology (ICT)–supported, problem-based learning contributed to greater intrinsic motivation. However, not all students were ready to adopt an active role. At the start, they saw teaching as a one-way knowledge transfer. This article recommends that e-learning initiatives in Mozambique always go together with an ICT-based literacy course and training in 21st-century learning skills.

Keywords: Student-centred learning, generic competencies, Web 2.0 tools, e-learning.

INTRODUCTION
Information and Communication Technology (ICT) is changing the way people process, access and distribute information. Technological skills are among the key qualities employers seek (Moeller & Reitzes, 2011; Young & Chapman, 2010; Alzu'bi, 2018). Higher education institutions are adapting themselves to employer demands to deliver 'technology-savvy' students. These institutions incorporate ICT in their programs in order to prepare students for working life (Moeller & Reitzes, 2011). Hayes, Schuck, Segal, Dwyer, & McEwen (2001) described how ICT can also transform pedagogy. In terms of educational philosophy, ICT can facilitate a shift in students' learning approach: from reproducing knowledge conveyed by others to constructing knowledge themselves. In terms of didactical approach, ICT implies a move from teacher-centred to student-centred learning (SCL). In terms of material, ICT shifts the focus onto global resources. In terms of activities, ICT helps students to perform complex tasks using multi-modal information. Those changes do not take place as separate phenomena; they are interwoven. Learning with technology assumes a participatory and self-regulatory approach, while SCL benefits from e-learning and Web 2.0 tools.

Eduardo Mondlane University (UEM) started a curricular reform programme around 2000 (Muianga et al., 2013). ICT and SCL were introduced to improve the quality of teaching and learning. At first, it was not easy. Evaluation of courses across faculties showed that direct instruction was still the dominant approach, despite the various attempts to introduce a constructivist learning model (Universidade Eduardo Mondlane, 2008). Teachers lacked knowledge about new pedagogical approaches and used technology ineffectively (Universidade Eduardo

Mondlane, 2008).

These findings urged UEM to speed up the reform process in almost all faculties. A second phase of curricular reform was launched (Cossa et al., 2012). Competency-based program design was emphasised to assure the highest quality of learning and a push was given to ICT as a tool for active and critical learning. Several faculties started Web-supported SCL pilots.

Besides the various positive experiences, there was also uncertainty about how students perceived the introduction of ICT and SCL. This doubt was not specific to UEM. Schweisfurth (2011, p. 430) pointed to a lack of research studies that focus on the voices of young learners in developing countries. In order to find out which obstacles hindered the adoption of a new way of teaching and learning, this study specifically aimed at exploring the perceptions of students. Given the prevalence of the situation, the Faculty of Education of UEM developed and started implementing a competencies-based curriculum supported by an SCL approach and ICT.

The aim of this study is to explore the effects of a student-centred learning approach combined with the use of Web 2.0 tools in order to develop generic student competencies in the course 'ICT in Environmental Education'. Action research was adopted to deal with real problems, preferably within communities, with the aim of finding solutions and producing guidelines for best practices (Koshy, 2005). The outcomes of the pilot could be helpful to improve all programs offered at UEM.

The research questions of the study were:

- How does the adoption of SCL in the course 'ICT in Environmental Education' contribute to the development of generic competencies, as perceived by the students?
- How do the use of Web 2.0 tools in the course 'ICT in Environmental Education' support the adoption of SCL, as perceived by the students?

LITERATURE REVIEW

Student-centred learning

A variety of learning theories speak about SCL in terms of self-regulated learning, the nurturing of higher-level learning abilities, collaborative learning, intrinsic motivation and metacognitive skills, surface learning strategies and intrinsic goals, as well as deeper learning strategies (e.g., Biggs, 1993; Marton & Säljö, 1976a; Laurillard, 2005). Felder and Brent (1996, p. 43) defined SCL as a broad approach that includes active learning experiences, self-paced and cooperative style, responsiveness to individual needs and the arousal of learning potential. The authors underlined the importance of giving students responsibility for their own learning and for engaging them in activities, such as peer discussions, writing of essays and exploration of each other's attitudes and values. Commonly used terms for SCL are 'active' and 'collaborative' learning, emphasising students' involvement in the learning process (Froyd & Simpson, 2008, p. 2).

The two dominant research traditions on SCL have focused on students' approaches to learning (SAL) and self-regulated learning (SRL) (Biggs, 1987; Lonka, Olkinuora, & Mäkinen, 2004; Apiola & Tedre, 2013). Researchers focusing on SRL have highlighted, for instance, deep learning, as it emphasises learners' autonomy. Students are encouraged to control and direct their actions to achieve learning goals like information acquisition and self-guidance of professional growth (Marton & Säljö, 1976b; Zimmerman, 2000). Many scholars point out that the main pillars of self-regulated learning are involvement of students in learning activities, responsibility to motivate oneself and attainment of personal goals (Zimmerman, 2000; Greene & Azevedo, 2007).

In SCL, the lecturer takes the role of facilitator, not just a presenter of information (Motschnig-Pitrik & Holzinger, 2002). This role is crucial for guiding students to become producers, instead of consumers, of knowledge. SCL is not exclusively focused on personal and cognitive growth; it also focuses on the development of competencies needed to perform as a professional in a future job or in self-employment.

Studies carried out in developing countries have shown SCL to have various advantages over traditional teaching methods. First, SCL supports students with diverse learning needs and increases students' retention of knowledge and skills. Second, SCL increases students' motivation and self-confidence by including them in the decision-making process (Baeten, Struvyen, & Dochy, 2013; Thanh, 2010). Third, SCL stimulates creativity

through emotional and intellectual discovery learning, which encourages students to become lifelong learners (Motschnig-Pitrik & Holzinger, 2002). Fourth, group work requires debate, brainstorming and negotiation, and this in turn gives students the opportunity to develop their communication and teamwork skills. Fifth, increased responsibility for one's own learning encourages students to become independent learners (O'Neill & McMahon, 2005).

The introduction of SCL into developing countries also faces challenges. Limited resources and large classes impede its implementation (O'Neill & McMahon, 2005; Schweisfurth, 2011). In the beginning, it is hard for teachers and learners to assume new roles as they must unlearn previous approaches (O'Neill & McMahon, 2005; Thanh, 2010). The shortage of staff trained in SCL is another problem (Tedre, Apiola, & Cronjé, 2011; Schweisfurth, 2011). Initial training in new pedagogy is therefore indispensable (O'Neill & McMahon, 2005).

UEM (2008) recognises that SCL is not a panacea for all problems. Not all students are involved, as independent, self-regulated learning might not suit everybody (UEM, 2008). Nevertheless, SCL offers opportunities for students to experience authentic learning as a basis to develop competencies that modern society requires of university graduates.

Generic competencies

In the world of work, a change is taking place from a qualifications-based working environment concentrating on jobs, to a competency-based environment focusing on the individual. Beyond the specific competencies related to a profession, people need generic competencies and skills that can be used to meet the needs of a modern society which is becoming more dynamic and complex and therefore demands professionals that are flexible enough to respond to new situations and problems (Rumsy, 1997; Kouwenhoven, 2003). According to Young and Chapman (2010), the term 'generic competency' is used to refer to competencies that can be applied across different job and life contexts. Males (2010) define generic competency as attributes or skills that are important to graduates across all disciplines. It is not easy to define this concept because some scholars use related terms such as 'generic attributes', 'generic skills' and 'employment skills' (Billing, 2003). In this study, the term generic competencies is used to refer all knowledge, skills, attitudes and attributes that can be utilised in new professional situations, in life today, as well as within and outside a profession (Kouwenhoven, 2003).

Web 2.0 tools and its integration in teaching and learning

In recent years, the use of Web 2.0 tools for education has been increasing. This is due to the fact that these tools are easily accessible to young people, expand communication, and promote information-sharing, interoperability and collaboration. The Web 2.0 tools are based on an open-access and open-source spirit, and they have accelerated the emergence of Web-based communities and new applications, like apps for social networking (Zeininger, 2009).

Although there are numerous definitions of 'Web 2.0 tools', for this study, we adopted Butler's (2012) definition: 'a wide array of Web-based applications which allow users to collaboratively build content and communicate with others across the world' (p. 139). This definition explains the purpose of this study, which is to allow students to collaboratively build content and communicate with others, and develop competencies like critical thinking, problem solving, communication, collaboration, media literacy, and information literacy. Some of the most commonly used Web 2.0 tools include blogs, wikis, Movie Maker, podcasts, Google Drive, social bookmarking, and social networking sites.

The use of Web 2.0 tools allows active participation, creation and sharing of digital and Web-based artefacts by groups and individuals, or by students and lecturers, thus leading to a change of attitudes related to the use of the Internet. According to McLoughlin and Lee (2010), the use of Web 2.0 tools for teaching and learning has great advantages because it seems to tap into the increase of the multifaceted capabilities of interaction and communication.

Web 2.0 tools can offer possibilities for improving the teaching and learning process when they are well integrated, encouraging the practice of information searching through the Internet, development of communication and language skills, and, fundamentally, promotion of cooperation and collaboration skills, as well as knowledge sharing (Coutinho & Bettentuit, 2007; Stubbé & Theunissen, 2008). Using Web 2.0 tools, students are free to express ideas and engage in reflective processes on an individual basis, combining both independent work and peer feedback, thus ensuring independent learning and collaborative interaction (Lui, Choy, Cheung & Li, 2006).

METHODOLOGY

The interventions in this study targeted two elements of the curricular reform programme: the professional

development of students and the modernisation of the teaching and learning approaches across the university.

Action research consists of self-reflective stages, which are fluid, open and responsive (Koshy, 2005). The first stage has to do with identification of the change pursued. This was done through context analysis: How can SCL contribute to the improvement of the university's courses? Researchers explored the current teaching and learning practices and the existing pedagogical vision. They pinpointed what could be improved through adoption of SCL. Next, the researchers developed the research questions and planned the research. It was decided to integrate SCL and ICT in a regular course. A formative evaluation scheme was designed with the intention to use the results to improve the SCL approach (third stage). SCL strategies based on Web 2.0 tools and learning activities were (re-)designed with the intention to promote generic competencies. Implementation of SCL and learning activities was stage four. The final stage was a summative evaluation of all steps. At each stage, researchers (experts) and students (learners) were involved.

In this study, the cycle of self-reflective action research stages was carried out once. However, the results of this research directly feed the future actions needed to improve the educational practice of the university.

Data collection and analysis

Data were collected through semi-structured interviews and observations by researchers having strong experience in ICT for education. The observations were used to collect data to verify whether the content was suitable for the class's learning needs and whether the proposed activities improved the student learning process. This technique was also used to monitor the appropriateness of resources used with the content. Observations were performed in the classroom, in the LMS and across Web 2.0 websites produced by students.

The interview and observations guidelines were developed following the suggestions from the literature by following the stages of preparation, construction of effective research questions and implementation of the interviews (Amado, 2000; Creswell, 2007; Koshy, 2005; Wragg, 2013). To validate both interview and observation guidelines, senior experts in the field of educational research methodology revised and even removed or adapted some questions or items to fit the objectives and to answer the research questions of this study.

For content analysis, we considered three phases. The first phase consisted of transcription of the interviews respecting completeness, representativeness, homogeneity, relevance and exclusivity. In the second phase, we chose the coding units, adopting the procedures of codification (semantic classification) and categorisation. In the third phase, we interpreted the information from the previous phases, making them meaningful and valid (Bardin, 2011; Wragg, 2013). For the content analysis phase, a research expert gave feedback on the results.

During the process of interviewing students, the focus was to understand whether and how Web 2.0 tools improved their competencies. During the eight-week course, an interview was conducted every two weeks with two students chosen randomly. Students' activities in their assignments were analysed using Creswell's (2007) data analysis spiral. Additionally, the interviews were also transcribed, coded, analysed, reflected upon and categorised in a circular process. Interviews were held in Portuguese and translated into English by the researchers.

Course organisation

Like other courses that are used as pilot on using the SCL approach, the course 'ICT in Environmental Education' was run for first-year undergraduate students in the Faculty of Education. The aim was to provide students with knowledge and skills about the use of Web 2.0 tools and an LMS for environmental education. With these tools, the students were expected to explore the content in a more creative and critical way, thus developing relevant generic competencies.

Until the start of the pilot, teaching was done in the traditional way: relying on transmission of knowledge, memorising theory that had no link to real-life problems and accumulating information through lectures. The teacher selected the content and materials, and evaluation was a reproduction of what was transmitted.

In the pilot, the lecturer changed roles from deliverer of knowledge to facilitator of learning in small groups at students' own pace. The lecturer helped students to develop skills, allowing them to construct their own knowledge and their own learning strategies. The lecturer also got involved more in organising the course activities and monitoring student's interactions in the LMS.

Twenty-nine students, divided into eight groups of three to four students, participated in the eight-week course.

The class met face-to-face twice per week, for three hours each, for theoretical and practical guidance. Independent work using the LMS, in groups or individually, took 18 hours per week. Besides ICT skills, the students were expected to develop generic competencies: communication and collaboration; information research and information production; cooperation and self-learning; media literacy and information literacy; critical thinking and problem solving.

At the start, students were trained to use the LMS. Each group worked for two weeks with one of the Web 2.0 tools: wikis; podcasts; or video sharing, social bookmarking or social networking sites (blogs, Facebook or Twitter). Each group wrote a blog entry with the chosen tool and presented it during a classroom meeting. For this task, students created multimedia content using a mobile phone, digital camera or Movie Maker. One computer lab assistant and two information technology (IT) technicians were available to help. Students discovered how to use different IT tools, and they taught others about it. Most discussions took place in the LMS.

In the first face-to-face session, students were introduced to Web 2.0 tools: they created Facebook accounts and connected their profiles. Then they were divided into groups. Each group chose a realistic environmental issue to study, produced videos and pictures, uploaded them to their blog and discussed their findings. Next, they decided how they could raise awareness among citizens about that particular issue. Some examples of the problems chosen were littering, erosion, increase of waste in poor neighbourhoods, and inappropriate use of drains.

During the following three-hour sessions, students analysed and evaluated the work of two other groups. For evaluation, a pre-defined rubric was used to generate questions and debates in the LMS discussion forum. The various assignments that were carried out were used to assess the course. Group work carried 50% weight in the final evaluation. The other 50% was divided between active participation in the classroom and the discussion forum, sharing resources, Internet search results, and evaluation of each other's work.

FINDINGS

Adoption of SCL and competency development

There was a shared feeling among students about the valuable contribution of group collaboration to their competency development. Their perception concerning the use of modern pedagogical practices had changed. One of the male students, 'I' (a pseudonym), described the changes in his mindset:

I___[male] 'At the beginning of this course, I could not take hold on the problems of my colleagues … nor formulate a constructive judgment … but now I understand how to help my colleagues ... and improve my own work after seeing the work of my colleagues.'

The above excerpt exemplifies that collaboration enabled students to take an active role in knowledge sharing. The decision-making processes in groups stimulated students to explore the views expressed by others. Analysis of blogs showed improvement of information management skills. Students collaborated to find information on the Internet about environmental problems, and they discussed their findings in order to come up with solutions. Working in groups requires interpersonal and communication skills, which are important professional characteristics in today's workplace (Young & Chapman, 2010). The following quote shows a combination of collaborative learning with ICT tools:

M___[female] 'We managed to select an environmental problem and uploaded pictures to illustrate it …. We also produced text to explain the pictures. This helped to discuss our topic with other groups .... We also managed to produce a video that showed our thinking.'

Since all the assignments were accessible online, students could comment and evaluate each other's work without the lecturer's interference. These activities contributed to critical and constructive thinking. M reported: 'This course and Web 2.0 tools helped us to reflect on our work and gave us a different vision on how to evaluate our own work and the work of our colleagues.' Constructive evaluation is essential for the development of critical thinking (Froyd & Simpson, 2008). Observation showed metacognitive development by students' learning from assessing their work with a rubric and by comparing their solutions with those of others.

ICT to facilitate adoption of SCL

The use of technology together with realistic and self-selected tasks increased students' intrinsic motivation, as in previous studies (Motschnig-Pitrik & Holzinger, 2002). R [female] commented: 'Real-world problems made me study the tasks more intensively, so I understood the topic better.' Students searched the Internet for relevant information, which enabled them to deepen their knowledge and to propose suitable solutions to environmental

problems. Reflection took place at each step of the learning process: orientation, problem analysis, and presenting conclusions. The method of learning in the course was a turning point for many students. They perceived the positive effects of collaborative and self-regulated learning as well as the advantages of modern ICT tools, all elements long campaigned for by the university.

Another positive effect was the increase in computer literacy. Students did not have smartphones or Internet connections at home and did not have email accounts or social networking accounts at the beginning of the course. During the course, all students learned how to create multimedia content with Web 2.0 tools and how to upload the content to various websites. The results confirmed Motschnig-Pitrik and Holzinger's (2002) argument that Internet technology is well suited for SCL as it enhances independent learning and problem-solving skills. Yet students had different perceptions of why and how technology was of value. Some appreciated tool-specific skills: 'I learned to edit videos and animate images with Moviemaker … and also to use a blog' (P [male]). Others emphasised the value of new tools for sharing knowledge: 'Now I can use a blog and share information about environmental conservation' (R [female]). Others mentioned growth of meta-knowledge: 'Now I understand why ICT is important .... I learned to select relevant information…. I also know how to learn without a teacher …. I can find solutions …. This is good when I have a job' (V [male]). Another student said: 'Multimedia is a strong tool for environmental education because you can illustrate what is wrong and what is good … and people learn faster.' Students' media literacy was developed, and they learned how to use Web 2.0 tools to produce digital content in different formats (videos, pictures and text).

The quality of group work improved throughout the course. All students learned to create and use blogs, and some students started to use Facebook and other social media instruments. They were able to discuss their cooperation and the final results.

Challenges found with the SCL approach

Observation showed differences between students' activity in the discussion forum. In the interviews, some of the less active students said that they lacked necessary basic ICT skills, while others disliked the new learning approach. Therefore, some additional explanation in the classroom meetings was needed on the use of the tools and on the participation that was expected.

Some students had difficulties adapting themselves to the new role of being an active learner that came along with SCL. According to Felder and Brent (1996), some resistance is to be anticipated when introducing SCL since its benefits are neither immediate nor automatic. In this study, SCL was introduced in a formal setting, which was new to most students. Therefore, the shift to ICT-based interaction and SRL raised problems. For example, some students waited until the time of the classroom meetings to ask questions, and others expected their lecturers to give direct help instead of using the course materials, rubrics or other self-guidance material. Those difficulties indicate a lack of confidence of learners in their own capacities, as P [male] explained: 'Most things were new …. I wasn't sure whether my group was doing the right thing .... Sometimes it wasn't easy to understand what the lecturers wanted from us.' Another challenge was how to comment on each other's work. Some students did not quite master the art of giving constructive feedback, which led to clashes.

Blog content and interviews showed that not all groups were successful in producing appropriate content for their selected problem. N [female] pointed out: 'In the presentation of your problem, your group spoke about the poor garbage collection by the city council, but the video that you uploaded reported health problems that arose from bad drainage maintenance. Although there is some relation between the two problems, they are not the same.'

DISCUSSION AND CONCLUSIONS

The interviews and assignments confirmed that students developed the generic competencies that this course was supposed to enhance: problem solving, collaboration, e-learning skills, information production on Web 2.0 and information search on the Internet. Mastering those skills is an absolute requirement for career readiness in the 21st century (Moeller & Reitzes, 2011).

Web 2.0 tools and the LMS supported the adoption of SCL. Similarly, SCL facilitated the technology-enhanced learning practices. The combination of e-learning and SCL worked well, even in this tradition-bound educational context. The Web 2.0 tools enhanced students' learning activities by stimulating them to write, collaborate, research, analyse, compare, debate, classify and publish what they had learned. Students searched for relevant information using the Internet and presented the information in appropriate formats. Even though the quality of the blog content varied between the groups, the results displayed students' growing ability to plan, organise and produce multimedia content. This was in line with the course objective: to develop information management

skills. The results of the pilot study confirmed other studies that also concluded that a combination of SCL and Web 2.0 tools enables students to explore information that is relevant to perform tasks at hand (Motschnig-Pitrik & Holzinger, 2002).

Most students did not feel too great a distance from the new practices, as they found that technology was of positive value for their construction of knowledge, even though some of them struggled to learn independently how to use these tools. The majority of students perceived the organisation of the course as exciting, which increased their intrinsic motivation. Several research studies confirm that SCL combined with modern technology is an enjoyable way to learn (Froyd & Simpson, 2008; Moeller & Reitzes, 2011; Motschnig-Pitrik & Holzinger, 2002; O'Neill & McMahon, 2005).

In terms of collaborative learning, group assignments encouraged communication, interpersonal skills, and knowledge sharing. However, students' level of engagement in group work varied. Previous studies showed that students without proper skills training work less effectively in groups (Brush & Soye, 2000). Hence, it would be incorrect to assume that every individual student benefitted equally from the group assignments. Also, individual performance was assessed by looking at active participation in the classroom and in the discussion forum, and by sharing materials and important resources.

In terms of competency development, the possibility to choose a real-life environmental problem as an assignment was motivating. Students showed that they could use available technology to find information, discuss problems and present a solution. Efficient use of technology promoted critical thinking and problem-solving skills. Evaluating group work, giving constructive feedback, commenting on group presentations and reflecting on how the learning process went all contributed to the gradual development of higher-order learning skills.

The implementation of SCL also faced several challenges. Not all students embraced SCL. This would hamper a wide-scale implementation of curriculum reform, as has been pointed out by several researchers (e.g., Schweisfurth, 2011). Furthermore, not all students adopted the available technology. They were not used to structuring their own work and assuming the role of an active learner. Students needed a lot of guidance and extra face-to-face meetings, as they had little experience in how to handle open-ended and (semi-)realistic assignments. This was an expected challenge, as it would be not very realistic to assume that students would perform perfectly on their first encounter with SCL. However, the adoption of SCL in a traditional learning environment could be improved by first giving a few smaller assignments as a way to carry out learning activities without direct instruction by the teacher. By practicing, students can slowly adapt to SCL (Froyd & Simpson, 2008; Brush & Soye, 2000).

The main reason for students' inability to use new technology was the traditional teaching and learning culture they were familiar with. This challenge has been pointed out in many previous studies and was expected to show up in this study as well (O'Neill & McMahon, 2005; Schweisfurth, 2011; Thanh, 2010). The buy-in time for SCL implementation varies and depends on the culturally appropriate distance between teachers and learners (Schweisfurth, 2011). In the case of Mozambique, students are used to receiving a lot of direct assistance from the lecturers, and they assumed that they would receive this during the pilot as well. When students had to work independently, they felt insecure and confused. Even though it is hard to change what is culturally appropriate, the pilot shows that with the necessary preparation and guidance, SCL can support the competency development of students.

The findings indicate that SCL and Web 2.0 applications have the potential to increase the quality of education in terms of equipping future graduates with necessary skills to perform as successful professionals in the 21st century labour market. The design of the pilot course and the lessons learned from this study are suitable to be adapted to other courses at UEM.

Because the results are promising, the university should continue to invest more in training lecturers in SCL. This new pedagogy is required to fulfil the requirements of the labour market to deliver competent students. By shifting to SCL—and using Web 2.0 tools—we believe that the quality of education at UEM will increase, especially in terms of a greater motivation, a better retention of knowledge, an increase in learning skills and a deeper understanding of the subjects taught (Froyd & Simpson, 2008). Lessons can be learned from the pilot study on how to realise a transformation of the direct teaching approach towards self-regulating learning. Guidance must enable students and teachers to leave behind the roles to which they are culturally accustomed. The curriculum must be restructured, and the assignments must be updated.

The findings presented in this paper about the improved learning results should be taken with some caution, as students had limited opportunities to practice their newly acquired skills. The solutions they presented for the environmental problems were theoretical. Hence, there is no assurance that the solutions will work in reality. Furthermore, the results of this study cannot be generalised to other populations outside this specific study. There is, however, no reason to believe the results would not be applicable, to some extent, to other similar contexts. The most important finding of this study was the successful test of a change in pedagogical approach and the development of ICT competencies that gave a push in the direction of SCL.

In further studies, it will be important to compare the learning outcomes before and after the introductions of pedagogical changes.

REFERENCE LIST

Alzu'bi, M. A. M. (2018). The degree of applying e-learning in English departments at Al-Balqa Applied University from instructors' perspectives. *Turkish Online Journal of Educational Technology, 17*(1), 192–196.

Amado, J. (2000). A Técnica da Análise de Conteúdo. *Referência. Revista de Educação e Formação em Enfermagem*. 5, 53-63.

Apiola, M., & Tedre, M. (2013). Deepening learning through learning-by-inventing. *Journal of Information Technology Education, 12*, 185–202.

Bardin, L.(2011). Análise de conteúdo. São Paulo: Edições 70.

Baeten, M., Struvyen, K., & Dochy, F. (2013). Student-centred teaching methods: Can they optimise students' approaches to learning in professional higher education? *Studies in Educational Evaluation, 39*(1), 14–22. doi:10.1016/j.stueduc.2012.11.001

Biggs, J. (1993). What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Educational Psychology, 63*(1), 3–19.

Biggs, J. B. (1987). *Student approaches to learning and studying* [Monograph]. Hawthorn, Victoria, Australia: Australian Council for Educational Research Ltd. Retrieved from https://files.eric.ed.gov/fulltext/ED308201.pdf

Billing, D. (2003). Generic Cognitive Abilities in Higher Education: An International Analysis of Skills Sought by Stakeholders. *Compare*, *33*(3) : 335-350.

Brush, T.; Soye, J. (2000). Implementation and evaluation of a student centered learning unit: A case study", *Journal Educational Technology Research and Development*, 48 (3), 79–100.

Butler, J. W. (2012). Grappling with Change: Web 2.0 and Teacher Educators. In Polly, D., Persichitte, K. & Mims, C. (Eds). *Technology in Teacher Education: Key Issues*, Hershey, PA: IGI Global.

Cossa, E. F. R., Tajú, G. A., Tembe, C. C. A., Domingos, L. N. C., Muianga, X., Rosário, L. S. C., Zimba, H. F., & Mambo, A. 2012. *Reflexão sobre a formação psicopedagógica dos professores do Ensino Superior*. Maputo: Universidade Eduardo Mondlane.

Coutinho, C. P. & Bottentuit Júnior, J. B. (2007a). Blog e Wiki: Os Futuros Professores e as Ferramentas da Web 2.0. *SIIE*. 199-204.

Creswell, J. W. (2007). Qualitative inquiry & research design: Choosing among five approaches (2nd ed.). Thousand Oaks, CA: Sage.

Felder, R., & Brent, R. (1996). Navigating the bumpy road to student-centered instruction. *College Teaching, 44*(2), 43–47. doi:10.1080/87567555.1996.9933425

Froyd, J., & Simpson, N. (2008, August). *Student-centered learning addressing faculty questions about student-centered learning*. Paper or poster session presented at the meeting of Course, Curriculum, and Laboratory Improvement, Washington DC. Retrieved at http://ccliconference.org/files/2010/03/Froyd_Stu-CenteredLearning.pdf

Greene, J. A., & Azevedo, R. (2007). A theoretical review of Winne and Hadwin's model of self-regulated learning: New perspectives and directions. *Review of educational research*, *77*(3), 334-372.

Hayes, D., Schuck, S., Segal, G., Dwyer, J., & McEwen, C. (2001). *Net gain? The integration of computer-based learning in six NSW government schools, 2000*. Retrieved at http://www.curriculumsupport.nsw.ed/learningtechnologies/files/Lea_netgain.pdf

Koshy, V. (2005). *Action research for improving practice: A practical guide*. Thousand Oaks, CA: SAGE Publications.

Kouwenhoven, W. (2003). *Designing for competence in Mozambique: towards a competence-based curriculum for the Faculty of Education of the Eduardo Mondlane University*, Doctoral dissertation, University of Twente.Enschede.

Laurillard, D. (2005). Styles and approaches in problem-solving. In F. Marton, D. Hounsell, & N. Entwistle (Eds)., *The experience of learning: Implications for teaching and studying in higher education* (pp. 126–144). Edinburgh: University of Edinburgh, Centre for Teaching, Learning, and Assessment.

Lui, A. K., Choy, S.-O., Cheung, Y. H. Y. & Li, S. C. (2006). A study on the perception of students towards educational weblogs. *Informatics in Education*, 5(2), 233-254.
Lonka, K., Olkinuora, E., & Mäkinen, J. (2004). Aspects and prospects of measuring studying and learning in higher education. *Educational Psychology Review, 16*(4), 301–323.
Males, S. A. (2010) Generic Engineering Competencies: A Review and Modelling Approach. *Education Research and Perspectives*, 37(1), 25-51.
Marton, F., & Säljö, R. (1976a). On qualitative differences in learning: I—Outcome and process. *British Journal of Educational Psychology, 46*(1), 4–11.
Marton, F., & Säljö, R. (1976b). On qualitative differences in learning: II—Outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology, 46*(2), 115–126.
Moeller, B., & Reitzes, T. (2011). Integrating technology with student-centered learning. Quincy, MA: Nellie Mae Education Foundation.
Motschnig-Pitrik, R., & Holzinger, A. (2002). Student-centred teaching meets new media: Concept and case study. *Educational Technology & Society, 5*(4), 160–172.
Muianga, X., Hansson, H., Nilsson, A., Mondlane, A., Mutimucuio, I., & Guambe, A. (2013). ICT in education in Africa—Myth or reality: A case study of Mozambican higher education institutions [Special issue]. *African Journal of Information Systems, 5*(3).
O'Neill, G., & McMahon, T. (2005). Student centred learning: What does it mean for students and lecturers? In *Emerging Issues in the Practice of University Learning and Teaching* (pp. 27–36). Dublin: AISHE Publications.
Rumsey, D. (1997). The changing workplace of the 21st Century: Implications for educators and trainers. Paper presented at the Annual Conference of the Australian Association for Research in Education. Retrieved at http://www.aare.edu.au/97pap/rumsd023.htm
Schweisfurth, M. (2011). Learner-centred education in developing country contexts: From solution to problem? *International Journal of Educational Development, 31*(5), 425–432. doi: 10.1016/j.ijedudev.2011.03.005
Stubbé, H.E. and Theunissen, N.C.M. (2008) Self-Directed Adult Learning in a Ubiquitous Learning Environment: A Meta-Review. In: Kalz, M., Koper, R., Hornung-Prähauser, V. and Luckmann, M., (Eds)., *Proceedings of the First Workshop on Technology Support for Self-Organized Learners*, RWTH Aachen University, Aachen, 5-28.
Tedre, M., Apiola, M., & Cronjé, J. C. (2011). Towards a systemic view of educational technology in developing regions. *AFRICON, 2011*, 1–8.
Thanh, P. T. H. (2010). Implementing a student-centred learning approach at Vietnamese higher education institutions: Barriers under layers of Casual Layered Analysis (CLA). *Journal of Futures Studies, 15*(1), 21–38. Retrieved at http://www.jfs.tku.edu.tw/15-1/A02.pdf
Universidade Eduardo Mondale. (2008). *Plano estratégico*: *2008-2012 [Strategic plan: 2008-2012]*. Retrieved from http://www.plano.uem.mz/images/PDF/Plano/PE20081.pdf
Young, J., & Chapman, E. (2010). Generic competency frameworks: A brief historical overview. *Education Research and Perspectives, 37*(1), 1–24.
Wragg, T. (2013). *An Introduction to Classroom Observation (Classic Edition)*. Routledge.
Zeininger, C. (2009) – The Use of ICTs in HEIs in Mozambique: Institutional Websites as Ambassadors for Educational Technologies? WSIS Knowledge Communities. Retrieved at www.wsis-community.org.
Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). San Diego: Academic Press.

High School Students' Proficiency Perceptions to the Usage of Technology Products at Physics Lessons

Aytekin ERDEM
Namık Kemal University, Vocational School of Technical Sciences, Department of Electronics and Automation, 59030 Süleymanpaşa-Tekirdağ/Turkey
aerdem@nku.edu.tr

Gürcan Uzal
Namık Kemal University, Vocational School of Technical Sciences, Department of Electronics and Automation, 59030 Süleymanpaşa-Tekirdağ/Turkey
guzal@nku.edu.tr

Mehpare Saka
Trakya University, Department of Elementary Education, 22000 Edirne/Turkey
msaka@trakya.edu.tr

ABSTRACT
The aim of this study was~~is~~ to determine the opinions of high school students' proficiency perceptions towards the technology products and their usage at physics lessons. Mixed method including quantitative and qualitative data collection tools was used for data collection. The study group consisted of 514 students studying at High Schools. The proficiency perceptions of high school students related to what they identified as technology products and the usage of these products at physics lessons were collected via 5 point Likert type scale developed by the researchers. The Cronbach α reliability coefficient of the developed scale was found as 0.84. The analysis of the scale data was conducted via SPSS packaged software with descriptive statistics methods. To analyze thoroughly the students' perceptions related to the technology products and their usage, semi-structured interviews were conducted with 34 volunteer students who were among the same study group. According to the results from the scale, although the students stated that they generally found their competencies to technology usage as good, the results from the interviews showed that the efficacy perceptions of students to these products were not only limited, also they did not use them effective enough in some subjects even poor or no knowledge or skill at all.

INTRODUCTION
The changes and improvements in technology not only affect business world but also at any point of our daily lives. While we live together with technological products such as visual media tools, video games, mobile phones, optical readers, remote controllers, mechanical and electronic toys etc., technology is included in education likewise and usage of technological tools in educational perspective has many advantages. Both traditional and new technological tools shape and accelerate the teaching process; they contribute to realize the educational activities.

In elementary education, Physics is a part of science lesson while in the secondary education Physics is a lesson which is established on conceptual bases with wide spectrum. Covering many fundamental and derived formulations, having inductive and deductive methods and setting an asset for using geometry and algebra skills, many students expressed that they perceive physics as a lesson heavily loaded with mathematics and that is the reason why it is hard to learn (Redish, 1994 cited in Örnek, Robinson and Haugan, 2008). In his studies examining the opinions about physics of high school students and teachers, Angell et al. (2004) stated that students defined physics lesson as hard to learn because of various notations such as experiments, formulations, calculations, graphics and at the same time conceptual explanations (Cited in Örnek et al., 2008). Physics lesson is considered as a purely numeral lesson so that it is thought that it is difficult to understand, learn and teach (Kolçak, Moğol and Ünsal, 2014), and most of the teachers teach Physics directly with formulations and it makes the lesson more difficult as making the students dealing with calculations instead of concepts. As a result, students have misconception about physics as they reconcile physics concepts and phenomena mistakenly. Some researches (Clement, 1982; Halloun and Hestenes, 1985) show that the hardship of physics education does not only stem from the teachers and students, but not using the necessary teaching methods and sufficient technology during the education also affects it. The complex information presented at the physics lesson might be visualized

(Kolçak et al., 2014) and with the help of various technologies they might be simplified and these techniques make students learn via living (Ramsden, 2002). It is stated that developing and using multimedia supported education activities for evoking the students' visual and intellectual bases affect students' success positively in teaching the acquirements of physics which is hard to understand (Harwood and McMahon, 1997; Kolçak et al., 2014).

Considering the students' increasing tendency of using technology and appealing their learning skills, many technologic products are using in physics/science teaching. In this context, it is highlighted that using proper education technologies such as IT products, Computers, Advanced Scientific Calculators and various teaching tools helps to realize the complete learning and constructive approach-based teaching activities, to appeal the students into the subjects of lessons and helps to increase the success levels of students (Gomes and Waits, 1996; Laughbaum, 2000). Trainings realized with computer-aided training software help to objectify and practice the science/physics concepts and enable some experiments to be done interactively with simulation applications via internet for which are difficult to create the suitable setting for applying in practice or buy devices for them (Altın, 2001; Fendt, 2004; Kiselev and Yanovsiky-Kiselev, 2004). In this framework, it is expressed that these kinds of applications (animation, simulation) realized with applets (Şengel, Özden and Geban, 2002) have more positive effects for perceiving many physics subjects such as displacement and velocity then the traditional laboratory applications. Besides, simulation methods carrying out by computer-aided trainings are more effective to attract the attention to science lessons then the other methods (Geban, Aşkar and Özkan, 1992; Hounshell and Hill, 1989).

We have encountered educational technological tools and computer-aided educational tools recently such as tablet PCs, smart boards called as interactive boards or electronic boards (Emre, Kaya, Özdemir and Kaya, 2011; Türel and Demirli, 2010) used in classrooms as in Turkey with the initiation of Fatih Project. Being interactive of the smart boards gives the opportunity to students and teachers to interfere the screen that means they are able to do changes during the lessons and save them (Erduran and Tataroğlu, 2009). Since the tools are relatively new, there is no persuasive in-depth knowledge from the teachers yet about their contribution levels and benefits to learning and teaching process. In addition, the studies showed that science and mathematics group teachers stated that using smart board positively affects learning environment by fostering the interest of students and making them more participative (Erduran and Tataroğlu, 2009). Controlled by touching on screen of the smart boards, it functions the same as using the mouse on the computers. Although smart boards resemble computers by the appearances usages, actually they have so many functions if they are used properly and effectively. Like other technological tools, while smart boards draw the attentions of students and make easier to learn from their perspectives, the students who enjoy learning via smart boards think that education technologies help them to learn new information and enable them to find a better job in future (Sünkür, Arabacı and Şanlı, 2012). Tablet PCs are among the devices gaining popularity and related to information technologies on which the students can take notes easily, draw graphics (Gök, 2012), access internet, listen audios, watch and record videos, read e-books and many other features (Shurtz, Halling and Mckay, 2011, cited in Aydemir, Küçük and Karaman, 2012). Having multimedia contents, tablet PCs make easier to all academic applications and exercises such as preparing lessons, home works, researches, scanning and designs (Gill, 2007). According to the latest researches, in case of using tablet PC especially at science lessons and other abstract lessons, the lessons become enjoyable, make the abstract concepts to be understood easily, maintain the retention on learning and increase the attention to the lesson (Aydemir, Küçük and Karaman, 2012; Daşdemir et al, 2012; Ellis-Behnke et al., 2003; Gorgievski et al., 2005; Fister and Mccarty, 2008; Bilen et al. 2009; Uzoğlu and Bozdoğan, 2012, cited in Özdemir, 2014).

While the above mentioned tools are widely and frequently used for educational purposes in some countries, the functions, importance and benefits of educational tools are ignored or are not effectively used for various reasons in other countries (Martin et al., 2008; Mullis et al., 2008). In this context, education technologies are determined as an investigation and research field, which tools are used how, where and how effective they are used are set the matters of questions (Alkan, 1997). When we examined the studies conducted in our country, there are researches about examining students' opinions and attitudes to the new technologies (Akgün and Yücekaya, 2015; Keleş, Öksüz and Bahçekapılı, 2013; Kurt, Kuzu, Dursun, Güllüpınar and Gültekin, 2013; Pamuk, Çakır, Ergun, Yılmaz and Ayas, 2013), the effect of smart board to motivation (Akgün, Yücekaya, 2015; Elaziz, 2008; İşman et al., 2012; Koçak and Gülcü, 2013; Türel, 2011) and its effect on the success of students (Çoklar and Tercan, 2014; Gençoğlu, 2013; Kaya, 2013). It was sent hat opinions of students and teachers were examined in the literature about the usage of Tablet PCs in teaching-learning environment (Aksu, 2014; Dündar and Akçayır, 2014; Küçükaydın, Bozdoğan and Öztürk., 2014; Özdemir and Bozdoğan., 2014; Uzoğlu and Bozdoğan, 2012). On the other hand, there is a research examining the perceptions of students on smart board in Physics lessons (Gürel, Olgun and Arslan, 2016). Yet there was nore search including high school students' self-efficacy and competency perceptions towards the usage of multiple technology products (smart board, tablet PC, MS

software, physics teaching software, scientific calculators etc.) at physics lessons. This study is important in this sense and it is thought that in the light of the results, this study will contribute on the usage of technology in education, especially on physics education by determining the important points to be paid attention and offering suggestions about the needs of students. The research problem of this study was "What is the level of opinions of high school students' proficiency perceptions to the usage of technology at physics lessons?"

METHOD

Research Model

This study was conducted in mixed method which is described as collecting data by integrating quantitative and qualitative approaches and presenting the collected data by analyzing and blending them (Baki and Gökçek, 2012; Creswell, 2014; Creswell and Clark, 2014,). Mixed method was used in this study to see the harmony and evaluate the answers in detail given to the measurement tool that was prepared for reaching out more people. For this reason, research pattern of this study is convergent parallel mixed pattern which combines qualitative and quantitative data enabling to analyze the data in a wider way (Creswell, 2014) related to the research problem.

Study Group

The students studying in Tekirdağ city, Süleymanpaşa Province in 2015-2016 academic years at High Schools of Science, Anatolian Teacher Training High Schools and Anatolian High Schools formed the study group. The sample of the study was designed as concurrent mixed methods sampling (Baki and Gökçek, 2012). Some demographic information of the volunteer students forming the study group was shown in Table 1.

Table1. Demographic Information of Students

Study Variables	Variables levels	Frequency (f)	Percentage (%)
Gender	Female	294	57
	Male	220	43
School Type	High School of Science	82	16
	Anatolian Teacher Training High School	84	16
	Anatolian High School	348	68
Grades	9th Grade	156	30
	10th Grade	126	25
	11th Grade	157	30
	12th Grade	75	15
Having Computer	Yes	494	96
	No	20	4
Having Internet Connection	Yes	469	91
	No	45	9

Data Collection Tools

Proficiency Perception of High School Students to the Usage of Technology at Physics Lessons (PPHSSUTPL) Scale

The scale was developed by researches aiming to get the proficiency opinions of high school students about usage of technology at physics lessons. Prepared in 5 point Likert type, the scale consisted of 9 items which were gathered under the single factor. The steps of scale were explained below.

Preparing the item pool: Related literature was reviewed by researchers, the measurement tools used in previous researches were examined and proficiency items were written for trial purposes by consulting the students' opinions. Five experts were consulted about the length, clarity and effectivity of items. Initially there were 10 proficiency statements about the usage of technology in physics teaching in the item pool.

Content validity ratios and finding the indexes: Content validity of 10 proficiency statements in the item pool about the usage of technology in physics teaching was refined through a form. The item pool was restructured by taking advices and feedback into consideration.

The content validity ratio (CVR) of prospective scale form was 0.99 for five expert opinions. Averaging CVRs which left in the form, content validity index (CVI) was found as 1.00. As CVI>=CVR, content validity of the whole scale was statistically significant (Yurdugül, 2005).

Structuring prospective form: 10-item prospective form was prepared whose content and validity was confirmed. Yet, "I have problems using graphic calculator" item was removed from the scale because graphic calculator, using for data collection and drawing graphics of these data, was mistaken for normal calculator. Positive question items in the prospective form were evaluated as 1 "Strongly disagree", 2 "Disagree", 3 "No idea", 4 "Agree", 5 "Strongly agree". The negative question items were evaluated as 1 "Strongly agree", 2 "Agree", 3 "No idea", 4 "Disagree", 5 "Strongly disagree".

Besides, there were 7 closed ended questions (gender, age, type of school, household income status, and internet connection/computer in the house) in the form to get the demographic information of participants.

Applying the prospective form: 10-item prospective form was applied to 20 students and was tested the clarity of the items. Then, it was applied to 61 students form 9^{th}, 10^{th}, 11^{th} and 12^{th} graders.

Calculating the structure validity: Exploratory and confirmatory factor analyses were carried out to determine the structure validity of the scale.

Exploratory factor analysis: Kaiser-Meyer-Olkin value, which identifies the reliability of sampling, was found as 0.903. The scale consisted of 9 items which were gathered under the single factor. Explained by this factor, total variance was 46%. The values of factor loadings varied between 0.539 and 0.782.

Confirmatory factor analysis: As a result of confirmatory factor analysis, it was found that chi-squared/df = 96.28/27 = 3.56. According to the analysis, fit indices were calculated as GFI=0.96, AGFI=0.94, NFI=0.97, NNFI=0.97, CFI=0.98, RMSEA=0.068.

Reliability calculation: The reliability of scale was calculated as 0.84. There was no reverse coded items in the scale and total scores determined as the results of scaling ranged from 9 as the lowest, to 45 as the highest score.

Interview: The interviews were conducted to get the opinions of high school students about the usage of technology at physics lessons. 34 students studying in different schools and grades were interviewed on the volunteer basis. Firstly, a question pool formed by semi-structured questions was composed by the researchers. Then, three experts were consulted by selecting the proper questions from the pool. According to the opinions of experts, the interviews were conducted with 9 questions. The following questions were asked in the interviews:

1. What comes to your mind when technology is said?
2. What comes to your mind when Information communication technology is said?
3. Do you use technology at the lessons?
4. Do you use smart boards at physics lessons? How do you use it?
5. Do you use software at physics lessons?
   Probe: On which stages and how do you use it?
6. On which purposes do you use information communication tools?
   Probe: Do you use them while doing your homework? How do you use it?

Demographic Information Form: The form was composed by the researchers to have the demographic information of the students participated in the research. The questions were asked to find out the students' genders, school types, grades and whether or not they have computers and internet connection in their houses.

Implementation Process: The research was started with developing ***PPHSSUTPL*** scale. The scale was applied to 514 high school students after validity and reliability analyses. After applying the scale, semi-structured interviews were conducted with 34 volunteer students among 514 students to get the in-depth knowledge. The interviews were recorded to refrain from lose the data and check/use them again during the analysis.

Data Analysis

Determining the proficiency levels for technology usage of high school students, the scores gathered from ***PPHSSUTPL*** scale were shown in Table 2 with options used on evaluating the scale and score intervals.

Table 2. The Evaluation of Scale Data Based on the Options of Scale and Score Intervals

Options	Scores	Score Intervals
Strongly Agree	5	4.20 - 5.00
Agree	4	3.40 - 4.19
No Idea	3	2.60 - 3.39

Disagree	2	1.80 - 2.59
Strongly Disagree	1	1.00 - 1.79

For data analysis of ***PPHSSUTPL*** scale, SPSS-PASW Statistics analysis program was used with conducting descriptive analysis. The average and standard deviation values of each one of the items were calculated.

The interviews used for qualitative data tool were transcribed in to a Word document by the researchers. While analyzing the data, open coded system was used for determining the codes and sub-codes at first, then inductive analysis method (Merriam, 2013; Patton, 2014) which was constituted the themes was adopted. The data obtained from the both data collection tools was organized in an integrated way and presented in the findings chapter. In order to support the findings and comments from research analysis (Merriam, 2013), the direct quotations were excerpted from the semi-structured interviews during the implementation process.

FINDINGS AND COMMENT

Analysis of the qualitative and quantitative data collection tools that were used within the scope of the research problem have been gathered and presented in this section.

During the interviews that had been conducted with the students, answers were given by students in order to set forth how they perceived technology, and it was found that great majority (f:15) of the students defined technology as "an electronic device, tool that facilitates our life". While some students (f:7) have defined the technology as a tool to reach the information, and as a communication tool, some students (f:8) have stated the technology as a communication device that provides one-to-one meeting, so that smart telephone is conceived by these students primarily when technological device is mentioned. Furthermore, while great majority of the students (f:28) have stated smart telephone, computer as technological device one each primarily; it has been ascertained there were some comments such as "S31: I do not consider the devices such as refrigerators, TVs as technological any more". Quotations from the expressions of the students regarding definition of the technology are stated below:

S01: Devices and information, developing, facilitating the life, meeting needs.
S08: The thing that can do anything at any time whatever I want.
S09: Tools manufactured by people practically in order to increase welfare level of the people.
S14: Innovations that facilitate the life.
S18: Electronical devices that facilitate the life.
S05: They facilitate researching; we are able to find anything at any time we want.
S25: To research, access information, we can take advantage of it, we can learn.

Data that was acquired from the ***PPHSSUTPL scale*** which had been applied to determine proficiency levels of the high school students regarding usage of the technology at physics lessons, who have defined the technology as the tools that facilitate the life in general, have been seen in the Table 3 below.

Table 3. Descriptive statistics of the proficiency perceptions of the high school students regarding usage of technology at physics lessons

Items		$\overline{X}$	**S**
I01	I have no problem for using of the Interactive (Smart) Board.	3.98	0.96
I03	My skills are adequate for using of the MS (Microsoft) Software in the computer.	3.90	0.94
I07	I prepare my homework easily by using appropriate software.	3.87	0.96
I10	I am able to use the technology in the lessons productively.	3.82	1.01
I09	I know functions of the Information Technology (Information Communication)	3.76	0.93
I08	I make calculations easily by using appropriate software.	3.65	0.95
I05	I do use scientific calculation machine (having keys such as Sin, Cos, Log. Etc.) easily.	3.39	1.14
I02	I am qualified to use Tablet PC within the activities of physics learning.	3.28	1.16
I04	I use physics learning software conveniently.	3.22	1.03

According to the results that had been acquired from the scale of ***PPHSSUTPL***, it was ascertained that students have deemed themselves at "I agree" ($\overline{X}$ =3.65) level. According to the results from the scale, although total

average of the students was at $\overline{X}$=3.65 level and while 18 of them deemed themselves were sufficient at computer concerning usage of the technological devices during the interviews conducted with the students; 16 of them deemed themselves sufficient for using of telephone. Students, who had indicated that they used computer and telephone for using of the technology, had stated that they used computer mainly for the purposes of to make researches through search engines over the internet, to understand better the subjects taught in the school, which they could not learned, to listen course lecturing from different web sites, to play game and to enter into social media sites. There are some quotations from the statements of students below:

S18: "I use it either for homework, or research and knowledge acquisition; sometimes I play game as well."
S23: "Mobile phone is handy I am able to access easier."
S05: "I am able to make any research from mobile phone what I want, I can talk to my friends."
S11: "I write directly to the search engines and it comes in view."
S30: "I use mobile phone frequently, because it is with me every time."

As it has been seen from the explanations above; students stated that usage frequency of the telephone has been increased since using of telephone is easier, and many things that the computer has made can be made via telephone as well and easy to carry feature of the telephone.

And again, as it has been seen from the Table 3, students answered as they agree to the I10 item ***"I am able to use the technology in the lessons productively"*** at ($\overline{X}$=3.82) level. During the interview, students who deemed themselves at adequate level regarding "I use the technology in the lessons productively", thought the smart board directly as a technological device in the lessons, and this was seen in the expression as well S10: "Since there are smart boards now, they have also been included in the technology directly, we have already taught our lessons and therefore we use technology". During the interview, while students have stated only smart board was used (f:34) as technology usage in the lessons, in the subsequent sections changing of the usage types and durations of the smart board at Physics lessons have been specified.

Students, who stated the smart board was used in many lessons in the interviews, have indicated that it was used since it provided facility by reflecting of the lectures and questions visually. Sample student expressions have been seen below:

S03: "We have been using the smart board mainly for visuals and some drawings, since writing and erasing is more comfortable".
S09: "We have been learning lessons mainly on the smart board; there are pdf formatted publications and we have been solving questions upon them".
S14: "Directly smart board; generally at Physics lessons and other lessons you may play video regarding the questions that were saved by the teachers in advance; and so forth some teachers show pictures by downloading during the teaching of the subject. They are able to prepare tests or teachers are able to make copy-paste, prepare visuals and teaching of the lessons upon the smart board is more convenient".
S28: "Each teacher does not use it; we follow the lessons through presentations during some lessons (there are book pages in the smart board) (purposed for learning of the subject) Yes, we have been watching videos, there are photos. There are also some lessons that we have not used it either".
S29: "We do not go on the internet; there are pdf files in the smart boards; there is information and learning; learning of the subject. First the teacher lectures the subject on the board, if there is any issue deficit according to him/her; we look books from the smart boards. Course books have also been uploaded".

It has been seen from the explanations that technological devices are used mainly in order to support traditional lecturing and to add some more visual quality and to facilitate it.

As it has been seen from expressions made by some (f:10) of the students such as; S9: "I have never done homework by using technology"; S32: "We have never prepared any homework, performance from physics lesson"; S33: "Homework is not given at Physics lessons toward using of technology, frankly an appropriate homework has not been given.", students have not done homework toward using of the technological devices productively.

When the Table 3 has been examined, it was observed that answers of the students to the item **I01: *"I have no problem for using of the Interactive (Smart) Board"*** were at the level "I agree" ($\overline{X}$=3.98). During the interviews that were made by the students mutually; while all of the students indicated that they use smart board

as the most important technological device; most of the students (f:26) deem themselves as adequate and some of them (f:8) deem as partially adequate. Some quotations from expressions of the students toward using of the smart boards are seen below;

S14: "Sure I am adequate enough to apply the issues taught in the lessons".
S19: "I am able to use and we may write as well, it is already enough."
S16: "Yes I may use it, as required."
S31: "Yes, sure I am inadequate since I have not used it continuously, but I may use it enough as the others, but I am not adequate completely".

Additionally, when students have been asked during the interviews how they learned the smart board, some of them indicated that (f:18) they learned by observing and simulating the teacher; few (f:5) stated that they learned by guidance and commands of the teacher. Furthermore, some of the students (f:9) stated that they learned by taking advantage of its similarity to the computer.

A great majority of the students (f:21) indicated that using of the smart board was realized in the physics lessons, and some of the students (f:5) stated that it has been sometimes used. Besides, some students (f:8), who stated that the smart boards had not been used, were ascertained during the interviews. It was remarked that (f:9) the smart board had been used mainly in order to lecture the courses upon then pdf formatted ready to use books; and (f:12) for the purpose of seeing questions from different sources. Expressions of the students regarding how the smart board was used in the physics lessons have been provided below:

S27: "Textbooks were loaded; we have been uploading textbooks and auxiliary books for example, and we have been solving questions from them as well."
S30: "Generally for solving of the problems".
S07: "It is like this; the teacher uploads textbook in the program; we open the book loaded in the computer; there are blank sections, missing sections in the textbooks, we fill in the blanks through the board."
S22: "Rather the teacher comes and opens the subject on the computer that she/will lecture; we solve questions on the board."
S29: "We mostly solve questions, subject is lectured from there; we do not use it for any other purpose."
S09: "There is pdf format of the publication and we have textbook, and in the same way we follow from the book and solve questions. The teacher explains us on the board upon the question."

As it has been observed from the sample expression below; some part of the students (f:6) have opinion that smart board has created advantage for them, since ready figures and questions are displayed on the board and this issue especially enables them to solve more questions.

S30: "It is especially useful at Physics and mathematics; because there are many figured questions and we do not waste time by drawing it. Instead of 5 questions, we solve 15 questions and it is advantageous for us."
S01: "Especially there is no problem such as chalk, board marker is consumed".

In addition to the expressions above regarding usage of the smart board, students stated that the smart board is used to write (f:10) as a normal board; to watch video (f:5) and to view slides (f:2) as well.

According to the results that were acquired from the ***PPHSSUTPL*** scale; responses ($\overline{X}$=3.28) given by the students to the item I02 ***"I am qualified to use Tablet PC within the activities of physics learning"*** have been determined as "I do not have any idea" level. During the interviews that had been made with the students, each of the students stated that tablet pc was not used in the lessons. It was also ascertained that only some students used it for writing purposes instead or writing on notebook.

In the implemented ***PPHSSUTPL*** scale, it has been seen that students deemed themselves at "I agree" level ($\overline{X}$=3.76) regarding the item I09 "***I know functions of the Information (Information Communication) Technology".*** During the interviews that were made with the students face-to-face, it has been observed that some of the students (f:12) defined the information communication technology as to obtain information primarily from computers and smart telephones through internet and some devices such as TV and radio afterwards. Again it was determined through the following comments, some of the students had declared that they did not have adequate knowledge regarding the informatics; and (f:8) perceived the social communications that had been performed primarily upon smart phones and computers afterwards upon internet, as the information technologies when examining their statements as (f:4) S29: "Is the Informatics as a thing such as to

reach something; I mean I have never heard it."; S4: "Actually it doesn't make any sense, again it is a branch of technology and a network that was established on the communication… anyhow it doesn't make any sense."

Students stated in the interviews that they usually used (f:14) computers and smart phones as information communication devices while they obtained information by making research upon internet and to learn concepts that they have not known. Furthermore, they stated that they have used them in order to make information retrieval (f:10) and to observe the subjects upon internet, which they could not learn sufficiently in the school, and to repeat the subjects (f:10) as well. Moreover, as seen from the statements below, it was understood that students used the information communication devices to obtain encyclopedic knowledge (f:13) regarding their homework.

S10: "I mean, too much research homework had not been given concerning physics, and lastly I made homework about particles of the atom, I performed slide presentation, researched from internet and did it, I had researched subatomic particles in my previous homework."

S18: "It has been given but it is encyclopedic knowledge for information purpose."

It has been understood that they participated in the opinions of the ***PPHSSUTPL*** scale I04 "I do use physics learning software conveniently" ($\overline{X}$=3.22) at the "I have No Idea" level. During the interviews that had been made with the students, as it has been indicated in the explanations above, the smart board had been used only as a board and as an alternative to the blackboard and had been defined as device provides saving of time.

Furthermore, it has been observed that they responded to the I08 Item of the ***PPHSSUTPL*** scale ($\overline{X}$=3.28) "I make calculations easily by using appropriate software" at "I agree" level and to the I05 Item "I do use scientific calculation machine (having keys such as Sin, Cos, Log Etc.) conveniently ($\overline{X}$=3.39)" at "I have no Idea" level. During the one-to-one interviews that had been made with the students, only one of the students stated that she/he had used scientific calculator. Again, it has been observed that students responded to the I03 Article "My skills are adequate for using of the MS (Microsoft) Software in the computer" ($\overline{X}$=3.90) and I07 "I prepare my homework easily by using appropriate software" ($\overline{X}$=3.87) of the ***PPHSSUTPL*** scale at "I agree" levels. However, opposite of scale results, it has been observed that software programs were used in the physics lessons scarcely (f:4) and some of these usages were realized for once only, as stated by the expressions of the students below.

S31: "I think we had done it once; since it was too efficient we decided to make experiments with our methods. We watched virtual experiments only."

S04: "We have been using only StarWord software for the solutions; it is simple software and it is an easy program for drawing purpose."

Furthermore, based on the expressions below; it has been observed that since many of the homework that had been requested for preparing of presentation, hence they knew using of limited programs: S31: "Here it is Word, Excel, PowerPoint; since I made many presentations I mean I am pretty good at them". S16: "Telephone, internet, computer; Operating systems – but not too much. Office programs- yes they are, for homework".

Additionally, in the interviews that had been made with the students, they were requested to provide their proposals for usage of the technology at Physics lessons, if any. It has been observed in the explanations that were made by the students as they could not use technology at their physics lessons very efficiently. Some of the comments given by the students are as follows:

S09: "In my opinion the subject that we treated is too numerical, it hangs in the air, we do not make practice, it remains in theory exactly, as I see it".

S11: "…. If there were simulations lecturer would have been better, but unfortunately physics syllabus is too intensive and teachers have difficulty to keep up them and could not allocate time for such kind of things… they all remain in theory… Formulas are given, some questions are solved, and we are obliged to pass it".

S14: "In fact there are many things to be learned in physics, but due to the examination system that we are subjected, we do not interest with the learning of physics too much… we try to learn how we will solve the subject. Such kinds of things cause waste of time".

S19: "I would like more usage of smart board in my school, and I wish using of it more efficiently in some physics lessons based on visual issues such as optics. Our teacher does not do this. Abstract subjects are difficult to perceive. I have difficulties to understand them personally; I think I may understand better through more visual issues and videos, in terms of understanding of the logic; and

not to memorize them".

S33: "In my opinion, we should use software programs and Java programs as you have said. We have smart board and according to me it is appropriate for this issue; however we may not use due to intensive syllabus, but we should use it more often and we should reflect this".

When the above specified expressions were taken in to consideration, it has been seen that students have opinion usage of the technology more efficiently, especially for abstract concepts since they are difficult and to make them more understandable. Due to examination system and intensive education programs, students cannot take advantages of these devices and they state their deficiencies in terms of learning through their explanations as "we do not interest learning of physics. (…) We cannot learn the subject, we try to learn how solve the problem."

DISCUSSION AND CONCLUSIONS

Alongside the today's education that lifelong learning approach has been taken into basis thoroughly, changes and improvements at the information technologies have increased the importance of the information technologies that are used in the education herewith. These changings and improvements that have been experienced in the technology cause changing and improving of the individuals in other words increasing of their technology oriented knowledge and skills, as well as transferring of them into the daily life even more. Students, who are at the center of the learning approaches, have been expected to be interrogator, researcher and explorer individuals by providing active participation to learning. In this direction, alongside the awareness levels, students should have knowledge and skills at high level for using the education technologies. In this study that was performed within this context, it was observed that students generally perceived their proficiency of technology usage as "I agree" level and, regarding how they perceive technology, students generally identified technology as tools that facilitate the life. In the study that Herdem, Aygün and Çinici (2014) had performed with the 8th grade students, it was determined that students had an idea that electronical devices were a must-be when technology was mentioned. In addition, most of the students have considered one-to-one communication between the people when communication was mentioned, and in terms of technological devices students enumerated put smart phones and computer primarily. Though, technology has been defined not only as the electronical devices but also application of tools, materials and methods by improving them, which were manufactured for fulfilling of human needs and producing of solution (Kaya, 2006; Reiser, 2007). Hence, while enumeration of the smart phones, computers and similar derivative tools by the students as the technological devices, indicates efficiency of the accessibility (Herdem, Aygün and Çinici, 2014), it also indicates that students do not consider other products out of these ones, in order to include them in technology class. Again, enumeration of the smart phones and computers by the students primarily in the education and especially at Physics education can be taken in to consideration, as they have perceived information retrieval upon internet as education applications. Though, the education technology that has been focused on learning includes many processes such as information, storage, method, technique and mutual interaction (Alkan, 1997; Kaya, 2006; Uşun, 2006).

Results that were obtained by the student interviews have indicated that Smart boards, which were come to the agenda through Fatih Project and distributed many schools have been considered by the students as the heavy-duty technologic devices, which are used at Physics lesson as well as other lessons. However, it has been understood that usage of smart boards are considered dominantly as they provide time saving and remove the problems such as dust, ending of board marker, caused by the other boards. Again the students have indicated that the smart board has been used mainly for the purposes of lecturing, providing visual materials and screening of a written material by reflecting it. It can be said that the reasons for not using of the smart boards at physics lessons without serving its purpose, have been caused mainly by viewpoint of the teachers and their proficiency levels. However, students who said "***I do not have any problem for using of the interactive (smart) board"*** ($\overline{X}$=3.98) stated that they learned usage of smart board by simulating their teachers. Thus, students are capable to use the smart boards as their teachers have known and used them. When actions that were realized and were not realized by the teachers have been taken in to consideration, the importance or the teacher comes in to the picture, in terms of attitudes of the students. Furthermore, the examinations such as Undergraduate Placement Exam and Transition to Higher Education, are an important problem of our education system. A perception of necessity to be prepared these examinations by multiple choice test method was improperly formed in teachers, students and their families. Because of the improper perception, students think that they can learn the subject by doing multiple choice test questions instead of learning the subject. Therefore, students aim to do more test questions and do them faster when they prepare for the exams. It can be said that it has affected usage of the technology more efficiently during the lessons. It has been understood that teachers perceived interactive boards for reflecting and displaying of the ready presentations and documents on the board (Pamuk, Çakır, Ergun, Yılmaz and Ayas, 2013), and thus they realized such kind of usages. It has been observed in the performed studies that this situation was caused by not providing sufficient training in our country for the teachers, who

realized this education and students subsequently (Gülcü et al., 2013; Keser and Çetinkaya, 2013; Pamuk, Çakır, Ergun, Yılmaz and Ayas, 2013; Somyürek, Atasoy and Özdemir, 2009; Türel, 2011).

It has been observed that students, who were partially adequate about smart board, did not realize usage of Tablet PC at Physics lessons as well. One of the reasons regarding for not using of tablet pc was that they were not distributed to all classes as well as their usage was not realized even in the distributed classes. Hence it has been seen that tablet PCs which their purposes are technology supported education do not serve to their purposes. Teachers have more negative approach for usage of the tablet PCs in comparison with the usage of smart boards and they indicate that they are insufficient in terms of their received education (Dağhan et al., 2015), these opinions of the teachers have seen in their lecturing processes as well. The study that was performed by Pamuk et al. (2013) has indicated that teachers require training, either pedagogic or professional point of view, regarding usage of the Tablet PC. Altın and Kalelioğlu (2015) determined in their studies that both teachers and students were in negative attitude regarding usage of the tablet PCs. The idea of tablet PCs were not used for educational purposes showed parallelism with our study.

In today's world, making of trained person and equipped with skills such as reaching the information, gathering of the information, for evaluating of the information, representing of information and establishing communication is very important. In the context of this research, while students have defined the usage of information communication technology as to obtain information only upon the internet, it has been understood that they were not informed about reaching to the information, storing and evaluation of it as well as and using of the information for mutual exchange in a group and especially usage purposes of the information in the education (Kahyaoğlu, 2011; Wellington, 1985). Furthermore, it has been ascertained that students perceived information communication technology as to establish one-to-one communication among the persons by considering smart phones primarily, as they did in the perception of the technology. It has been determined in the study that was performed by Sarı and Altun (2015) that students perceive the technology related to teaching of mathematics by their class teacher as the projection device and computer and they prefer usage of interactive education web sites as well as ready presentations and materials (source books and questions) from internet. It has been evaluated that course of actions of the teachers affected thinking of the students in the education process as well.

Again another impressive conclusion is that the students are not aware from usage of simulation type programs, which facilitate the concretizing the abstract concepts and facilitate learning at the Physics lessons and they are not aware even existence of such kind of programs. Though, while simulation type software programs remove hazardous situations and decrease costs, they provide bringing of some physical situations at visual situations especially. At the same time they provide possibilities such as obtaining of the students and teachers quick results, when they focus on the subject, as well as graphic drawing, data collection and immediate amendments (Kim and Hannafin, 2011; Newton and Rogers, 2003; Osborne and Hennessy, 2003). Furthermore, it has been ascertained that students have not had adequate knowledge and skills about many software programs that have been used at the physics education. It has been observed that students use some MS Office programs such as PowerPoint and Word when they prepare their homework, in addition to limited smart board usage in the schools. It has been determined in the study that was performed by Gürcan (2008) that student perceive that they see themselves as active in using the MS program. According to the obtained findings of the research, it has been understood that effectiveness such as graphic drawing and calculation with simulations were not implemented by the teachers; thus students did not have efficacy levels for these applications. It was an important outcome that although students have negative experience and insufficient information, they are in need of using education technologies such as visual experiments, some software programs, simulations especially for learning of the abstract concepts and providing of permanent learning.

In accordance with the obtained results, especially teachers are required to orientate students more efficiently for using of the technological devices. Again, it is unfolded that teachers should provide more active usage of technological devices and software programs, both in the lessons and homework they have given to the students; yet it is obvious that first teachers should be educated with undergraduate education or in-service training. Furthermore, it should be aimed to make the syllabus suitable for performing of more applications and to educate teachers and students as more sufficient individuals at the present day through the devices beyond traditional expression and learning.

Acknowledgement
We would like to thank to the contributions of Directorate of National Education in Süleymanpaşa – Tekirdağ for permitting us to conduct the face-to face interviews and students who have participated in the study voluntarily.

REFERENCES

Akgün, M. & Yücekaya, G. K. (2015). Akıllı tahta kullanımına yönelik öğrenci tutumu ve öğretmen görüşlerinin incelenmesi (Ankara ili örneği), *NWSA- Qualitative Studies*, *10*, 1-11.

Aksu, H.H. (2014). An evaluation in to the views of candidate mathematics teachers over "tablet computers" to be applied in secondary schools. *Turkish Online Journal of Educational Technology, 13* (1), 47-55.

Alkan, C. (1997). *Eğitim teknolojisi* (5. Baskı). Ankara: Anı Yayıncılık.

Altın, K. (2001, Eylül). *Fizik dersinde bilgisayar kullanımı: Bir simülasyon yardımıyla ders geliştirilmesi.* Fen Bilimleri Eğitimi Sempozyumu. Maltepe Üniversitesi, İstanbul.

Altın, H. M. & Kalelioğlu, F. (2015). Fatih Projesi ile ilgili öğrenci ve öğretmen görüşleri (Perceptions of Students and Teachers about Fatih Project). *Başkent University Joumal of Education*, *2*(1), 89-105.

Aydemir, M., Küçük, S. & Karaman, S. (2012). Uzaktan eğitimde tablet bilgisayar kullanımına yönelik öğrenci görüşlerinin incelenmesi. *Eğitim ve Öğretim Araştırmaları Dergisi*, *1*(4), 153-159. https://scholar.google.com.tr/ alanından 25.05.2016 tarihinde alınmıştır.

Baki, A. & Gökçek, T. (2012). Karma yöntem araştırmalarına genel bir bakış. *Elektronik Sosyal Bilimler Dergisi*, *11*(42), 1-21.

Clement, J. (1982). Student's preconceptions in introductory mechanics. *American Journal of Physics*, 50, 66.

Creswell, J. W. (2014). *Nitel araştırma yöntemleri* [Qualitative research methods] (S. B. Demir B. Çev.). Ankara, Turkey: Siyasal Kitap.

Creswell, J.W. &Clark, V.L.P. (2014). *Karma yöntem araştırmaları, Tasarımı ve Yürütülmesi*. (Y. Dede ve S.B. Demir, Çev.) Ankara. Turkey: Anı Yayıncılık.

Çoklar, A.N. & Tercan, İ. (2014). Akıllı tahta kullanan öğretmenlerin akıllı tahta kullanımına yönelik görüşleri. *İlköğretim online*, *13*(1), 48-61.

Dağhan, G., Nuhoğlu Kibar, P., Akkoyunlu, B. & Atanur Başkan, G. (2015). Öğretmen ve yöneticilerin etkileşimli tahta ve tablet bilgisayar kullanımına yönelik yaklaşımları ve görüşleri. *Turkish Journal of Computer and Mathematics Education*, *6* (3), 399-417.

Daşdemir, İ., Cengiz, E., Uzoğlu, M. & Bozdoğan, A. E. (2012). Tablet PC'nin fen bilimleri derslerinde kullanılmasıyla ilgili fen bilimleri öğretmenlerinin görüşlerinin incelenmesi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *9*(20), 495-511.

Dündar, H. & Akçayır, M. (2014). Implementing tablet pcs in schools: Students' attitudes and opinions. *Computers in Human Behavior, 32,* 40–46.

Elaziz, F. (2008). *Attitudes of students and teachers towards the use of interactive whiteboards in EFL classrooms* (Yayınlanmamış yüksek lisans tezi, Bilkent Üniversitesi, Ankara). http://www.thesis.bilkent.edu.tr/0003608.pdf adresinden edinilmiştir.

Emre, G., Kaya, Z.,Özdemir, T.Y. & Kaya, O.N. (2011, Mayıs). *Akıllı tahta kullanımının fen ve teknoloji öğretmen adaylarının hücre zarı yapısı konusundaki başarılarına ve bilgi teknolojilerine karşı tutumlarına karşı etkileri*. 6th International Advanced Technologies Symposium (IATS'11), Elazığ, Turkey.

Erduran, A. & Tataroğlu, B. (2009, Mayıs). *Eğitimde akıllı tahta kullanımına ilişkin fen ve matematik öğretmen görüşlerinin karşılaştırılması.* 9th International Educational Technology Conference (IETC2009), Hacettepe Üniversitesi, Ankara, Turkey.

Fendt, W. (2004). Java Applets on Physics. *http:// www.walter-fendt.de/ph11/index.htm* den alınmıştır (2004, March 29)

Geban, Ö.,Aşkar, P. & Özkan, I. (1992). Effects of computer simulations and problem-solving approaches on highschool students. *The Journal of Educational Research*, *86*(1), 5-10.

Gençoğlu, T.(2013). *Geometrik cisimlerin yüzey alanları ve hacmi konularının öğretimde bilgisayar destekli öğretim ile akıllı tahta destekli öğretimin öğrenci akademik başarısına ve matematiğe ilişkin tutumuna etkisi* (Yayımlanmamış yüksek lisans tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara). https://tez.yok.gov.tr/UlusalTezMerkezi adresinden edinilmiştir.

Gill, T.G. (2007). Using the tablet PC for instruction. *Decision Sciences Journal of Innovative Education, 5*(1), 183-190.

Gomes, P. & Waits, B. (1996). *Roles of calculators in the classroom.* Proceedings of Icme-8, Una Empresa Docente, USA.

Gök, T. (2012). Real-time assessment of problem - solving of physics students using computer-based technology. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *43*, 210-221.

Gülcü, A., Solak, M., Aydın, S. & Koçak, Ö. (2013). İlköğretimde görev yapan branş öğretmenlerinin eğitimde teknoloji kullanımına ilişkin görüşleri. *Turkish Studies- International Periodical for the Languages, Literature and History of Turkish or Turkic*. *8*(6),195-213.

Gürcan, H.D.(2008). *Bahçeşehir Fen ve Teknoloji Lisesi öğrencilerinin BT yeterliliklerinin ölçülmesi için bir model* (Yayımlanmamış yüksek lisans tezi, Bahçeşehir Üniversitesi, İstanbul).

http://acikerisim.bahcesehir.edu.tr:8080/xmlui/bitstream/handle/123456789/1000/071503.pdf?sequence=1 adresinden edinilmiştir.
Gürel, C., Olgun, H. & Arslan, A. (2016). Fizik dersinde öğrencilerin akıllı tahta kullanımı ile ilgili algıları. *Journal of Human Sciences*, *13*(2), 2804-2819. doi:10.14687/jhs.v13i2.3816 2819 p.
Halloun, I. A. & Hestenes, D. (1985). The initial knowledge state of college physics students. *American Journal of Physics*, *53*(11), 1043-1055.
Harwood, W. S. & McMahon, M. M. (1997). Effects of integrated video media on student achievement and attitudes in highschool chemistry. *Journal of Research in Science Teaching*, *34*(6), 617-631.
Herdem, K., Aygün, H. A. & Çinici, A. (2014). Sekizinci sınıf öğrencilerinin teknoloji algılarının çizdikleri karikatürler yoluyla incelenmesi. *Amasya Üniversitesi Eğitim Fakültesi Dergisi*, *3*(2), 232-258.
Hounshell, P. B. &Hill, S. R. (1989). The microcomputer and achievement and attitudes in highschool biology. *Journal of Research in ScienceTeaching*, *26*(6), 543-549.
İşman, A., Abanmy, F. A., Hussein, H. B. & Al Saadany, M. A. (2012). Saudi secondary school teachers attitudes' towards using interactive whiteboard in classrooms. *Turkish Online Journal of EducationalTechnology - TOJET*, *11*(3), 286-296.
Kahyaoğlu, M. (2011). İlköğretim öğretmenlerinin Fen ve Teknoloji dersinde yeni teknolojileri kullanmaya yönelik görüşleri. *Journal of Educational Sciences Research, International e- Journal*, *1* (1), 79- 96.
Kaya, Z. (2006). *Öğretim Teknolojileri ve Materyal Geliştirme*. Ankara: Pegem A yayıncılık (2. Baskı).
Kaya, G. (2013). *Matematik derslerinde akıllı tahta kullanımının öğrencilerin Dönüşüm Geometrisi üzerindeki başarılarına etkisi*. (Yayımlanmamış yüksek lisans tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara). https://tez.yok.gov.tr/UlusalTezMerkezi adresinden edinilmiştir.
Keleş, E., Öksüz, B. D. & Bahçekapılı, T. (2013). Teknolojinin eğitimde kullanılmasına ilişkin öğretmen görüşleri: fatih projesi örneği. *Gaziantep University Journal of Social Sciences, 12*(2), 353-366.
Keser, H. & Çetinkaya, L. (2013). Öğretmen ve öğrencilerin etkileşimli tahta kullanımına yönelik yaşamış oldukları sorunlar ve çözüm önerileri. *Turkish Studies- International Periodical for The Languages, Literature and History of Turkish or Turkic*. *8*(6), 377-403.
Kırbağ Zengin, F. Kırılmazkaya, G. & Keçeci, G., (2011, September). *Akıllı tahta kullanımının ilköğretim öğrencilerinin Fen ve Teknoloji dersindeki başarı ve tutumuna etkisi*. 5th International Computer ve Instructional Technologies Symposium, Fırat University, Elazığ, Turkey.
Kim, M. & Hannafin, M. (2011). Scaffolding problem-solving in technology-enhanced learning environments (TELEs): Bridging research and theory with practice. *Computers and Education*, *56*, 403– 417.
Kiselev, S.& Yanovsky-Kiselev, T. (2004, April 09). *Interactive Physics and Math with Java*. http://www.physics.uoguelph.ca/applets/Intro_physics/kiselev/ den alınmıştır.
Koçak, Ö. & Gülcü, A., (2013). Fatih projesinde kullanılan lcd panel etkileşimli tahta uygulamalarına yönelik öğretmen tutumları. *Kastamonu Eğitim Dergisi, 21*(3), 1221-1234.
Kolçak, D.,Y., Moğol, S. & Ünsal,Y. (2014). Fizik öğretiminde kavram yanılgılarının giderilmesine ilişkin laboratuvar yöntemi ile bilgisayar simülasyonlarının etkilerinin karşılaştırılması. *Eğitim ve Bilim39*(175), 154-171.
Kurt, A. A., Kuzu, A., Dursun, Ö. Ö., Güllüpınar, F. & Gültekin, M. (2013). FATİH projesinin pilot uygulama sürecinin değerlendirilmesi: öğretmen görüşleri. *Journal of Instructional Technologies &Teacher Education, 1*(2). 1-23.
Küçükaydın, Z., Bozdoğan, A.E. & Öztürk, P. (2014). Secondary school students' views in a village school about the use of tablet computers in science course. *Mevlana International Journal of Education (MIJE)*, *4*(2), 52-58.
Laughbaum, E. D. (EDS.) (2000). *Hand-Held Technology in Mathematics and Science Education: a Collection of Paper.* Ohio: The Ohio State Uni. Pub.
Martin, M.O., Mullis, I.V.S. & Foy, P. (WithOlson, J.F., Erberber, E., Preuschoff, C., &Galia, J.). (2008). *TIMSS 2007 International Science Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades.* Chestnut Hill, Ma: TIMSS & Pirls International Study Center, Boston College.
Merriam, S. B. (2013). *Nitel araştırma, desen ve uygulama için bir rehber* [Qualitativeresearch: A guide to design and implementation] (S. Turan, Çev.). Ankara, Turkey: Nobel Yayınevi.
Mullis, I.V.S., Martin, M.O. & Foy, P. (withOlson, J.F., Preuschoff, C., Erberber, E., Arora, A., Galia, J.). (2008). *TIMSS 2007 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades.* Chestnut Hill, Ma: TIMSS ve PIRLS International Study Center, Boston College.
Newton, L. & Rogers, L. (2003). Thinking frame Works for planning ICT in science lessons. *School Science Review*, *84*(309), 113-120.
Osborne, J. & Hennessy, S. (2003). *Literature review in science education and the role of ICT: Promise, problems and future directions*. Bristol, Nesta Future Lab.

Örnek F., Robinson R. W. & Haugan, P. M. (2008). What makes physics difficult? *International Journal of Environmental & Science Education*, *3*(1), 30-34.
Özdemir, U. (2014*). Fen Bilimleri öğretmenlerinin tablet bilgisayarların derslerde kullanımına ilişkin görüşlerinin farklı değişkenler açısından incelenmesi: Giresun İli Örneği*. (Yayımlanmamış yüksek lisans tezi, Giresun Üniversitesi, Giresun). https://tez.yok.gov.tr/UlusalTezMerkezi adresinden edinilmiştir.
Özdemir, U. & Bozdoğan, A, E. (2014). Fen bilimleri öğretmenlerinin tablet bilgisayarların derslerde kullanımına ilişkin görüşlerinin farklı değişkenler açısından incelenmesi: Giresun ili örneği. *Cumhuriyet International Journal of Education-CIJE, 3*(1), 59-73.
Pamuk, S., Çakır, R., Ergun, M., Yılmaz, H. B. & Ayas, C. (2013). The use of tablet PC and interactive board from the perspectives of teachers and students: Evaluation of the FATİH Project. *Kuram ve Uygulamada Eğitim Bilimleri*, *Educational Sciences: Theory&Practice*, *13*(3), 1799-1822.
Patton, M. Q. (2014). *Nitel araştırma ve değerlendirme yöntemleri* [Qualitative research and evaluation methods]. (M. Bütün ve S. B. Demir, Çev.). Ankara, Turkey: Pegem Akademi.
Ramsden, E. (2002). *An introduction to computer simulation and modeling*. Retrieved from http://www.sensorsmag.com/articles/0602/life/
Reiser, R. A. (2007). *What field did you say you were in? Defining and naming our field. In Trends and issues in instructional design and technology* (2nd ed.) (pp. 2-9). Upper Saddle River, NJ: Pearson Education, Inc.
Sarı, M. H. & Altun, S. A. (2015). Sınıf öğretmenlerinin matematik öğretiminde teknoloji kullanımı üzerine nitel bir araştırma. *International Journal of Eurasia Social Sciences, 6*, 24-49.
Somyürek, S., Atasoy, B., & Özdemir, S. (2009). Board's IQ: What makes a board smart? *Computers & Education*, *53*(2), 368-374.
Sünkür, M., Arabacı, İ., B. & Şanlı, Ö. (2012). Akıllı tahta uygulamaları konusunda ilköğretim II. kademe öğrencilerinin görüşleri (Malatya İli Örneği). *NWSA-Education Science, 7*(1), 313-321.
Şengel, E., Özden, Y. & Geban, Ö. (2002). Bilgisayar benzetişimli deneylerin lise öğrencilerinin yer değiştirme ve hız kavramlarını anlamadaki etkisi. *V.Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi,* Cilt 2, (pp. 1424-1429), Ankara, Türkiye: ODTÜ
Türel, Y. K. & Demirli, C. (2010). Instructional interactive white board materials: Designers' perspectives. *Procedia-Social and Behavioral Sciences*, *9*, 1437-1442.
Türel, Y. K. (2011) An interactive white board student survey: Development, validity and reliability. *Computers & Education, 57*(4), 2441-2450.
Uşun, S.(2006). *Öğretim teknolojileri ve materyal tasarımı*. Ankara: Nobel Yayın Dağıtım.
Uzoğlu, M. & Bozdoğan, A.E. (2012). An examination of preservice science teachers' views related to use of tablet pcs in science and technology course in terms of different variables. *Mevlana International Journal of Education (MIJE), 2*(1), 1-14.
Wellington, J. J. (1985). *Children, Computers and the Curriculum: an introduction to information technology in education*. Paul Chapman Publishing.
Yurdugül, H. (2005, Eylül). *Ölçek geliştirme çalışmalarında kapsam geçerliği için kapsam geçerlik indekslerinin kullanılması*. XIV. Ulusal Eğitim Bilimleri Kurultayı, Pamukkale üniversitesi, Denizli, Türkiye.

Iews of Pre-Service Teachers on Internet Supported Learning

Fırat Sarsar
Ege University, Turkey
firat.sarsar@ege.edu.tr

Stephen Harmon
Georgia Institute of Technology, United States
swharmon@gatech.edu

ABSTRACT
Having knowledge of computer hardware is one of the skill sets of computer teachers that allows them to understand and predict hardware problems in advance. Therefore, computer hardware courses are often added as required courses in pre-service teacher curricula in Instructional Technology Departments. This study aimed to understand the effectiveness of one such course with the integration of internet technologies. 44 students enrolled in this course in a western public university in Turkey. Students used an online learning environment in addition to a traditional face to face classroom setting for 14 weeks during the 2015-2016 Fall Semester. Participants were divided into two groups. One of the groups, which was called Bloggers, wrote all their learning experiences and outcomes in their blog postings. The other group, which was called Webbers, designed a website to share their knowledge. Both groups also shared other new technologies which could help them to improve their professional skills. During the 14-week explanatory case study, data were collected from students` reflection papers, forum postings, researcher's journal and learning outcomes. Data were analyzed by following content analysis strategies. The results show that for the majority of students, integrating internet technologies into traditional classroom settings motivated them to engage more during the course. However, some of students who created websites noted that the additional responsibilities were overwhelming. Creating a website and maintaining it were challenges for them. On the other hand, students who were blogging their learning experiences noted that they had fun during the course. They also highlighted that writing comments for each blog posting helped them to learn more by sharing their knowledge. Both groups thought that they enriched their content knowledge during the course.

INTRODUCTION
The emerging technologies have that have been integrated into education are often labelled as different pedagogical approaches, such as blended learning, hybrid classes, flipped learning, etc. Bates and Sangra (2011) mention that combining these technologies and approaches, such as occurs with blended learning, has ushered in a new era of strategies in higher education. Educators, especially in higher education, have more opportunities to apply emerging technologies into educational settings.

Nowadays, students have become comfortable with using new and different technological tools and applications in universities. This is a natural outcome for them as digital natives. Also, students in the new era have become not only tech-savvy people in their lives, but also learners who would like to use technology in learning processes. Sandars & Morrison (2007) suggest teachers need to be aware of students' needs and expectations in the use of technology in education. It can seem quite a challenge to know and decide how those needs can be met, but there are many educational tools that can help in educational settings. Blessinger and Wankel (2012) mention that wikis, blogs, and WebQuests allow teachers to increase students' engagements in learning environments. Using other tools such as websites, social media, and Web2.0 tools assist to enhance learning processes (Ifinedo, 2017; Sarsar, Başbay and Başbay, 2015). Sarsar, Kaval, Klasser & Güneri (2016) highlight that digital materials might also increase students' motivation.

Goh and Kale (2016) define Web 2.0 as a read-and-write web which gives an opportunity for users to create and edit content on the web. The number of tools for those contributions has increased in recent years, as blogs, websites, social media tools, etc become more common. These all may be effective online teaching tools for student-oriented learning environments. Internet technologies may contribute to meaningful learning by supporting collaborative and interactive learning environments (Lee & Tsai, 2010). But unless teachers also take advantage of the affordances of these technologies by using appropriate pedagogies, their potential may be

wasted. Therefore, teachers need to integrate different instructional strategies and various technologies for efficient teaching and learning (Chang et al., 2015; Santos, García and Díaz, 2016).

Blogs have strong potential to be used in educational purposes (Ifinedo, 2017). Kim (2008) suggests that blogs are affordable and user-friendly for teachers to use in educational settings. Blogs provide an easy-to-use platform for not only teachers but also students; therefore blogs could have an important role in teaching and learning by effectively using text, images, videos, audio, and so on for learning. Blogs enhance content by using those media, and improve communications skills by allowing discussions of blog posts. Students might use their critical skills by posting their learning experiences, while reading, and commenting on their teachers' or peers' blog posts.

Web2.0 technologies such as blogs, websites, and wikis can increase students' motivation and create more dynamic learning situations (Blessinger and Wankel, 2012). Internet technologies in educational settings occupy very important part of the learning process. Santos and his colleagues (2016) mention the internet as a powerful and motivational "weapon" in various educational levels.

Those technologies can be meaningful by using them to create an effective learning environment, which is one of responsibilities of instructors. Therefore instructors should be aware of creating learning activities to enhance meaningful interaction and effective learning (Blessinger and Wankel, 2012).

Using web technologies in educational settings can increase students' satisfaction and provide effective learning environments (Jeong, Ramírez-Gómez & González-Gómez, 2017; Gaines, 2017). Therefore, the incorporation of online teaching and learning tools may bring different perspectives of both teachers' teaching processes and students' learning processes. Kosloski (2016) highlights that available online tools give many advantages such as enriching learning environments and letting students focus on the task. He also mentions that those tools offer active learning environments for all level of learners.

Acquaro's (2017) study results show that the most effective online tools for students should require less set up, less organization and less activity. In other words, the increasing complexity of using online tools may decrease the effectiveness of the teaching and learning process. However, complex tools that are just slightly beyond learner capability may be used with proper scaffolding from the teacher. This finding shows similarity to Vygotsky's (1978) theory of the zone of proximal development. It refers to completing or performing a task with learners' own skills or with guidance. That is, if the task is complex to learn, learners may not use their own skills to find the learning path, so it may decrease willingness of learning. But at the same time, learners' gains may be increased by supporting them in tasks which they could not complete just on their own, but can complete with some assistance.

Gaines (2017) suggests that technology supported learning environments in higher education should be studied annually to understand the effectiveness of learning process. This study attempts to do that. It investigates learners' views on internet supported learning by utilizing internet technologies in a computer hardware course. It also examines how these technologies affect student engagement.

METHODOLOGY

This explanatory case study aimed to understand students' views on the effectiveness of a computer hardware course with the integration of internet technologies. Case studies allow for exploration of contemporary contexts or events (Sarsar, 2014). A case study can be limited to a single individual, a group of individuals, courses, events, programs, etc. (Bassey, 1999; Yin, 2009). By nature most case studies are qualitative (Yin, 2009) and require qualitative analysis strategies to make data more meaningful. A single case study mainly has a single unit of analysis which is defined as the case in the study. This study defines the case as the course of Computer Hardware.

Data Collection Tools

Data were collected by (i) students` reflection papers, (ii) blog/website forum posts, (iii) researcher's journal, and (iv) learning outcomes.

(i) Students` reflection papers: Students were asked to write their reflection on the course itself and their learning process. Students were to write their reflection papers voluntarily without an award in any grade or bonus event.

(ii) Blog/Website forum posts: Both groups (bloggers and webbers) had opportunities to type their comments in both environments. The comment box under each blog post and webpage were collected as data.

(iii) Researcher's Journal: The lead researcher took notes during the study. The journal included important states which might affect research.

(iv) Learning outcomes: Students created presentations and recorded their own content with related videos to upload on blogs and websites. They also wrote and structured the content of information, and shared the results of their research processes for assigned topics for each student. The relation between design and content of websites and blogs were also considered as learning outcomes.

Data Analysis

All data were analyzed qualitatively. Content analysis was employed by analyzing (i) students` reflection papers, (ii) blog/website posts (iii) researcher's journal, (iv) learning outcomes.

Data were analyzed by following content analysis strategies. Schreier (2012) describes steps for content analysis after selecting materials as (i) creating a code frame, (ii) categorization of coding (iii) testing coding frame, (iv) modifying coding frame, (v) shaping main analysis, and (vi) instructing a strong interpretation.

During this study, researchers followed the steps below which were completed twice. (See Figure 1)

Step 1. Classification: The raw data were classified.

Step 2. Coding process: A code sheet was created by body/unit of text such as (i) students` reflection papers, (ii) blog/website posts, (iii) researcher's journal, and (iv) learning outcomes.

Step 3. Categorization: The categories were defined by using the code sheet.

Step 4. Theme: The categorization phase was addressed as literature-related themes.

In the first round, data were analyzed by researchers. During the second round, a sample part of data was analyzed by three other experts independently. In this round, a sample of four coded data sets were compared and the code frame was finalized. After data coding was finished, the data were abstracted.

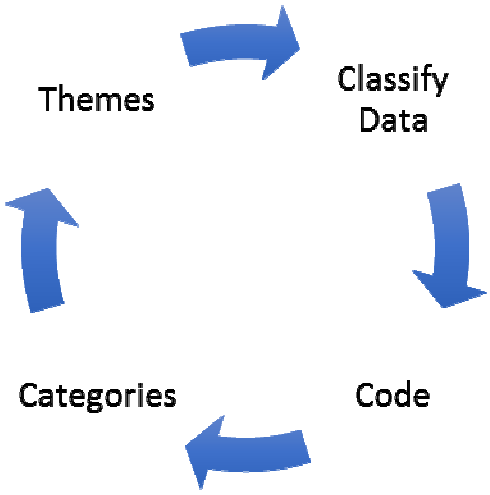


Figure 1: Data Analysis Process

Participants

There were 44 sophomore students who enrolled in a computer hardware course at a western public university in Turkey. The nature of the course had two groups which were assigned randomly. The course content included the computer and its hardware system. The course aimed to explain computer components and computer hardware problems seen in professional environments and the practical solutions of those problems.

Design

The Computer Hardware course was designed as a 14-week course. Students used an online learning environment in addition to a traditional face to face classroom setting for 14 weeks during the 2015-2016 Fall Semester (See Figure2).

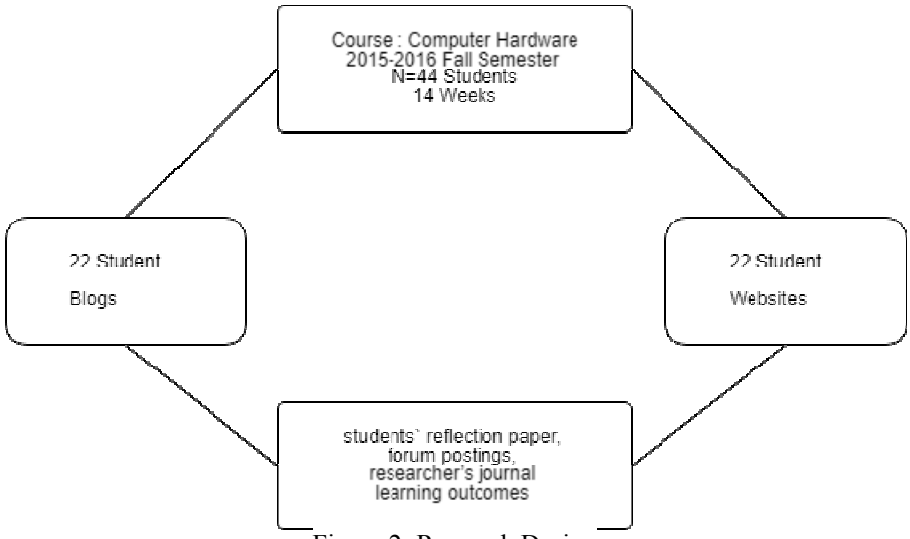


Figure 2: Research Design

During the first week of the study participants were randomly divided into two groups and were given instruction for the course explaining the expectations of the course. One of the groups, which was called Bloggers, wrote all their learning experiences, research results, and outcomes in their blog posts. They created a blog account for the course and each student had free access to write, read, and edit blog posts. Students created content and designated additional materials to enrich their contents. The other group, which was called Webbers, designed a website to share their knowledge. They created their own websites and delivered the content via their internet pages. Each group wrote on different topics related to computer hardware for each week. The last week of the study, students were asked to write their own reflections on their learning process and the way the course was delivered.

RESULTS

The results of this study fell into two categories. These categories are students' views and researchers' view on internet-supported learning environments.

Students' view on internet supported learning environment

The majority of students felt that integrating internet technologies into traditional classroom settings motivated them to engage more during the course. As seen in Table X, the first two most common themes of students on internet supported learning environment were the same for both groups. They reflected that using different internet tools for learning was motivating and fun.

Table1: Students' Views on Internet Supported Tools

Bloggers	Webbers
Motivation	Motivation
Fun	Fun
Easy-to-use	Learning new technology
Teamwork	Increase problem solving skills
	Team work
	Challenges
	Overwhelmed

However, some of the students who created websites noted that the additional responsibilities were overwhelming. Webbers considered that creating a website and maintaining it were challenging for them. They also mentioned that although learning new technologies was fun, it forced them to deal with additional sets of problems. However, they believe that handling those problems also helped them to improve their problem-solving skills (See Table 1).

Both Bloggers and Webbers mentioned that writing comments for each post helped them to learn more by sharing and discussion. However, some of the students in the Bloggers group highlighted that they had fun

during the course, but after the 5th week, using the blog was too easy and sometimes writing there became boring.

> S1B: *"…blogging was great option for us to work on. I feel that I am on the right track to do my homework by blogging. It motives me to do more."*

> S1W: *"I cannot say creating a website is easy but the designing process and showing what we have done to the other classmates was so great. I was willing to write more. It was like an online exhibit, fun and colorful."*

> S2W: *"I had a hard time to learn some codes and designing tools. I was working on creating the website more than doing my task"*

> S3B: *"If I ask a question of myself about how fun it was to post our weekly task in our blog? The answer is definitely YES. I am writing my topic and adding my comments to enrich my context. It is a great motivation to have fun"*

> S6W: *"Sometimes I was hoping to see the end of the course. I got tired and so frustrating during the course. I was enjoying creating the website but I felt that I was really tired to do all the duties on my own."*

> S17W: *"I hadn't had those many problems in any of my courses before. I was dealing with not only technical problems but also designing problems. I felt that I became an expert by solving all those problems. At the end, I learned a lot, as much as I enjoyed the course"*

> S19B: *"The teamwork had a great value for my learning. I took my own responsibilities during the submission and posting process. I needed a hand and teamwork made everything easier. I wouldn't expect more…"*

At the end of the course, it was asked that both the groups share their experiences on internet-supported learning in a forum environment. Students mentioned more thoughts on internet-supported learning in their reflection papers. Their thoughts were categorized into four topics. These topics are (i) motivation, (ii) learning, (iii) teamwork, and (iv) course requirement. See Figure 3 below.

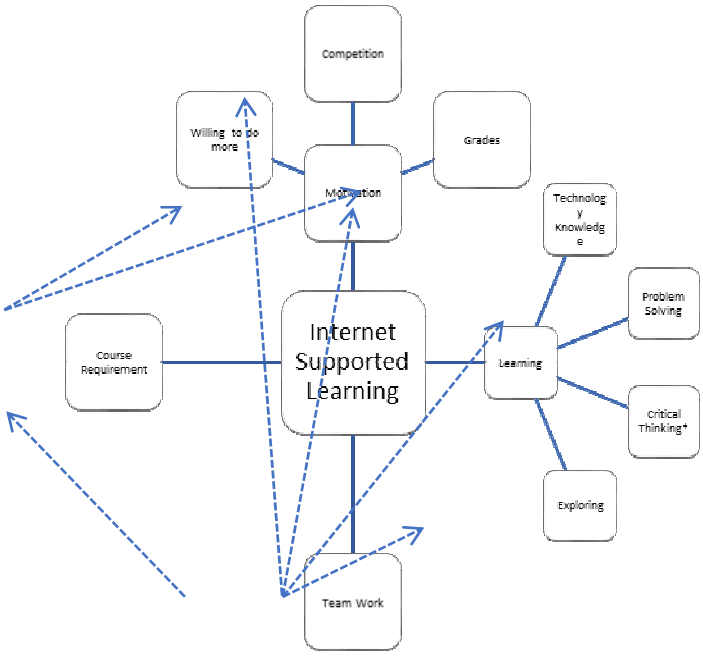


Figure 3: Student Reflections on Internet-Supported Learning

Students mentioned that they would like to add learning materials as much as they could. The majority of students stated that adding new learning materials and making the learning environment effective were motivating. Also, each week tasks were completed by different groups of students in a competition to show their design skills to their classmates. Grades were one of the strongest motivations for students. Although they did consider that grades were important to pass the course by meeting course requirements, they noted that other learning outcomes such as blogging, creating websites, and teamwork were more important than grades. They also said that facing problems let them improve their problem-solving skills and increase their exploring ability to find the right solution to each problem in a correct matter.

> S7B: *"I was so confused at the beginning of the course, because I didn't get why our teacher was giving those task and extra responsibilities. Moreover, I was worried about completing the course. Middle of the semester all my thoughts changed "*

> S7W: *"…this course was more than a designing a website or finishing our homework. I realized that it had own philosophy. I learned by doing. While achieving my goals I saw many challenges, but overcoming all the problems made me a great problem solver. I can say now, there is nothing to be scared of if you know how to think…"*
>
> S18B: *"Teamwork was great but being responsible for others' attitudes was not that nice. Because not all of us were focusing on real problems"*

Researchers' view on internet-supported learning environment

According to notes in the researcher's journal, students had different challenges during the study. It was observed that each group had their own difficulties and boundaries. The lead researcher reflected that students stopped enjoying writing blogs around mid-semester because they started to think it was a monotonous process to perform. They also complained that posting something in blogs was very easy and didn't improve their technical skills. It was not expected that students were looking for more challenges. Although bloggers mentioned they learned a lot during the semester, they were willing to have more challenging tasks. On the other hand, webbers mentioned their learning experiences very often. Although they were complaining about HTML codes, they believed that they learned more than they had expected. They also reflected that weekly changes in websites were time consuming, because they needed to create a new page for each topic weekly. Even though they believed that they learned new technologies while doing their classwork, each week came with an extra challenge to accomplish. It was clearly observed that Webbers were exploring new things to add and enrich their websites more than bloggers. Bloggers found the simplest ways to create and maintain their blogs. They typically did not add anything new for the purpose of enriching their blogs.

> RJ3: *"Blogger are doing great and they submit their homework on time, but webbers haven't obeyed the timing rules. When I ask them the reasons, they mention additional works let them delay"*
>
> RJ5: *"… some students in Blogger group asked to give them another task instead of blogging. The said that blogging was too easy and getting boring…"*
>
> RJ6: *"Bloggers started to complain."*
>
> RJ7: *"This week, webbers had issues on HTML coding and they said they need extra time to submit homework. Although I gave them extra time', they couldn't finish on time. But after the submission, I realized that they add some HTML codes in their assignment to show what they learned while doing their task"*
>
> RJ13: *"we are almost the end of semester, webbers are happy to learn some extra stuff, but being familiar with coding was a problem. On the other hand, bloggers were willing to add more into their blogs. I think either too easy or too difficult tasks are not encouraging students learn more. "*

Learning Outcomes

Overall, learning outcomes based on students' blogs and websites were assessed by three experts. Experts views on learning outcomes categorized them into four categories: (i) Content, (ii) Effectiveness, (iii) Innovative, and (iv) Design.

Table2: Students' Evaluation on Using Internet Supported Tools

Bloggers	webbers
Effectiveness	Innovative
Content	Design
Design	Content
Innovative	Effectiveness

As seen Table 2, three experts stated that bloggers focused on effectiveness and content more than webbers. Webbers focused on more innovativeness and designing than Bloggers. Those results also show that students in the webbers' group spent more time in designing and trying some new technologies to enrich their content. Therefore, they might decrease the priority of effectiveness of the teaching and learning process. On the other hand, bloggers mentioned that they had limited options for designing blogs and adding new learning materials to develop the content.

> S3B: *"...could just change the colors of blog and wanted to add additional videos and couple of images but it turned to a messy design. Then we gave up…"*
>
> S8W: *"...I felt that I spent time more than was necessary for designing my website page. It was taking time forever. That is why I was sending all my assignments at the last moment."*
>
> S14W: *"he[her teammate]was so busy to find new things to add our website to make it more fancier than others. However we were having a hard time to write our task almost each week. Anyway our website page was perfect…"*
>
> S18B: *"... were doing our task very quick and sending to blog and that is it…"*
>
> S22B: *"...tried to change the design of our blog but it didn't work. It didn't allow us to do those changes as we wanted."*

DISCUSSION

This exploratory case study investigated the students' perspectives on internet supported learning in a course at a large public university. Technology enriched the educational outcomes of the students. However, this doesn't mean that using many technological tools in educational settings improves students' learning skills. On the contrary, doing so ineffectively may decrease students' motivation and their willingness to learn. Learning new technologies in education might create an extra stress for students while doing their main tasks related to the course. As the Yerkes-Dodson law in 1908 states, arousal stress and performance have a significant relationship (Deshpande and Kawane,1982). That means stress might affect the performance in both positive and negative ways. Therefore, instructors should be aware that learning new and unfamiliar technologies might increase stress in a negative way. Moreover, it might be thought that if the task was too easy to do, it might decrease the stress more than expected, therefore task might be boring or attract no willingness to complete it. This might be the reason why students mentioned that blogging became boring after mid-semester. This also might be interpreted with Vygotsky`s Zone of Proximal Development theory which refers to completing or performing a task at the edge of a learner's own skills or with guidance (Vygotsky, 1978). That means if the task is too easy it causes boredom which causes students to learn less. On the contrary, if the task is too difficult, it makes them overwhelmed which also causes them to learn less. Likewise, bloggers found the simplest ways to create and maintain their blogs. They typically did not add anything new while creating their blogs. This might be a limitation for blogs, because they have a fast-publish (write and upload) process. Acquaro (2017) stated that students would prefer to have less complicated tasks. Therefore, very simple or too difficult tasks reduce the efficiency of the course. Instructors should be careful while giving specific tasks to students.

Students mentioned that when learning and working together to do their tasks better a competition started in a positive way. This unplanned competition created a motivation for completing their task weekly. It might be

interpreted that competition encouraged them to put more effort into completing their tasks. Lin and Young (2017) mentioned similar results in their study. They highlighted that competitions let students collaborate and encourage each other.

This study shows that teaching with internet technologies can have some challenges, such as being difficult-to use, unfamiliarity, too easy tasks and so on. It can also lead to real benefits such as increased motivation and problem-solving skills. Instructors should choose the most effective tools considering by students' skills, and prior knowledge. They should carefully monitor student's progress and continuously adjust the task load and difficulty level to ensure that students are working in the optimal zone for learning.

REFERENCES

Acquaro, P. E. (2017). *Investigation of the selection, implementation, and support of online learning tools in higher education* (Order No. 10259577). Available from ProQuest Dissertations & Theses Global. (1906670138). Retrieved from https://search.proquest.com/docview/1906670138?accountid=10699

Bassey, M. (1999). Case study research in educational settings. Philadelphia: Open University Press.

Bates, T., & Sangra, A. (2011). Managing technology in higher education. San Francisco: Jossey-Bass.

Blessinger, P., & Wankel, C. (2012). New directions in higher education: An introduction to using wikis, blogs, and webquests. In *Increasing Student Engagement and Retention Using Online Learning Activities* (pp. 3-16). Emerald Group Publishing Limited.

Chang, H. Y., Wang, C. Y., Lee, M. H., Wu, H. K., Liang, J. C., Lee, S. W. Y., ... & Wu, Y. T. (2015). A review of features of technology-supported learning environments based on participants' perceptions. *Computers in Human Behavior*, *53*, 223-237.

Deshpande, S. W., & Kawane, S. D. (1982). Anxiety and serial verbal learning: A test of the Yerkes-Dodson Law. *Asian Journal of Psychology & Education, 9*(3), 18-23.

Gaines, L. L. (2017). *Web-based technology integration and student engagement in a fully online graduate program* (Order No. 10246320). Available from ProQuest Dissertations & Theses Global. (1848682530). Retrieved from https://search.proquest.com/docview/1848682530?accountid=10699

Goh, D., & Kale, U. (2016). The urban–rural gap: project-based learning with Web 2.0 among West Virginian teachers. *Technology, Pedagogy and Education*, *25*(3), 355-376.

Ifinedo, P. (2017). Examining students' intention to continue using blogs for learning: Perspectives from technology acceptance, motivational, and social-cognitive frameworks. *Computers in Human Behavior*, *72*, 189-199.

Jeong, J. S., Ramírez-Gómez, Á., & González-Gómez, D. (2017). A web-based scaffolding-learning tool for design students' sustainable spatial planning. *Architectural Engineering and Design Management*, *13*(4), 262-277.

Kim, H. N. (2008). The phenomenon of blogs and theoretical model of blog use in educational contexts. *Computers & Education*, *51*(3), 1342-1352.

Kosloski, M. (2016). Web Tools: Keeping Learners on Pace. *Technology and Engineering Teacher*, *75*(8), 16-20.

Lee, M. H., & Tsai, C. C. (2010). Exploring teachers' perceived self efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science*, *38*(1), 1-21.

Liu, I. F., & Young, S. S. C. (2017). An exploration of participative motivations in a community-based online English extensive reading contest with respect to gender difference. *Interactive Learning Environments*, *25*(1), 48-61.

Schreier, M. (2012). Qualitative content analysis in practice. London; Thousand Oaks, Calif.: Sage Publications

Sandars, J., & Morrison, C. (2007). What is the Net Generation? The challenge for future medical education. *Medical teacher*, *29*(2-3), 85-88.

Santos, A. M., García, J. A. C., & Díaz, R. G. (2016). Websites of learning support in primary and high school in Portugal: a performance and usability study. In *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 1121-1125). ACM.

Sarsar, F., Başbay, M., & Başbay, A. (2015). Öğrenme-öğretme sürecinde sosyal medya kullanımı. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *11*(2).

Sarsar, F., Kaval, M. E., Klasser, G. D., & Güneri, P. (2016). Impact of internet supported dental education: Initial outcomes in a study sample. *Journal of Human Sciences*, *13*(3), 4986-4997.

Yin, R. K. (2009). Case study research: design and methods (4th ed.). Los Angeles, Calif: Sage Publications.

Mobile Electronic Performance Support System as a Learning and Performance Solution: A Qualitative Study Examining Usage, Performance, and Attitudes

Aadil Askar
King Saud University, Riyadh, Saudi Arabia,
aadil@ksu.edu.sa

ABSTRACT
Advanced technology innovations have contributed to the development of learning and performance solutions in both traditional and mobile workplaces. This study observed the use of the proprietary Global Positioning System (GPS) developed by Phonenav as a performance improvement solution in a mobile workplace. Thus, the study investigated the use of data assisted GPS as a performance improvement solution for delivering live instructions in a work environment, and attempted to understand its impact on users' work performances and attitudes to technology. A cross-sectional qualitative study, supported by multiple data sources, was employed. The findings of this study revealed that the use of mobile EPSS resulted in an increased work performance and work efficiency of its users. This study contributes to the field of Human Performance Technology, by facilitating an understanding of the impact of mobile EPSSs on workplace performance. It provides a useful resource for professionals and researchers in the field of Educational Technology interested in exploring the use of mobile technology for instruction delivery in mobile workplaces.

INTRODUCTION
Today's expanding mobile technological environment invites an increasingly innovative use of technology in organizational processes. According to Gayeski (2002), statistics show that modern communications technology has enabled people to become increasingly mobile. This has influenced the shift of workplace boundaries beyond traditional offices, often allowing employees more flexibility in their work schedule. Employees working remotely often find they require the use of electronic support tools. In this study a proprietary mobile global positioning system (GPS), a satellite-based guiding system, developed by Phonenav, was used as an Electronic Performance Support System (EPSS) for mobile computer specialists. The Phonenav GPS used an external satellite box to relay signals to an app on the user's cell phones through which the GPS was operated. The external box needed to be in the user's car at all times. It provided the functionality of voice and visual guidance to a location inputted by the user. To keep the participants and company names anonymous all identifiers have been replaced with pseudonyms. The technicians used the technology to perform specific work-related and non-work related tasks. This study used the GPS technology as an EPSS (Wilmore, 2006) to determine whether mobile EPSSs improve the performances of its users in the workplace, through a qualitative analysis.

An EPSS, commonly used in the workplace, provides support for its users in accomplishing and performing specific tasks, thus helping them to perform their work more efficiently (Reiser & Dempsey, 2012). EPSSs contain combinations of task structuring, knowledge, data, tools, and communication components to support four activities: learning, doing, referencing, and collaborating (Gery, 2002). Wager and McKay (2007) argued that EPSSs offer the ability to improve performance in the workplace. According to Mitchem, Fitzgerald, Miller and Hollingsead, (2013), the goal of an EPSS is to provide support that is necessary to ensure performance and learning at a moment of need in a recurrent activity. GPS technology can be incorporated into an EPSS to provide navigational assistance as Wilmore (2006) states: "An EPSS can be a global positioning system (GPS) device that identifies exactly where the user is located by tapping into GPS satellite signals" (p.13). The for-profit company Phonenav produces such technology. Its platform incorporates features such as just-in-time instructions, live streaming of visual and voice-activated directions retrieved from Phonenav's database, and other advanced features such as the ability to call businesses that appear on navigational maps, determine local fuel prices, and compare gas station locations. Phonenav's service was chosen for this study due to its highly adaptive and advanced technology.

Purpose of the Study
Clark and Estes (2008) concluded almost a decade ago that an understanding of how performance in the workplace can be enhanced is incomplete. As Nyugen (2012) has established, EPSSs are continuing to evolve with new technology. The deficiency of knowledge Clark and Estes highlighted is therefore arguably renewed

and possibly greater in the area of mobile technology to aid workplace tasks. An examination of the effectiveness of mobile technology to facilitate improved performance in the workplace is therefore long overdue. This study aimed to address this need.

The purpose of this study was to investigate how the use of a mobile EPSS, specifically Phonenav's data-assisted GPS system, affected computer technicians' work performance and attitudes toward mobile technology. It also sought to determine which elements of the GPS system had the greatest impact on improving the computer technicians' performance, as indicative of the wider impact that the use of mobile devices could have in the workplace. In order to achieve this it was important to examine the complete work environment of the participants. The Phonenav GPS platform will henceforth be referred to as the EPSS. This study examined technicians performing tasks before, while, and after using the EPSS. The following research questions were considered:

1. How do technicians use the EPSS?
2. How do technicians' performances on tasks supported by the EPSS change as a result of its use?
3. How do technicians' attitudes towards cell phone technology change as a result of using the EPSS?

This study has implications for performance specialists, through its exposition of how handheld wireless technology can affect the productivity of mobile workers as well as their attitudes toward wireless handheld technology.

LITERATURE REVIEW

The relationship between an EPSS and the field of instructional technology needs to be defined. The Association for Educational Communications and Technology (AECT) has defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources." (Reiser, 2012, p. 4). AECT goes on to state that:

> "the field of instructional design and technology… encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace." (Reiser, 2012, p. 5)

Van Tiem and Moseley (2004) have argued that:
"Instructional performance support interventions are selected when the problem is a lack of knowledge or skill. Non-instructional performance support interventions are selected to improve individual, group, or team performance, to improve processes, products, and services; to guide business plans, deliverables, results, and success measures (p. 67).

GPS is, in this context, used as a non-instructional solution. The researcher's reasoning for using GPS as an EPSS is substantiated by Tracey's (2000) assertion that instructional design "involves the design of the appropriate, affordable, easy-to-use, accessible instructional and non-instructional solutions to create intentional changes in learning and performance." (p. 389) We can consider EPSS a non-instructional solution by using the description of EPSSs provided by Barker, Schaik and Famakinwa (2007) as "computer delivered performance improvement interventions that guide and inform task completion." (p. 421) It is important to understand what we mean in this study by a mobile EPSS. Ahmed (2009) has defined it as a "focus on improving performance at the right time and in the right place in relation to a task a user performs on a mobile device." (p. i) A GPS can be used as an EPSS in this study due to the tasks given to the targeted participants are related to identifying client addresses and finding places of interest.

METHODOLOGY

This study used a descriptive methodology to investigate the participants' experiences using the EPSS, focusing on how they used it, how it altered their performance in the workplace, and how it altered their attitudes to mobile technology. Creswell (2012b) indicates that researchers should use a qualitative approach, i.e., collecting data in the subjects' environment, and data analysis, which is inductive and creates patterns for qualitative research. Participants in this study were observed over a period of one month while using the EPSS. The data sources used in this study were questionnaires, observations, log tables, a database from the EPSS, and interviews with the participants.

Sample
Creswell (1998) recommends that "no more than four cases" should be included in a case study to obtain an in-depth analysis of every case, and that "the more cases an individual studies the less the depth in any single case" (pp.76 & 63). Consequently, for this study, only three participants were chosen. Maximum variation sampling (Gall, M. D., Joyce P. Gall, 2007), a type of purposeful sampling (Creswell, 2012a), was used to identify the participants. This approach enabled an identification of important common patterns (Creswell, 2012a).

The participants were information technology (I.T.) professionals and employees of AZ Electronics (AZE), a well-known business in the United States. AZE has a division, Tech Force, that, among other capabilities, provides on-site computer maintenance and support. The researcher accessed participants through a gatekeeper: a manager at Tech Force. In this study the researcher selected at least two technicians from each hierarchical category used by AZE. These were "supervisors", "special agents", and "double agents", from highest to lowest ranking respectively. Though the intended number of participants was six, two from each category, only three candidates were willing to participate. Both the organization and participants involved in this study, were assigned pseudonyms, so as to guarantee their anonymity. In a consent form, submitted alongside a questionnaire and signed by all participants, they were instructed to use pseudonyms. The researcher guarantees that no participant used their actual names.

Procedures
This study was conducted with technicians of Tech Force, all of whom commuted daily to both individual and enterprise client sites. Technicians in each category served certain types of clients. Technicians in the double-agent category were allowed to serve individuals in their houses; special agents could serve in homes and small and medium-sized businesses; and supervisors could serve at all sites, including large businesses. The latter also supervised the technicians, as their title suggests. Tech Force provides smartphone (iOS) devices and wireless connectivity to all of its technicians. The EPSS was operated via a box installed in the technician's car, and connected via Bluetooth to Phonenav's application installed on their iOS smartphones.

The Institutional Review Board (IRB) permission was obtained from a US higher education institution. Three levels of review were provided by the institution depending on what level of interaction with human subjects would occur. They are Expedited Review, Full Board Review, and Exempt from Review. The researcher submitted the required documents as well as copies of the research instruments and consent form. The documents included general information about the research as well as disposition of the data, and documentation. It went through the institutional process and procedures for the IRB and granted permission.

Data Collection
Data was collected through a variety of means, all of which are detailed below.

Questionnaire
A questionnaire was given to each participant before the EPSS was provided to them. The questionnaire was used to evaluate the technicians' time spent completing various work-related tasks and the difficulty they attributed to each task, their cell phone experience and attitudes towards cell phone technology, and their level of skill in using mobile technology.

Observation
Two observations of each technician were performed. These were conducted to document events that occurred while the technicians used the EPSS. The record of these observations include the technicians' comments and the researcher's reaction. Observations were performed in participants' vehicles as the researcher commuted with them in order to observe them in their work environment. The first observation was conducted in the middle of the study period. The second observation took place at the end of the period. Each observation took approximately fifteen to thirty minutes.

Log Table
Participants were given a log table by the researcher at the start of the study (see Table 2) and instructed to use it throughout (Creswell, 2012a). It was used to determine how technicians used the EPSS. Participants were asked to record their reasons for using the various features of the EPSS, the date of use, the time they began performing the task and the amount of time spent on each one.

Database
The database in the EPSS stored all destinations that the participants' reached while using it. Comparing the data provided by Phonenav with the participants' log tables helped provide further clarity on how the technicians used the EPSS.

Interview
The interview sessions lasted between fifteen and thirty minutes; sufficient time to ensure that all relevant topics were discussed. The interview sessions comprised open-ended questions, such as "How has your performance of tasks changed since you began using the EPSS?" and closed questions (yes/no), such as "Do you use the EPSS to support your job performance/other activities?"

Data Analysis
Field notes were generated from the time of the first observation, conducted in the middle of the study period. Although the generation of field notes was considered the starting point of the data analysis, there was no exact point at which the analysis began or ended (Patton, 1990). A preliminary analysis provided information regarding the accuracy and relevance of the data collected.

To analyze the multiple cases, the researcher conducted a within-case analysis, followed by a cross-case analysis. As Creswell (2012a) states, "when multiple cases are chosen, a typical format is to first provide a detailed description of each case and themes within the case, called within-case analysis, followed by a thematic analysis across the cases, called a cross-case analysis, as well as assertions or an interpretation of the meaning of the case" (p. 63).

Open coding was the first phase of the within-case analysis. The researcher searched the entire dataset to find and assign codes to retrieve certain pieces of data. Searching the entire dataset involved reading each data source at least twice. This process assisted with the organization and management of the data and with the development of the description for each case (Merriam, 1998).

For the next level of the within-case analysis, the researcher constructed categories, as suggested by Merriam (1998), through a "continuous comparison of incidents, respondents' remarks, and so on, with each other" (p.179). This process was implemented throughout the analysis and writing stages. The researcher summarized each case in the form of answers to the research questions.

The cross-case analysis was initiated in this stage. The researcher compared the themes and categories that emerged from each case. This procedure assisted in identifying the categorical similarities and differences among the cases. This level of analysis, Merriam (1998) states, "can lead to categories, themes, or typology that conceptualize the data from all the cases; or it can result in building substantive theory offering an integrated framework covering multiple cases" (p. 195).

Tentative conclusions were derived from evidence of consistent results from within-case and cross-case analyses. The researcher analyzed the accuracy and reliability of the results generated, including any possible inconsistencies among them.

Credibility/Trustworthiness
According to Creswell (2012b), strategies such as triangulation and member checking are used to determine the accuracy and credibility of findings. The researcher used two types of triangulation: data triangulation and methodological triangulation. These methods were used to enhance the dependability of the data. Data triangulation was conducted through multiple cases and multiple computer technicians within Tech Force. Methodological triangulation was achieved through the questionnaires, the observations, the log tables, a database from the EPSS, and the interviews. The researcher conducted member checking by returning to participants to determine the accuracy of the recorded interviews.

Transferability
Transferability is related to issues of generalizability and was a consideration in choosing the methodology employed in this study. Merriam states that "rich, thick descriptions" enable readers to "be able to determine how closely their situations match the research situation, and hence, whether findings can be transferred" (Merriam, 1998, p. 211). The data sources in this study provide "rich, thick descriptions" to readers. Another way to address transformability is purposeful sampling (Creswell, 2012a, 1998), which is employed in this study. Purposeful sampling helps establish a connection with readers, through increasing the chances of them identifying with the participants in the study.

Analysis and Findings

In this section, the results of the three cases are presented. Each case is described and discussed. All three participants were male. The descriptions of each case were developed from the multiple data sources described above. These data sources supported each other and, in some cases (such as the database and the log tables), provided overlapping information.

First Case Analysis: John

John was in the 20-29 age group. He had been working with Tech Force for more than three years and, at the time of the study, he was working as a double agent. His educational background included a bachelor's degree.

Technician task.

As mentioned in the research questions, the tasks examined in this study included only those supported by the EPSS. John's responses to the questionnaire indicated that he mostly used the EPSS to find clients' residences, gas stations, and restaurants. John often used cell phone applications to assist him with his work. The software he used included Timebox, Schedule Sync, and messaging. John's responses to the questionnaire showed that he was a skilled user of technology and felt comfortable using cell phones. Though he rated his anxiety in using the cell phone as three on a five-point scale.

How John used the EPSS.

When John received his Bluetooth receiver and his Phonenav account password, he followed the user guide that the researcher had given him. He was able to download the software from the Phonenav website and to activate it in his mobile device. Additionally, he was able to explore and operate the EPSS without any problems. John used the EPSS to go from his house or office to clients' houses and to find gas stations, coffee shops, banks and other places on the way. With respect to going from one job to another, he explained:

> "It made it a lot easier, compared to—if I had to run to another place real fast before going to that job, my directions wouldn't be correct because it'd be from my other address - previous address - and now this one would actually be to the correct address." (John, personal communication)

John did however encounter the problem of the EPSS at times giving him incorrect directions and providing him with an intermittent service in a particular geographical area. John did use technical support function, though not for any technological assistance but to ask a representative to key in an address for him while he was driving.

While being observed, John went to visit an older customer whose address was already stored in the EPSS. He spent approximately forty seconds finding the client's address in his mobile device and then placed his device atop the cup holder in his car. He followed the directions as they were presented by the EPSS and listened to the verbal directions feature more than he looked at his cell phone.

How John's performance changed.

The EPSS helped John perform his duties more efficiently without the burden of having to navigate himself, as he explained: "I've been able to get there more efficiently now. I can just take off, leave my house, and use [the EPSS] wherever I need to" (John). The EPSS also provided alternative routes to many different places, allowing him more options for navigation. Though the EPSS provided John more accuracy when navigating between his house, office, and clients' locations, one improvement to the EPSS interface he would like to have seen was updates of the road conditions as this would have helped him plan his route more effectively.

How John's attitude changed.

John had a positive attitude toward the mobile technology from the start. He noted that the EPSS "was very good," and "made [navigation] a lot easier" (John). John even considered buying the EPSS after he participated in the study.

Table 4: John's Task Ratings

Tasks	Difficulty	Amount of Time
Finding clients' location	5	5
Finding directions	4	5
Finding gas stations	3	4
Finding restaurants	2	4

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

Second Case Analysis: George
George was also in the 20-29 age group, had worked as a special agent at Tech Force for more than three years and was also responsible for supervising other technicians. His educational background included a bachelor's degree. He was the researcher's primary contact in conducting this study.

Technician task.
George had neutral expectations of becoming more productive through using the EPSS. However, he found that using it helped him to manage his job better. George experienced the least anxiety and most comfort out of any of the participants in adopting the technology. In his questionnaire responses George indicated that, aside from finding directions to work related tasks, he mostly used the EPSS to find places for lunch (Table 5). He spent less time finding gas stations. Prior to using the EPSS George liked to utilize the cell phone applications Timebox, Schedule Sync, Internet Explorer, and Outlook to assist him with his work.

Table 5: George's Task Ratings

Tasks	Difficulty	Amount of Time
Finding gas stations	4	2
Finding driving directions	4	5
Finding places for lunch	2	4

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

How George used the EPSS.
After he received his Bluetooth receiver and Phonenav account password, George was able to download, activate, and run the EPSS on his mobile phone. In the first observation he spent approximately two minutes entering his client's address; in the second observation he spent approximately one minute performing the same action. In both observations he held the cell phone in his hand, listening to and looking at the directions presented by the EPSS unit until he reached his destination. He did not use the technical support function, and believed that no training was needed to use the EPSS.

George used the EPSS to support his tasks in both his work and personal life, stating "I didn't have any problems." (George, personal communication) He used it to go to clients' locations, restaurants, and non-work related places with his family. He used the EPSS so he did not "get lost" when going to see his clients (George).

How George's performance changed.
The EPSS helped George arrive at his clients' locations, his house or his office without becoming lost. He no longer spent time finding directions and was free of the distraction of looking at a piece of paper for directions while he was driving. He also felt that the EPSS enhanced the accuracy of the directions. The EPSS also helped him reach places that were not available on the map or for which "there is no map." (George) He considered that arriving on time to a client's location was one of the most important factors that encouraged him to use the EPSS. An improvement George suggested for the EPSS was voice recognition. This would have allowed him to enter his address by talking instead of typing. As it was he was forced to stop his car to type in addresses.

How George's attitude changed.
George's responses to the questionnaire revealed that he had a positive attitude toward technology prior to the study. He indicated that his positive attitude towards mobile technology had not changed as a result of using the EPSS, stating that "it was great" and "easy to use." (George)

Third Case Analysis: Bob
Bob also fell in the 20-29 age group and was a double agent with Tech Force. He had been working there for over three years. His educational background included a bachelor's degree.

Technician task.
The questionnaire responses indicated that Bob spent a substantial amount of time finding gas stations, places for lunch, going to the store for supplies, and calling clients (Table 6). He spent less time finding places for car maintenance. He spent a considerable amount of time calling clients, including a fair amount of time calling them to confirm their location.

Bob often used cell phone applications such as Timebox, Schedule Sync, Outlook, and STS to support him in his work. He liked using a cell phone in his work environment. Bob expected to improve his work performance through the use of the cell phone technology and was comfortable in making use of it.

Table 6: Bob's Task Ratings

Tasks	Difficulty	Amount of Time
Finding gas stations	1	4
Finding maps	4	5
Finding places for car maintenance	1	2
Finding places for lunch	1	5
Going to the store to get supplies	3	4
Calling clients	4	5
Calling clients to confirm location	3	3

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

How Bob used the EPSS.
Bob received a Bluetooth receiver and his Phonenav account password, and downloaded the software from the Phonenav website. Bob never used technical support, the device worked properly and he encountered no problems in activating it. He also successfully installed and ran the EPSS on his mobile phone. Bob described using the EPSS as a "cakewalk" and thought that there was no need for any type of training (Bob, personal communication). He liked the voice-activated feature, enabling him to listen to the device rather than look at it as he was driving. During the observation Bob spent approximately forty-five seconds entering his client's address. He also looked at and listened to the directions provided by the EPSS and followed the directions until he reached his destination. He used the EPSS to commute between his office and work assignments, stating that if his company did have access to the technology "we would use it every day." (Bob) Although the cell phone application usually ran well, Bob found that it terminated after he received a phone call. He found that restarting the application helped restore its functionality.

How Bob's performance changed.
Bob found that the EPSS helped him reach his clients with greater accuracy and saved him time in looking for directions. Furthermore he found he no longer needed to call his clients for directions. He found that it helped him correct his route if he went off course. He also found that the mobility and portability of the EPSS helped him accomplish his tasks without having to spend time looking for directions, notably including cases in which he was given an unscheduled job. Although the EPSS consistently provided Bob with the quickest route, one problem he encountered was the system "trying to force you on the toll way, so you've got to keep telling it to redirect." (Bob) He indicated that one improvement he would make to the EPSS would involve adding a feature that provided information about the quickest route with the option of avoiding toll charges.

How Bob's attitude changed.
Prior to the study Bob had a positive attitude toward technology in general and toward mobile technology in particular. Comparing his experience using the EPSS with that of the mobile technology he had been exposed to before he noted that "I've embraced it even more." (Bob) Bob was enthusiastic about his experience using the EPSS, stating that it was "awesome; it's been great. It's a great tool." (Bob) He would like to see all Tech Force technicians have access to the use of the technology as "it makes the job a lot easier." (Bob)

Cross-case analysis
After conducting a within-case analysis, a thematic analysis across the cases was employed (Creswell, 2012a). The cross-case analysis (Table 7) explored the similarities and differences among the cases which were later used to generate overarching themes. The themes that emerged from the cross-case analysis were organized into three sections: EPSS Use, Change in Task Performance, and Attitudes to Technology.

EPSS UseEase of use.
All participants found the EPSS easy to use. They were able to successfully download, activate, and run the EPSS on their mobile phones without needing technical assistance. One participant, John, called technical support but only to ask the representative to enter an address for him while he was driving. The mobility and portability of the EPSS was arguably a major factor in its ease of use.

Time.

All responses to the questionnaires indicated that the technicians had previously spent a substantial amount of time navigating to client sites prior to using the EPSS. This time was spent finding maps or finding directions via the Internet. Participants stopped checking directions or looking for maps after they acquired the EPSSs. Their only task was to enter their clients' addresses. The amount of time each participant took varied. John took between thirty to sixty seconds, George took between one to two minutes, and Bob took approximately forty seconds.

Interacting with the EPSS.

All participants successfully interacted with the EPSS and followed its directions to their respective destinations. They all used the verbal directions and the interactive map to navigate. Of the participants, only John used verbal directions more often than he looked at the device while driving. This was one of the advantages noted by Bob: "I hardly even have to look at it; I just listen to it as I'm driving and let it navigate me there." (Bob)

Tasks.

All participants used the EPSS to go from one job to another or to go to or from the office to a client site, and to reach nonscheduled jobs. They used it to perform tasks between jobs, such as finding gas stations and restaurants, and also used it in their activities outside work.

Usage encouragement.

Different motivational factors encouraged the participants to use the EPSS. George was motivated by his increased ability to be punctual. Bob was encouraged by the verbal directions feature, which enabled him to listen to and follow directions without looking at a map. John was impressed with the EPSS's large area coverage, which helped him navigate places even out of State.

Problems.

Two participants encountered problems in using the EPSS. On one occasion John received incorrect information regarding the location of his destination while the application was running on his mobile device. This happened to be due to him being in a low coverage area at the time. The application running on Bob's mobile phone suddenly stopped working abruptly and never started up again. He resumed using the application on another mobile device.

Change in Task Performance

Efficiency and accuracy.

John was the only participant that encountered a lack of reliability associated with the EPSS. The EPSS improved efficiency in all three cases: notably in helping John navigate to nonscheduled jobs, enabling George to reach clients' location on time, and absolved Bob of the need to call his clients to check their location: "I've been a lot more accurate; I haven't had to call my clients, saying, 'Hey, I'm lost!'" (George)

Mobility and portability.

The mobility and portability of the mobile EPSS meant that the participants could carry the device with ease when traveling between jobs. Having the EPSS readily available prevented all participants from getting lost.

Driving time.

Participants saved time performing tasks in two ways. Firstly they stopped checking online directions and maps: activities that had consumed more time than entering addresses into the EPSS, according to the questionnaire responses. There also seemed to be an additional safety benefit in using the EPSS as all participants indicated that they focused more on the road while driving.

Attitude to Technology

Attitude.

Tech Force employees work with technology daily, and the participants' questionnaire responses indicated that they all held positive attitudes towards technology prior to their participation in the study. This arguably influenced their positive reception of the EPSS.

Table 7: Summary - Cross-Case Analysis

Cross–Case Analysis					
Research Questions	Themes	Specification	Case 1	Case 2	Case 3
			John	George	Bob
EPSS Use	Ease of use	Download	Successful	Successful	Successful
		Activation	Successful	Successful	Successful
		Running	Yes	Yes	Yes

	Time	(Seconds)	45 (approx.)	90 (approx.)	40 (approx.)
	Interacting with the EPSS	Interactive map	Yes	Yes	Yes
		Verbal directions (VD)	Yes	Yes	Yes
		VD usage	Higher	Normal	Normal
	Tasks	Task rate (TR)	Multiple	Multiple	Multiple
		TR within each Task	Multiple	Multiple	Multiple
	Usage encouragement	Factor	Timeliness	Verbal directions	large coverage area
	Problems	Type	Hardware/Software	None	Software
		Coverage	No	Yes	Yes
Change in Task Performance	Efficiency and accuracy	Data accuracy	Yes	Yes	Yes
		Off route support	Yes	Yes	Yes
		Loss of direction	No	No	No
	Mobility and portability	Portability	Portable	Portable	Portable
		Mobility	Mobile	Mobile	Mobile
	Driving time	Additional online directions and maps needed	No	No	No
		Enabled fastest route	Yes	Yes	Yes
Attitude to Technology	Attitude	Before using EPSS	Positive	Positive	Positive
		After using EPSS	Positive	Positive	Positive

Discussion and Conclusion

In “Transforming Organizations Through Human Performance Technology” Rummler (1999) argues that, for the Human Performance Technologist, organizations are viewed as systems comprised of many channels that combine to produce products and services for end-users. In this study Tech Force, a division of AZE, acted as an adaptive system, using the EPSS as an input with which to enhance the service it could offer its clients. It did this primarily through enabling the technicians to arrive at the client sites on time, and freed the technicians of much of the logistical burden of navigating without the use of a mobile EPSS, allowing them to spend time on other tasks. Though the participants encountered problems with the technology on two occasions, the findings of this study support the idea that the use of an EPSS had an overall benefit in helping the participants to complete their work in a more reliable and timely manner. This was due to their enhanced ability to provide instruction at the moment of need without the need to print out or view instructions gathered from a web-based information provider on the internet.

The topic of mobile EPSSs and their impact on workplace performance is an underdeveloped area within the field of Human Performance (Clark & Estes, 2008). This study goes some way to addressing this gap in existing literature through investigating how mobile EPSS technology meets several performance-improvement challenges. More broadly it facilitates an understanding of how mobile devices and EPSS virtual networks can benefit workers and organizations by streamlining specific tasks, and may well point to similar benefits in other mobile work environments. A further study is needed to ascertain the long-term effects of this technology on an organizational level. Similarly, while the motivations of the technicians for using the EPSS in this study were

made clear, a further study is needed to focus specifically on what would motivate such workers to engage more with an EPSS, given that an EPSS seems to have the potential to improve work efficiency significantly. This could include an investigation into how EPSSs can continue to improve their abilities to meet the continually evolving needs of users in the mobile workplace. And lastly the potential that EPSS technology has for organizations to monitor its workforce and the impact this could have for further improvements in workforce efficiency and employee relations is a subject that requires further consideration. Taken as a whole these recommendations address how technology, to revisit Rummler, can help streamline an organization's many channels in order to improve the product it offers to its customer base.

REFERENCES

Ahmed, N. (2009). *Examining the Effectiveness of a Mobile Electronic Performance Support System in a Workplace Environment*. Ann Arbor, MI: ProQuest.

Barker, P, Schaik, & Famakinwa, O. (2007). Building electronic performance support systems for first-year university students. *Innovations in Education and Teaching International, 44(3),* 421-433. http://dx.doi.org/10.1080/14703290701486530

Clark, R. E., & Estes, F. (2008). *Turning research into results: A guide to selecting the right performance solutions*. Atlanta, GA: Information Age Publisher. http://doi.org/10.1002/pfi.4140430110

Creswell, J. W. (2012a). Educational research: Planning, conducting, and evaluating quantitative. Upper Saddle River, NJ: Pearson.

Creswell, J. W. (2012b). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (3rd ed.). Thousand Oaks, CA: Sage Publishing House.

Douglas, L. L. (2003). *An EPSS approach to automated instructional design: Its effect on novice designers' development (Order No. 3116492).* Retrieved from http://search.proquest.com/docview/305293922?accountid=142908

Gall, M. D., Joyce P. Gall, W. R. B. (2007). *Educational Research: An Introduction, 8th Edition. Pearson* (Vol. 8). Pearson Merrill Prentice Hall Upper Saddle River, NJ.

Gayeski, D. M. (2002). Beyond Web-Based Training: Learning Unplugged. *Educational Technology*, *42*(6), 55–57.

Gery, G. (2002). Achieving performance and learning through performance-centered systems. *Advances in Developing Human Resources*, *4*(4), 464–478.

Graham, S. W., Wedman, J., Tanner, T., & Monahan, C. (1998). Yes, classroom sales training can enhance performance. *Performance Improvement Quarterly*, *11*(2), 101–112.

Masumoto, Y. (1993, May 11). Global positioning system. Washington, DC.

Merriam, S. B. (1998). Qualitative Research and Case Study Applications in Education. Revised and Expanded from "Case Study Research in Education." 350 Sansome St, San Francisco, CA 94104: Jossey-Bass Publishers.

Mitchem, K. J., Fitzgerald, G., Miller, K., & Hollingsead, C. (2013). Using electronic performance support systems to improve academic performance of secondary students with disabilities. *Journal of Special Education Technology*, *28*(3), 1–20.

Nyugen, F. (2012). Performance support. In R. A. Reiser & J. V Dempsey (Eds.), *Trends and issues in instructional design and technology.* (3rd ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Patton, M. Q. (1990). Qualitative evaluation and research methods. SAGE Publications, inc Reiser, R. A., & Dempsey, J. V. (2012). *Trends and Issues in Instructional Design and Technology* (3rd ed.). Pearson Merrill Prentice Hall Upper Saddle River, NJ.

Reiser, R.A. (2012). What field did you say you were in? In R. A. Reiser & J. V Dempsey (Eds.), *Trends and issues in instructional design and technology.* (3rd ed.) (pp. 5-13). Upper Saddle River, NJ: Merrill/Prentice Hall.

Rummler, G. A. (1999). Transforming organizations through human performance technology. In H. D. Stolovitch, & E. J. Keeps (Eds.), *Handbook of performance technology* (pp. 47-66). San Francisco: Josey-Bass.

Tracey, M. (2015). Instructional Design Practice. In Spector, J. M. (2015). In *The SAGE Encyclopaedia of Educational Technology* (pp. 389-391). Thousand Oaks, CA: SAGE Publications.

Van Tiem, D, Moseley, J. (2004). *Fundamentals of Performance Technology: A Guide to Improving People, Process, and Performance, Second Edition.* Silver Spring, MD: International Society for Performance Improvement.

Wager, J., McKay, W. W. (2007). EPSS: Visions and viewpoints. In R. A. Reiser & J. V Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Wilmore, J. (2006). *Job AIDS Basics*. Alexandria, VA: American Society for Training and Development.

Appendix

Table 1:Log Table

#	Task (e.g. locate gas station or food or customer etc.)	Date	Time	Amount of time (e.g. 3h, 15m)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Day_____Date_____/_____/_____
Please fill out the log table daily. (Please print)

Table 2:Structured interview - interview questions

Do you use the EPSS to support job performance/other activities?

If yes	**If no**
1) What kind of activities do you use the EPSS to support? 2) How has your performance of tasks changed since you started using the EPSS? 3) How has the time spent performing tasks changed? 4) What are some of the factors that would influence your usage of other features in the portable EPSS? 5) What factors might encourage technicians to use the EPSS? 6) How has your attitude toward technology changed as a result of using the EPSS? 7) How did the technical support for the EPSS affect your usage (if applicable)? 8) What type of training is necessary for technicians to use the EPSS? 9) Do the EPSS functions support some of your activities? 10) What improvement would you make to the cell phone EPSS and why? 11) What type of problems have you encountered using the EPSS?	1) What were the major factors for you not using the EPSS? 2) How can the EPSS be successfully integrated into your work environment? 3) Even though you did not use the EPSS, has your attitude changed about using technology to support some of your tasks? 4) Do you think training on how to use the EPSS would help? a) If yes, what factors will be helpful to include in the training? 5) What improvements/changes would you make to the EPSS and why?

12) Please tell me about your overall experience.	

Table 3:Participant Questionnaire

General Information
Name:
Check the following:
Gender:
☐ Female ☐ Male
Age Range:
☐ 20 – 29 ☐ 30 – 39 ☐ 40 – 59 ☐ 60+
Technical Experience:
☐ Less than three years ☐ More than three years
☐ Other (please specify)
Educational Background: Indicate highest level obtained
☐ Bachelor ☐ Master ☐ Specialist ☐ Doctorate
☐ Other (please specify)
_____

What cell-phone applications, provided by your employer, do you use? Please write the application(s) you use. And rank how often you use each one. The scale ranges from 1 (rarely) to 5 (often).

Application	Rarely				Often
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

Attitudes
Please circle your response to the items. Rate aspects of the wireless handheld device (cell-phone provided by employer) on a 1 to 5 scale. NA= Not applicable 1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree

a)	I like to use a cell-phone in the work place.	NA	1	2	3	4	5
b)	I could manage my job much better if I had a cell-phone.	NA	1	2	3	4	5
c)	I feel comfortable using cell-phone technology.	NA	1	2	3	4	5
d)	There is not enough support for using cell-phone technology.	NA	1	2	3	4	5
e)	I am anxious about using cell-phone.	NA	1	2	3	4	5
f)	I would expect to be more productive by using a cell-phone.	NA	1	2	3	4	5

Tasks
Amount of Time:
Driving to your customers involves many different tasks, such as finding your customer's address and location (ex. map quest), fueling at the gas station, dealing with car problems, finding food, etc.
Please list the tasks you complete on a daily basis and estimate how much time you think other technicians spend on these tasks from 1 (little time) to 5 (much time).

Little Time	Much Time				
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

_____	1	2	3	4	5
_____	1	2	3	4	5

Difficulty:
Please rewrite the above list, then rate each item by the degree of difficulty you encounter while performing it. The scale ranges from 1 (easy) to 5 (very difficult).

Easy			Very Difficult		
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

Modeling Vocational Blended Learning Based on Digital Learning Now Framework

Kadek Cahya Dewi
Business Department, Politeknik Negeri Bali, Indonesia
cahyadewi@pnb.ac.id

Putu Indah Ciptayani
Electrical Engineering Department, Politeknik Negeri Bali, Indonesia
putuindah@pnb.ac.id

Herman Dwi Surjono
Electronics & Informatics Department, Universitas Negeri Yogyakarta, Indonesia
hermansurjono@uny.ac.id

Priyanto
Electronics & Informatics Department, Universitas Negeri Yogyakarta, Indonesia
priyanto@uny.ac.id

ABSTRACT
The flexibility of blended learning in implementation makes it compatible to various models of the education system, as well as applied to the learning system of vocational education. Politeknik Negeri Bali (PNB) is a vocational institution in Indonesia. The research objectives to develop a Vocational Blended Learning (VBL) model in PNB based on Digital Learning Now framework. Research and development approach implemented in this study. Data collection procedures and methods were ongoing system evaluation, interview and observation method, and also focus group discussion (FGD). The system implementation methods and procedures were based on the Digital Learning Now framework. The research found the considerations for determining the appropriate instructional models for VBL. VBL model required resources, infrastructure and curriculum as inputs. It can be concluded that vocational education can organize blended learning with VBL by applying rotation instructional model and supported by teacher-developed content.

INTRODUCTION
The changing economy leading to borderless free trade brought about a major change in the economic order of Indonesia. According to the data, Indonesia's competitiveness tends to have degradation. Indonesia's competitiveness index in 2016 is ranked 34th and dropped to rank 41st in 2017 (The Global Competitiveness Index 2017-2018). Human resources that can compete in the global era must have seven skills, namely: (1) Critical Thinking and Problem Solving, (2) Collaboration Across Networks and Leading by Influence, (3) Agility and Adaptability, (4) Initiative and Entrepreneurialism, (5) Effective Oral and Written Communication, (6) Accessing and Analyzing Information, dan (7) Curiosity and Imagination (Wagner, 2008).

Referring to the needs of human resources in the global era, universities should be able to build a balanced competency between hard skill and soft skill. Implementation of education should be able to increase labor productivity, able to contribute in economic development, and able to reduce the unemployment rate. To achieve this, experts argued that addressing issues in employment requires a vocational-based education development strategy. Vocational education is an education that directs students to develop applied skills, adapt to specific occupations and create job opportunities. The finding in Vocational Education was vocational learning transition from generic to specific knowledge. Vocational learning settings also stimulated the acquisition of general abilities through experience and or didactical approaches of adjacent or problem-based learning (Deutscher & Winther, 2017). The efficient and qualified vocational education was the education that can facilitate students with real experience, tools, machines, materials, and methods of work. Munastiwi proposed Holistic Skills Education (HOLSKED) concept to guarantee the quality of holistic students in Vocational Education (Munastiwi, 2015). Blinova's research found that vocational education reduced the risks of youth unemployment in Russian regions (Blinova, Bylina, & Rusanovskiy, 2015).

In line with the purpose of organizing vocational higher education, the implementation of learning should be designed with a very specific pattern. The pattern of vocational higher education development referred to the collaborative design between the needs of the labor market (demand) with the providers of labor in this case the

college that acts as a supplier. Some things that need to be taken seriously are: curriculum, market share, and cooperation with the business and industrial world. The design of teaching and learning activities is more dominated by practical activities, such as laboratory, workshops, experimental gardens, and studios. In general, the comparison between practical and theoretical activities in vocational education was 60% versus 40%, although in some cases the rate of comparison can be 50% to 50%, so students and lecturers would spend most of their effective time to learning and working in the practicum place. Selection of learning systems becomes very important to be taken into consideration in achieving the effectiveness of the process of transfer of knowledge from lecturers to students. The concept of future education leads to the concept of Student Center Learning (SCL), a learning system directed to how student learn in fun.

The current conventional learning system is believed to be less effective in line with the development of information and communication technology (ICT), where the concepts of brainpower, intelligence, and creativity have grown rapidly along with advances in technology and communications. In the current era of globalization, ICT becomes a fundamental requirement in determining the quality and effectiveness of the learning process. The presence of ICT was a reinforcement for conventional learning systems that want to correct the existing weaknesses and shortcomings. In conventional systems, the transfer of knowledge process is managed by using whiteboard as the primary media, the room is managed in a static format and the educator becomes the only informant (teacher centered). But with the development of ICT, the learning process is no longer static but can be packaged in online learning. The role of online learning in the vocational learning system is not as a substitute for face-to-face roles but becomes a reinforcement of conventional learning systems. It means that the effectiveness of vocational learning can be achieved by combining the face to face learning with online learning. Adult students will have flexible use of time and location by taking the theoretical part of their face to face vocational courses over the internet. Some of the problems can be solved by giving training in such a way to the students who have sufficient internet and computer skills (Uzunboylu, Vuranok, Celik, & Bilgin, 2010). It reinforced with findings of indication that computer skill levels did have a direct correlation with a student's academic performance level (Pardamean & Suparyanto, 2014)

The combination of face-to-face learning with online learning is often called Blended Learning (Ghirardini, 2011), (Oliver & Trigwell, 2005), (Koohang, 2009), (Mishra & Koehler, 2006). Some experts mentioned the usefulness of the use of blended learning in the learning process, which had the potential to improve the quality of learning. According to Sahin's research in 2010 that blended learning could play an important role in vocational learning sessions, both in educational organizations and in working world (Sahin, 2010). Blended learning could improve access and flexibility for learners, improve active learning levels, and achieve better student learning experiences and outcomes. For faculty, blended learning could improve teaching practice and classroom management (Saliba, Lynnae, & Cortez, 2013). According to research results from Yagci, that courses supported with online learning tools had a positive effect on students' motivation, and correspondingly had a positive effect on academic success. In addition, the results revealed that introvert students need online learning tools more than others. Furthermore, it was found that thinking styles had an effect on motivation and academic success. Eventually, using blended learning approach in a programming language course had a positive effect of student's motivation, academic success and satisfaction (Yagci, 2016).

The implementation of blended learning varies greatly according to the discipline of science, time, student characteristics and learning outcomes, and had a student-centered approach to instructional design (Saliba, Lynnae, & Cortez, 2013). The flexibility of blended learning in implementation makes it compatible to various models of the education system, as well as applied to the learning system of vocational education. According to Blended Learning Implementation Guide of Digital Learning Now Framework, the movement of learning patterns into blended learning required a variety of support including academic goals, stakeholder supports, and funding. Application of blended learning model required good planning. After going through the planning stages then proceed with the implementation stages with attention to several issues such as infrastructure, integration, professional development and support. In the implementation stage it is also necessary to study the institutions culture that will implement blended learning and determine the communication strategy in running blended learning. Evaluation and development is the next step to manage blended learning. Institutions that implement blended learning should perform periodic evaluations (Bailey, Ellis, Schenider, & Vander, 2013).

There are several things that need to be considered in implementing blended learning in learning. Collaboration between the behavior of lecturers and students, computer capability, availability of facilities infrastructure, and learning environment. Computer attitudes, computer teaching efficacy and school environment have direct effects towards the levels of integration of blended learning use in teaching and learning From the results, it has been corroborated that computer attitudes have positively influenced the use of computer among teachers. Therefore, it goes to show that computer attitude has an important role to play in influencing teacher's use of

computers. It was also conclusively reported that school environment has very strong impacts on BL use Technical support is vital when teachers are having difficulties in operating the computer based technologies equipment. Having knowledgeable people and willingness to answer questions are critical in overcoming the obstacles of using computer (Wong, Hamzah, Goh, & Yeop , 2016).

The development of blended learning model has been done in several universities. Digital Learning Now (DLN) is a policy framework in the development of Blended Learning which recommends several things, namely (1) full and partial access to online learning, (2) eliminating the need for study time, (3) preparing evaluation as needed, (4) requiring adequate funding, (5) providing teaching materials digitally, (6) providing devices for students, and (7) supported by broad access.

Blended learning (BL) fundamentally redesigns instructional models with the aim of accelerating future learning and career preparation. BL provides a wider opportunity to develop education to be more productive both lecturers and students with independent learning, utilization of the right learning resources, and appropriate coaching to the students at the right time. BL also means how classes are organized, how time is spent, and how to allocate limited resources (Bailey, Ellis, Schenider, & Vander, 2013).

The current research conducted Politeknik Negeri Bali (PNB) a vocational institution in Indonesia as the case study in the development of blended learning model on vocational learning using Digital Learning Now Framework. PNB currently has e-learning through http://kuliah.pnb.ac.id and it was still supporting e-learning with function as preparation media of course material and was not used as a system yet in the learning process. Therefore, the purpose of this research is to develop a Vocational Blended Learning (VBL) model then it can be implemented on PNB e-learning. The research problem is how to develop a Vocational Blended Learning (VBL) model in accordance with the concept of Digital Learning Now framework.

METHOD

The study is done by research and development approach to develop blended learning model in Vocational Blended Learning (VBL). This research consisted of two stages, among others preliminary and formative evaluation. The preliminary stage covered the preparatory phase by developing strategies, timelines, schools models, platforms and content, devices, staffing and development plans, and improvement and impact measurement. Formative evaluation stage included self-evaluation and prototyping. Self-evaluation is done by conducting student analysis, curriculum analysis, and analysis of the device or material to be developed. Self-evaluation results were used as the basis for making VBL model, which then used as VBL prototype. VBL models and prototype were then given to experts to be assessed and evaluated. Experts review the content, constructs, and language of every prototype. Expert's advice was used to revise the developed device.

Data collection procedures and methods were ongoing system evaluation, interview and observation method, and also focus group discussion (FGD). While the system implementation methods and procedures was based on the Digital Learning Now framework. The research object was blended learning in vocational learning (VBL) with study case Politeknik Negeri Bali specifically in Management of Information System course. The research used primary data that obtained through interviews, FGD and documents in Politeknik Negeri Bali. It also used secondary data in the form of previous research results. Research respondents consisted of assistant director of academic, head of department, head of study program and also lecturer at PNB.

The stages of developing VBL model was according to the Digital Learning Now framework, it can be seen in Figure 1.

Figure 1. Digital Learning Now Framework (Bailey, Ellis, Schenider, & Vander, 2013)

As described in Figure 1, Digital Learning Now describes four phases namely Create conditions for success, Plan, Implement, and Improve. In first phase the Create conditions for success, displacement of learning patterns into blended learning required a variety of support, including academic goals, stakeholder supports, and funding. Second phase (Plan) described that the application of blended learning model required a good planning. There were four main issues in the third phase (Implement), among others infrastructure, integration, professional development and support (technical and implementation support). In the implement stage was also concerned on the institution's culture. It would determine the communication strategy in running blended learning. The last

phase was the continuous improvement phase. This phase was very important in the development of blended learning. Evaluation and development are the main issues in this phase. Institutions that run blended learning should conduct periodic evaluations.

Based on the concept of blended learning development according to Digital Learning Now framework, research framework in this research is done as in figure 2.

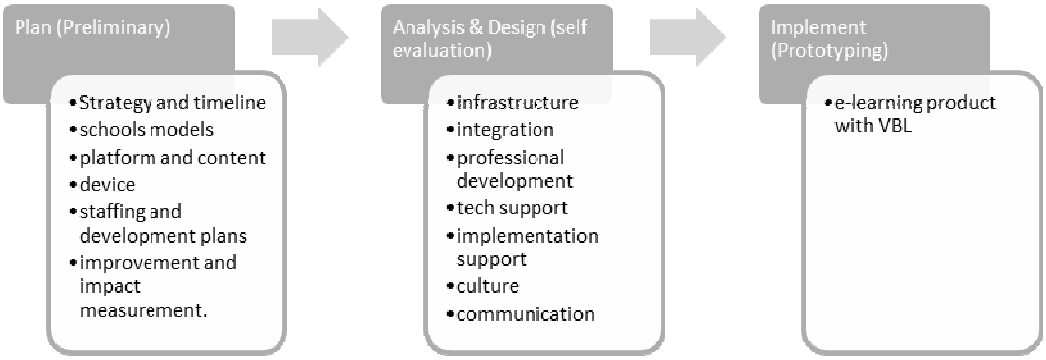


Figure 2. Research Framework

RESULTS AND DISCUSSION

The results section reported the result of preliminary, self-evaluation and prototyping stage implementation of research framework as in Figure 2. The implementation used Politeknik Negeri Bali (PNB) as study case.

Plan Stage (Preliminary)

Plan Stage purposed to create an appropriate blended learning model for vocational learning. Redesign of teaching and learning was fundamentally needed in the implementation of blended learning (Garrison & Kanuka, 2004). Here are the steps that were taken at the stage plan:

a. Strategy and timeline

Strategies are emphasized on regulatory management, organizational management, infrastructure and system management, user management, and content management. The timeline of blended learning is also adapted to the e-learning PNB strategic plan, which the target of blended learning was in 2018, as shown in Figure 3.

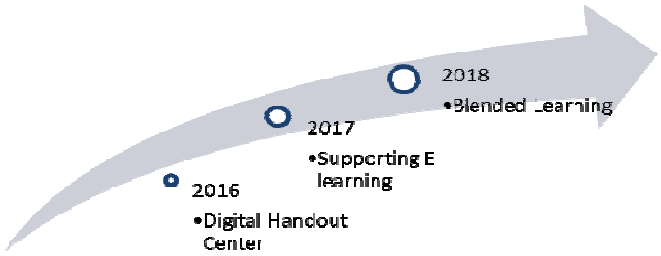


Figure 3. E-learning Strategic Plan Timeline

b. School and instructional models

It was found that in determining the appropriate instructional models for a college, as in Figure 4, the considerations were the suitability between the educational model, the learning techniques and methods of the course, and the availability of learning facilities and infrastructure. In this research, the course used as sample was the course Management of Information System that used the flipped classroom model as an instructional model for the implementation of blended learning.

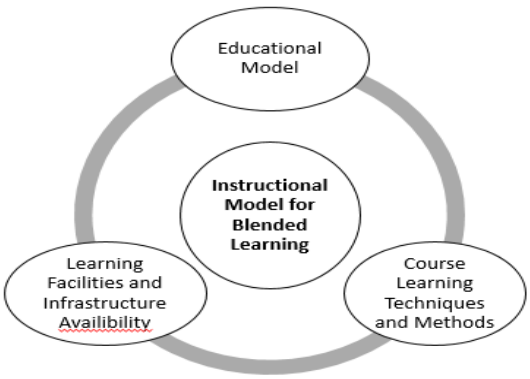


Figure 4. The Scheme of Instructional Model Determination

c. Platform and content

The platform used in building e-learning at PNB was LMS Moodle. The type of learning content provided was teacher-developed content. There are several types of learning content that can be prepared that was text-based, graphic, and multimedia learning content.

d. Device

PNB provided facilities and infrastructure as learning support equipment in the form of computer laboratory and internet connected classroom. For courses that were held in the classroom, students must prepared their self the course's equipment like laptop (bring your own device / BYOD).

e. Staffing and development plans

Since 2017, PNB has owned a special division that handles e-learning named e-learning division on Unit Management Information System (MIS). However, e-learning division is centralized in the MIS unit, it is considered not optimal enough in e-learning implementation. Therefore, in order to develop human resource, e-learning managers would be established at the level of study programs that are responsible for the completeness of e-learning content. Based on business environment internal analysis in PNB on e-learning strategic planning, it also needed content creator team in e-learning division to assist lecturers in making learning content.

f. Improvement and impact measurement

The graph in Figure 5 is the e-learning user graph of each study program at the Bali State Polytechnic. The graph is based on data recapitulation in June 2017. In line with the PNB e-learning development timeline that 2017 is the target of supporting e-learning, there is a graph showing that in June 2017 only 21.43% of study programs were still not optimal in organization of e-learning. This means there is optimism for the achievement of blended learning target in PNB in 2018 according to strategy and timeline in point a.

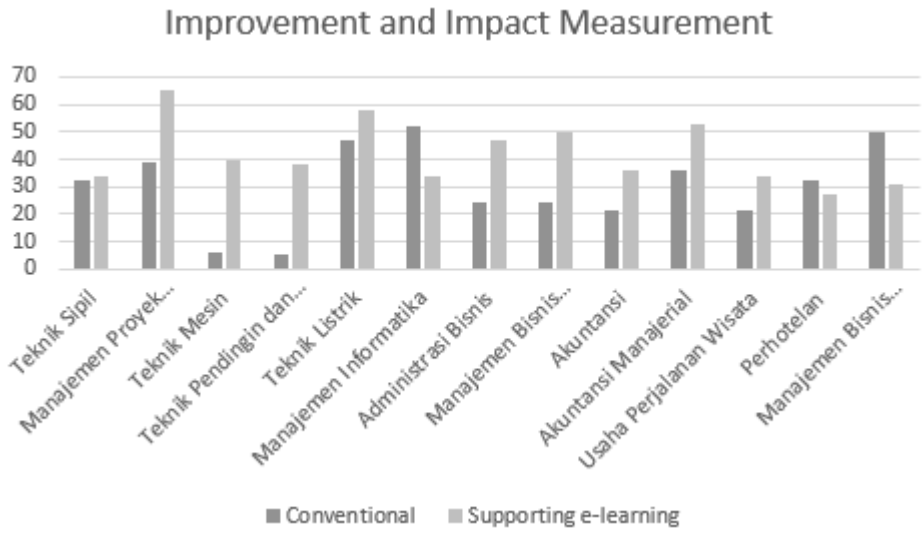


Figure 5. Improvement and Impact Measurement Graph

From the elaboration of the plan stage based on Digital Learning Now framework, it can be designed a blended learning model on vocational learning, hereinafter abbreviated as VBL (Vocational Blended Learning). VBL model is described as in Figure 6, it needs inputs in the form of human resources competencies (IT, learning

content), IT infrastructures, learning facilities & infrastructures (laboratory, workshop, classroom), and curriculum (learning achievement, semester learning plan) to be able to analyze VBL. VBL analysis can determine the right type of instructional model and produce learning content in the form of teacher-developed content as appropriate.

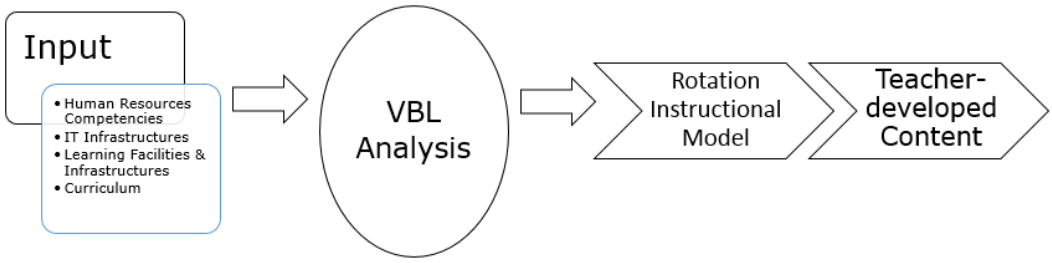


Figure 6. Vocational Blended Learning Model

In accordance with Figure 6, the input stage of VBL considers the following in the VBL analysis process:
a. Human Resources Competencies, namely IT skills from lecturers and students. It was in line with Poon and Joanna research, that attitudes, readiness, and technological skills as facilitators are crucial, as all of these factors influence how successful use and development of information technology-based learning (Poon & Joanna, 2013)
b. IT infrastructure, namely the readiness of IT infrastructure such as internet network in classroom, lab, and workshop. According to Singh, the technical requirements that can guarantee the success of blended learning are determined by the availability of server, bandwidth and accessibility, security, infrastructure, hardware and software (Singh, 2003).
c. Learning facilities & infrastructures, ie learning facilities and infrastructure such as computers, cables, power.
d. Curriculum, namely learning achievement and Semester Learning Plan (RPS)

After describing the four inputs it can be determined the type of rotation instructional model that used in learning. Then the selected instructional model would affect the form of provided learning content in e-learning (teacher-developed content). Table 1 described the rotation instructional model in accordance with the type of course that held at PNB. The portion of online learning utilization on VBL was also discussed in Table 1.

Table 1. Instructional Model at Politeknik Negeri Bali

Course	Instructional Model	The portion of online learning utilization on VBL
Theory	Station – Rotation Flipped Classroom	Face to Face (including Mid-Term and Final-Test) 11 times, self-learning with online tutorial 3 times, self-learning without tutorial 2 times
Practicum at Computer Laboratory	Lab – Rotation Flipped Classroom	Face to Face (including Mid-Term and Final-Test) 11 times, self-learning with online tutorial 3 times, self-learning without tutorial 2 times
Practicum at Classroom	Lab – Rotation Flipped Classroom	Face to Face (including Mid-Term and Final-Test) 11 times, self-learning with online tutorial 3 times, self-learning without tutorial 2 times
Practicum at Lab/Workshop	Lab – Rotation	In accordance with the needs that refer to the achievement of learning courses

Figure 7 described a VBL formula simulation in the practice course that held at lab/workshop with the learning block system.

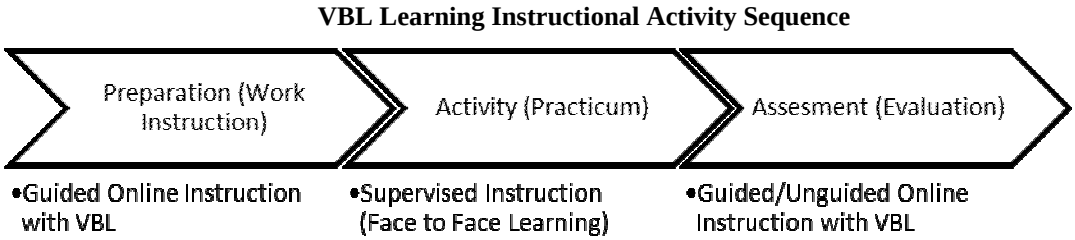


Figure 7. Activity Sequence Practice Course with VBL

Preparatory activities can be organized with blended learning either through face-to-face or online. The material provided in the form of guided online instruction is the work instructions about the practice to be done. Practical activities carried out in a supervised instruction that is face-to-face learning accompanied by a laboran / instructor. Assessment activities are carried out at the end through guided or unguided instruction.

Implement Stage (Self-evaluation and Prototyping)

The application of blended learning model on vocational learning (VBL model) in Figure 6 done on learning-site of Politeknik Negeri Bali (http://kuliah.pnb.ac.id). The implementation stage consists of analysis and design (Self Evaluation) as well as the prototyping stage. The following were the steps performed at the self-evaluation stage:

a. Infrastructure

PNB provided adequate infrastructure to classrooms that were running Blended Learning. The classroom or computer laboratory is equipped with internet and power facilities.

b. Integration

Currently there was no integrated system between LMS Moodle and academic information system in PNB. As development, it need to make integration module so it will facilitate in controlling the online classes.

c. Professional development

Implementing a new system required careful preparation. The adaptation of regular learning patterns to blended learning required great effort. Development is targeted at the understanding and user acceptance in using the new system. The target participants were lecturer and department top level management. Things that should be developed from the target participant were the mindset of online learning and skill in using e-learning as well as in creating learning content. In PNB routinely MIS unit held an annually workshop / e-learning training that targeted at lecturer including head of department and also head of study program with purpose of adding competence in the field of e-learning.

d. Tech support

PNB had MIS unit that had several divisions among others e-learning division and also system and network division. These two divisions are the technical support for e-learning users.

e. Implementation support

The e-learning division was one of the MIS divisions that had responsible for implementing e-learning in PNB. So that the e-learning division provided services of implementation support for e-learning.

f. Culture

From the side of social culture, it can be drawn the conclusion that it still need assistance for the lecturers and others education personnel in running e-learning. It need to socialize the concept of teaching and learning using e-learning approach.

g. Communication

To maintain communication with stakeholders, PNB had a special email account for e-learning that was kuliah@pnb.ac.id which can be used to communicate with the e-learning division.

The prototyping stage, the research used Management of Information System course at Business Department Politeknik Negeri Bali as the sample case on implementing VBL. The course held with Flip Classroom Instructional Model and facilitated with teacher-developed content that were uploaded on e-learning (http://kuliah.pnb.ac.id).

CONCLUSIONS

Based on Digital Learning Now framework, the development of Vocational Blended Learning (VBL) model began with preliminary stage and then continued by self-evaluation and prototyping as implement stage. The research found that for determining the appropriate instructional models, the considerations were the suitability between the educational model, the learning techniques and methods of the course, and the availability of learning facilities and infrastructure. VBL model required inputs in the form of human resources competencies (IT, learning content), IT infrastructures, learning facilities & infrastructures (laboratory, workshop, classroom),

and curriculum (learning achievement, semester learning plan) to be able to analyze VBL. VBL analysis determined the right type of instructional model and teacher-developed content as appropriate. VBL model in PNB generated instructional model that suitable with PNB characteristics, among others station-rotation, flipped classroom and also lab-rotation depend on the course type. It can be concluded that vocational education can organize blended learning with Vocational Blended Learning by applying rotation instructional model and supported by teacher-developed content. Digital Learning Now framework can help in planning and blended learning development in accordance with the condition of the institution.

REFERENCES

Bailey, J., Ellis, S., Schenider, C., & Vander, K. A. (2013). *Blended Learning Implementation. Version 1.0.*

Blinova, T., Bylina, S., & Rusanovskiy, V. (2015). Vocational Education in the System of Determinants of Reducing Youth Unemployment: Interregional Comparisons. *Procedia - Social and Behavioral Sciences 214*, 526 – 534.

Deutscher, V., & Winther, E. (2017). Instructional sensitivity in vocational education. *Learning and Instruction*, 1-13.

Forum, T. W. (n.d.). *The Global Competitiveness Index 2017-2018.* Geneva: World Economic Forum.

Garrison, D., & Kanuka, H. (2004). Blended learning: uncovering its transformative potential in higher education. *The Internet and Higher Education*, 95-105.

Ghirardini, B. (2011). *E-learning methodologies: A guide for designing and developing e-learning courses.* The Federal Republic of Germany: Food and Agriculture Organization of the United Nations (FAO).

Koohang, A. (2009). A learner-centered model for blended learning design. *International Journal of Innovation and Learning*, 76–91.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 1017–1054.

Munastiwi, E. (2015). The Management Model of Vocational Education Quality Assurance Using 'Holistic Skills Education (Holsked)'. *Procedia - Social and Behavioral Sciences 204*, 218 – 230.

Oliver, M., & Trigwell, K. (2005). Can 'blended learning' be redeemed? *SAGE Journal*, 17-26.

Pardamean, B., & Suparyanto, T. (2014). A systematic approach to improving e-learning implementations in high schools. *TOJET: The Turkish Online Journal of Educational Technolog*

Poon, & Joanna. (2013). Blended learning: an institutional approach for enh *y*.ancing students' Learning Experiences. *MERLOT Journal of Online Learning and Teaching.*

Sahin, M. (2010). Blended learning in vocational education: An experimental study. *International Journal of Vocational and Technical Education*, 95-101.

Saliba, G., Lynnae, R., & Cortez, H. (2013). *The Fundamentals of Blended Learning.* Learning and Teaching Unit University Of Western Sidney.

Singh, H. (2003). Building effective blended learning programs. *Issue of Educational Technology*, 51-54.

Uzunboylu, H., Vuranok, T., Celik, B., & Bilgin, H. (2010). Using internet applications as a solution for vocational adult education. *Procedia Social and Behavioral Sciences 2*, 5720–5725.

Wagner, T. (2008). *The Global Achievement Gap : Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need and What We Can Do About It.* US: Ingram Publisher Services.

Wong, K.-T., Hamzah, M. S., Goh, P. S., & Yeop , M. A. (2016). Blended E-Learning Acceptance as Smart Pedagogical Tools: An Initial Study in Malaysia. *TOJET: The Turkish Online Journal of Educational Technology*.

Yagci, M. (2016). Blended Learning Experience in a Programming Language Course and the Effect of the Thinking Styles of the Students on Success and Motivation. *TOJET: The Turkish Online Journal of Educational Technology*.

Online Communities of Practice in the Service of Teachers' Technology Professional Development: The Case of Webheads in Action

Ali Bostancioglu
Department of English Language Teaching (ELT), Faculty of Education, Nevsehir Haci Bektas Veli University, Nevsehir/ TURKEY
abostancioglu@nevsehir.edu.tr

ABSTRACT
The aim of this study was to investigate whether an online community of practice (OCoP) approach can be a viable alternative form of technology professional development (TPD) for teachers. In line with this aim, the Webheads in Action (WiA) community, members of which were mainly English as a foreign language (EFL) teachers gathered online to learn more about educational uses of technology, was selected as the case to be studied. A mixed method research approach following convenience sampling strategy was adopted which combined the use of questionnaires (*n*= 44) and interviews (*n*= 24). In order to support findings, members' interactions within the public space of the community were also collated for a period of nine months. Both quantitative (questionnaire) and qualitative (interview) results suggested that participation in the WiA community led to members' perceived TPD. Moreover, significant differences in questionnaire results, supported with interview data, were observed among members with different levels of participation (e.g. peripheral, active, and core). This finding highlighted the importance of participation and collaboration in online learning environments. It is concluded that teachers should be encouraged to participate in OCoPs for their professional development and the creation of OCoPs appealing to different areas of professional development should be supported.

Keywords: Teacher professional development, technology, online learning communities, online communities of practice, English as a foreign language

INTRODUCTION
Little (1987, p. 491) defined professional development as "any activity that is intended partly or primarily to prepare paid staff members for improved performance in present or future roles in the school districts". In a general sense technology professional development (TPD) can be defined as activities that aim to increase teachers' performance and technology integration through development of their technical skills in the use of video, software, computers, and so on. Additionally, in line with Little's (1987) definition, TPD should provide teachers with opportunities that allow them to relate technology knowledge to the pedagogy and content knowledge that they already possess. Furthermore, due to the fast pace of technological change, TPD needs to be continuous. Therefore for the purposes of the present study, TPD has been defined as activities that are intended not only to improve teachers' skills in using technology but also to extend their knowledge of how to relate it to the components of content and pedagogy employed in the teaching/learning process; it is an ongoing cycle of development.

In an environment in which governments across the world make continuous investments into increasing the use of technology in education, teachers' TPD has become an important issue for all stakeholders (i.e. teachers, students, school administrations, and so on; UNESCO, 2011). The value and significance of TPD becomes more obvious, especially when the low uptake of technology in educational systems across the world is taken into consideration (i.e. Turkey; Cakir, 2012) and realize that the main reason for this outcome is teachers' (in)capacity to use it in teaching/learning processes (UNESCO, 2011). Thus, it can be understood that TPD is an essential factor that can aid the successful integration of technology into education.

Teachers engage in various forms of TPD which include; workshops (including education conferences and seminars which could be as short as one hour) and cascade training (also referred to as the train the trainers model; Lawless & Pellegrino, 2007; OECD, 2009). While each one of these forms of professional development has their value, the low uptake of technology in educational settings suggests that the provision of such professional development opportunities is not able to meet the ongoing nature of TPD. On the other hand, professional development networks which can allow mentoring and informal dialogue (Lawless & Pellegrino, 2007; OECD, 2009) have been found to be ongoing and allowing follow-up and feedback opportunities (i.e.

Meskill, Anthony, Hilliker-VanStrander, Tseng, & You, 2006) which can potentially meet the requirements of TPD. Similarly, an online community of practice can allow the creation of such professional networks within online environments eliminating the boundaries of time and space and allowing anytime and anywhere learning. Thus, OCoPs have recently emerged as an alternative means for professional development and, in the present study, for TPD. There is, however, a need to conduct more research on OCoPs and investigate further whether following an OCoP approach can facilitate teacher professional development. Therefore, taking the case of Webheads in Action OCoP, an online community of English as a foreign language teachers (EFL) gathered online in order to develop themselves in the use of technology for language teaching, the present study sought to find an answer to the following research question;

"Does participation in the WiA OCoP lead to EFL teachers' perceived technology professional development?"

ONLINE COMMUNITIES OF PRACTICE

"An online community of practice (OCoP) is a group of people, who are brought together by a shared interest and with the aim of deepening their understanding of an area of knowledge through regular interactions facilitated by computer mediated communication (CMC) tools" (Bostancıoğlu, 2016, p. 20). The concept of OCoP is built on Lave and Wenger's (1991) communities of practice (CoP) framework and the three fundamental characteristics of CoPs have been reflected in the above definition; 1) a shared domain (the area of interest for which members are brought together), 2) community (members of the community interacting regularly), and 3) practice (the knowledge that is the result of members' endeavours to develop their understating of an area of interest; Wenger, McDermott, & Snyder, 2002; Wenger, White, & Smith, 2009).

The learning taking place within OCoPs can be explained by Vygotsky's (1978) theory of sociocultural learning. Vygotsky (1931; as cited in Rieber, 1997, p. 105-106) noted that "any function of the child's cultural development appears on the stage twice, or on two planes .... first between people as an intermental category, then within the child as an intramental category". This quote suggests that learning is not just a cognitive process but also a social one and, in fact, highlights the importance of social interactions in knowledge building. According to Vygotsky (1978), there is a difference between what children already know and what they can achieve with guidance from more able peers. The distance between a child's actual and potential development has been referred to as the zone of proximal development (ZPD). Though slightly in a different way, Vygotsky's (1978) concept of ZPD has been applied in the community of practice (CoP) framework and been referred to as legitimate peripheral participation (LPP; Lave & Wenger, 1991). The premise of LPP is that, in line with principles of ZPD, members of a community initially do not actively participate in community activities since they do not know how to act in the community and thus are in the periphery. However, in time, through their observations and/or interactions with more experienced community members, they develop an understanding of community workings as well as gain the knowledge and skills that would enable them to become active and/or core members of that particular community who are knowledgeable and experienced in the practices of the community (see Figure 1; Wenger, et al., 2002).

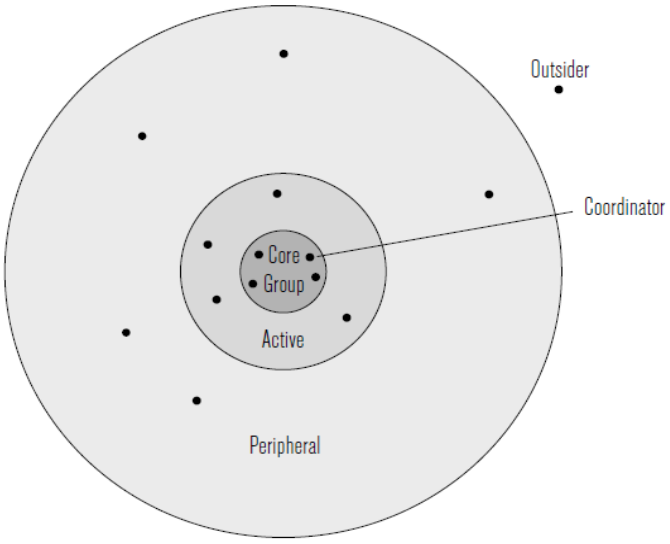


Figure 1. Member participation in communities of practice (Wenger et al., 2002, p. 57)

When applied to technology professional development (TPD), the OCoP framework and the concept of LPP suggest that teachers who become members of an OCoP would go through various stages of LPP and change from being "newcomers" into "old-timers" (Lave & Wenger, 1991, p. 56) as a result of their participation. Thus, it is considered that such a process would encourage scaffolding among teachers which can allow less experienced teachers to advance their knowledge and skills in their profession, and develop professionally. It can be argued that the formation of such professional learning networks for TPD can be valuable since such professional development opportunities reflect components of effective teacher professional development that has been stated in the literature such as; collaboration, an opportunity for mentoring and coaching, and sustainability over time (Cordingley, Bell, Thomason, & Firth, 2005; Darling-Hammond & McLaughlin, 1995; Little, 1993; Putnam & Borko, 1997; Walter & Briggs, 2012). While there has been a considerable amount of research on OCoPs (see for example edited books by Barab, Kling, & Gray, 2004; Lindberg & Olofsson, 2010), there has been limited research on the effects of teachers' participation in OCoPs on their professional development. Few studies to date have studied this phenomenon and have found positive effects of community participation on teachers' professional development (Guzey & Roehrig, 2009; Kulavuz-Onal, 2013; Pachler, Daly, & Turvey, 2010; Scott & Scott, 2010; Vavasseur & MacGregor, 2008; Zygouris- Coe & Swan, 2010). However, the results of those small scale studies are far from being conclusive and it is not clear whether all community participation levels were represented (i.e. core, active, and peripheral members. In addition, communities in most of those studies were blended communities in which teachers extended their face-to-face communication via the online community platforms. Considering their potential in the service of teacher professional development, further research on OCoPs and teacher professional development is necessary. Thus, the present study aims to contribute to research in this area through examining an OCoP which mainly functions online and taking into consideration the representation of community members with different levels of participation. As mentioned above, taking the case of Webheads in Action (WiA) OCoP, the answer to the following research question has been sought in the present study:

"Does participation in the WiA OCoP lead to EFL teachers' perceived technology professional development?"

THE CASE

The search for online teacher communities resulted in a number of groups that could be studied. However, the preliminary analysis of the amount of interactions taking place within those communities showed that the WiA OCoP was relatively more engaged in discussions compared to other groups, which suggested that potentially more collaboration and/or mentoring opportunities were present in the WiA community. Therefore, the WiA OCoP has been selected as the case to be studied. The WiA community was founded in 2002 after an eight-week long online training session with the same name, which aimed to develop participants' understanding of how technology can be employed effectively in teaching languages. At the end of the training, participants decided to maintain their online interactions and Vance Stevens, organizer of that online training session, became the moderator of the community (Johnson, 2005). Unlike most of the online communities studied in the past, most of which existed for a period shorter than *12 months* (Blitz, 2013), the WiA community had existed for over *12 years* (at the time of research). Therefore, it has been considered to provide an *extreme* and *critical* case (Yin, 2014).

METHODOLOGY

Conducted within the paradigm of pragmatism, the present study followed a case study approach utilizing a mixed method strategy that included the use of questionnaires, interviews, and document analysis (see Figure 2 for the overview of methods)

In the summer of 2014, an invitation to participate in the study was sent to WiA's public Yahoo! group page. The invitation included information about the study and the link to the survey. The aim of utilizing the survey method was to be able to reach as many members of the community as possible, collect demographic information about the members of the community, and measure English as a foreign language (EFL) teachers' perceived TPD. In relation to the last point, the EFL-TPACK questionnaire, which was developed by Bostancıoğlu (2014) for measuring EFL teachers' perceived technological pedagogical and content knowledge (TPACK), was used. The EFL-TPACK questionnaire was the result of extensive research into what constitutes TPACK for the EFL context and a two-stage validation which included; a) the consultation of computer assisted language learning (CALL) experts and b) the administration of the survey to a cohort of 542 English language teachers across the world, following a convenience sampling strategy, for conducting exploratory factor analysis (EFA). The EFL-TPACK survey consisted of 11 item measuring technology knowledge (TK), 7 items measuring technological content knowledge (TCK), 7 items measuring technological pedagogical knowledge (TPK), and 7 items measuring technological pedagogical and content knowledge (TPACK) which makes a total of 32 items.

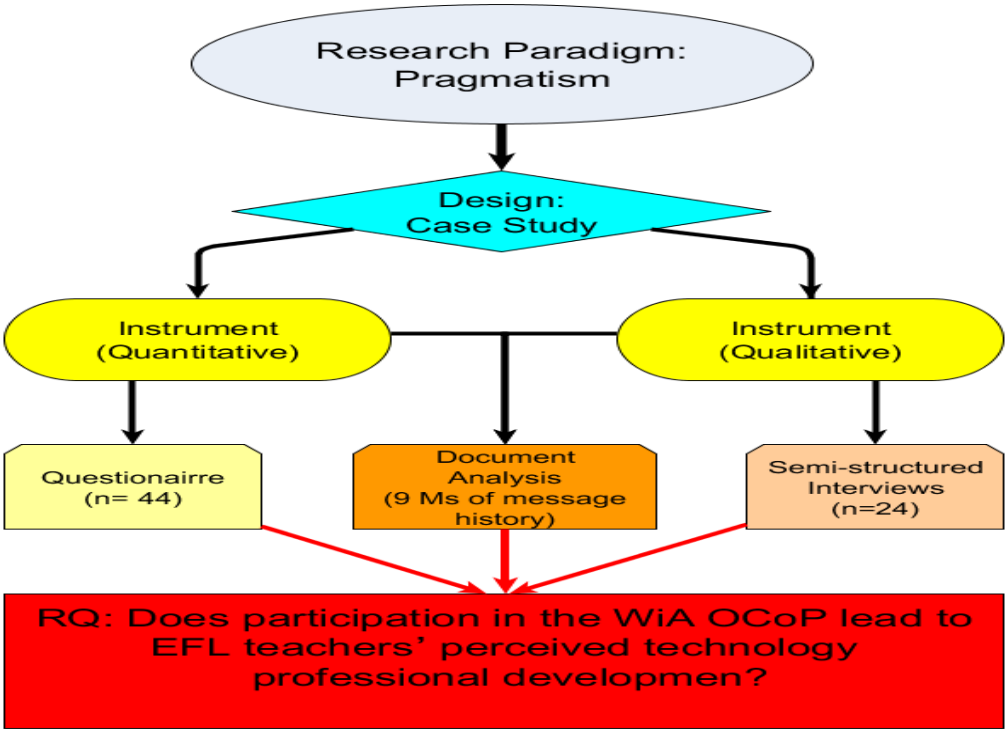


Figure 2. Overview of methods

The survey was open for participation for a period of one month and during that time frame a total of 69 participants with various levels of participation in the community responded to the survey. However, 25 of these respondents were either English as a second language (ESL) or retired teachers and since the focus of the present study was EFL teachers, these 25 responses were only used for demographic purposes. As a result, 44 EFL teachers' responses were used for measuring perceived technology professional development. At the end of the survey, participants were asked if they would want to volunteer to do a follow-up interview. Of the 44 EFL teachers 24 agreed to be interviewed. The interviews took place online (via Skype) since members of the community were dispersed across the world. In line with the research question asked in the present study, interviewees were first asked about how they integrated technology into their teaching and where possible they were asked to provide example uses. After that, they were asked to what extent they would relate their use of technology to their participation in the WiA community. Additionally, community interactions spanning over a period of nine months (from October 2013 to June 2014, prior to the administration of the survey) were collated to support findings from the survey and/or the interviews.

Different data analysis techniques were used due to the use of both qualitative and quantitative data collection tools. Descriptive statistics were used to present demographic information collected from survey respondents. In line with the premise of LPP, inferential statistics were used in order to find out whether there was a significant difference among peripheral, active, and core members' scores in technology knowledge (TK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPCK). As for the interviews, thematic analysis (TA), which is claimed to be "a foundational method for qualitative data analysis" has been used (Braun & Clarke, 2006, p. 78). Since TA is not bound by theory and/or epistemological positioning, its use fits the pragmatic nature of the present study. As such, TA in the present study has been used both inductively and deductively. It has been used deductively since technological pedagogical and content knowledge (TPACK) framework and its sub-components (i.e. TK, TPK, TCK, and TPCK) have been utilized as predetermined categories in analysing the interview data. As explained previously, the document analysis approach has been used to support, challenge, and/or elaborate on the findings of the interviews and questionnaires.

In terms of validity and reliability, Bostancıoğlu (2014) established the validity of the EFL-TPACK instrument through content validation (consulting subject matter experts) and exploratory factor analysis. The reliability of EFL-TPACK instrument was established through the calculation of Cronbach's alpha values which ranged between .81 and .89 for various sub-dimensions of the TPACK framework. Additionally, a number of steps were followed in order to establish the trustworthiness of the study as a whole. For example, a member checking

procedure was followed in order to establish credibility. Thus, the preliminary results were shared with community members and they were asked to confirm and/or contest the conclusions that the author of the present study had reached. Another step in establishing credibility was the use of multiple data collection tools which facilitated triangulation. To increase the transferability of the findings, as much detail as possible was included to be able to offer a "thick description" of the case (Mertens, 2010). Last but not least, the ethical procedures that the Association of Internet Researchers (AoIR, 2012) suggested for doing online research have been followed and the Department of Education Ethics Committee at the University of York (UK) granted ethical approval for conducting the present study. Pseudo names were used in order to protect interviewees' identities.

RESULTS

Demographic data showed that the members of the Webheads in Actions (WiA) community (*n*= 69) were dispersed across the seven continents around the world (see Table 1). The average teaching experience of the participants was 22 years and their experience ranged from 1 year to 55 years, indicating that the WiA community harboured both veteran and novice teachers. The number of female participants (*n*= 53, 77%) were significantly higher than male participants (*n*= 16, 23%), which reflects the higher proportion of female teachers in the field. As discussed before, 44 of the 69 responses received belonged to EFL teachers. Prior to the invitation to participate in the survey, member interactions within the community were observed for a period of nine months, and the 44 EFL teachers' participation in community activities were categorized based on how active they were within that time frame. As a result, 27 teachers (61%) were considered to be peripheral members, 14 (32%) active members, and 3 (7%) core members (Wenger, et al., 2002; Wenger, et al., 2009).

Table 1. Countries in which community members were located

Country	N	Country	N	Country	N
Argentina	7	Italy	1	Spain	4
Australia	4	Kuwait	1	Sudan	1
Brazil	4	Morocco	1	The United Arab Emirates (UAE)	1
Canada	1	Nigeria	1	The United Kingdom (UK)	2
Czech Republic	1	Oman	1	The United States of America	8
Egypt	1	Poland	1	Turkey	2
France	1	Portugal	2	Ukraine	1
Germany	3	Saudi Arabia	1	Venezuela	7
Iran	5	Slovenia	2	N/A	5
Total N: 69					

Apart from the demographic information, the participants were also asked to rate themselves on a 7-point Likert scale (1= strong disagreement; 7= strong agreement) to measure their perceived technological pedagogical and content knowledge (TPACK; Mishra & Koehler, 2006). Participants were presented with statements in the four subscales of the TPACK framework that related to; 1) technology knowledge (TK), 2) technological pedagogical knowledge (TPK), 3) technological content knowledge (TCK), and 4) technological pedagogical content knowledge (TPCK). TK refers to the skills required for operating and working with technologies. TPK refers to the understanding of how the use of particular technologies in particular ways can change teaching and learning. TCK, on the other hand, is described as "knowledge about the manner in which technology and content are reciprocally related" (Mishra & Koehler, 2006, p. 1028). And TPCK refers to the understanding of how to use technology in a meaningful and pedagogically sound way in order to be able to provide opportunities for learners so that they can better understand the content to be learned.

The descriptive statistics showed that WiA members' perceived TPACK knowledge levels were high (see Table 2). Community members scored highest in the TK subscale (*Mn*= 6.64) and their scores slightly decreased for TPK (*Mn*= 6.26), TCK (*Mn*= 6.24), and TPCK (*Mn*= 6.05). Additionally, members generally considered their community participation to be helping them to "grow professionally" (Mary, Active member). In support for this statement, community interactions indicated that members helped each other through; 1) experimenting (online) in the use of different technologies for teaching purposes, 2) asking each other questions in community's public space, and 3) following what has been shared in the public space (i.e. information about specific tools, invitations, and so on).

Table 2. Perceived TPACK levels of EFL teachers in the community

	N	Mean	Min.	Max.	Range	Std. Deviation	Variance
Technology Knowledge (TK)	44	6.64	4.09	7.00	2.91	.68	.46
Technological Pedagogical Knowledge (TPK)	44	6.26	2.00	7.00	5.00	1.03	1.06
Technological Content Knowledge (TCK)	44	6.24	1.86	7.00	5.14	1.16	1.34
Technological pedagogical and content knowledge (TPACK)	44	6.05	2.29	7.00	4.71	1.19	1.43

To begin with, community members seemed to be motivated to both experiment and share their knowledge within the community:

> "the more we see that people are motivated and actively participating, […] the more it makes us feel like participating and carrying on and going to extremes" (Telma, Core member).

As a result of this, members were found to be encouraged to "take risks with no problems of failure" (Cecilia, Core member). Cecilia added that "there is no such a thing of failure for us". This supports Betty's (Active member) statement that members "are mostly […] geared at exploring the technological processes". In fact, the community interactions supported these statements. In November 2013, the community gathered in an online session in which they tried to overcome the 10-people participation limitation of Google+ Hangouts by airing the session on YouTube and embedding the YouTube link to an EtherPad clone, which allowed the audience to interact with the presenter via text-chat. Within the nine-month time frame, the community also explored many different topics such as the use of IPads in language teaching and ideas for flipped classrooms.

Secondly, the perceived professional development seemed to occur through the questions that members directed to the community. Over the nine months, members exchanged 556 messages which have been grouped into 190 threads (the average length of a thread was 3 messages). 20 of those message threads (11%) were help requests about the use technology. Moreover, there has been at least one answer to a query on the day it has been posted and the fastest response was received to Annie's (Peripheral member) query about how to teach a lesson using technology more effectively (see Thread 43 in Appendix 1). Annie posted her query at 15:01 and the first response was received at 15:14 which is less than a quarter of an hour. In their responses, community members tried to direct Annie to resources that might help her with her query (see Thread 43 in Appendix 1). It is possible that the geographical diversity of the community helped members receive timely responses to their queries

Thirdly, members also seemed to benefit from the community's expertise by following the knowledge created and shared within the community:

> "…sometimes a new topic, a new tools is being introduced or someone wants to learn how they can use a specific tool […] So by just seeing what are being raised and the responses that other Webheads give… So I get some ideas" (Havva, Peripheral member).

Parallel to this, it has been observed that members shared resources within the community (34 threads, 18%), which included; articles, e-books that can be used for teaching English, recordings of events such as conference presentations, information on webpages/software/applications, and excerpts from members' teaching practice using technology (see for example Thread 49 in Appendix 1). In general, these messages tended to invite feedback and responses from other members. One other way in which members shared information was the Learning2gether updates that Vance Stevens (the moderator) shared with the community. Learning2gether is the name given to the online synchronous sessions that the community held every other week in order to come together and share and discuss issues that relate to educational uses of technology. The Learning2gether message threads (n= 42; 22%) included information on past Learning2gether sessions as well as an invitation to the upcoming ones (see Thread 19 in Appendix 1).

At this point it is timely to revisit the notion of legitimate peripheral participation (LPP) which indicates that peripheral members who, in theory, do not know much about the practice of the community would become more knowledgeable in time as they observe and participate in community activities (Wenger, et al., 2002; Wenger, et al., 2009). Inferential statistics were run to test this hypothesis. Normality tests were carried out in order to decide which analysis to run. The results of Kolmogorov-Smirnov ($p < 0.001$) and Shapiro-Wilk ($p < 0.001$) tests were significant, suggesting that the data was not normally distributed (see Table 3). Therefore, Kruskal Wallis, a non-parametric test, was run (Field, 2009). Kruskal Wallis test results yielded significant results for all TPACK subscales, but TK [H (2) = 6.54 for TCK; 7.99 for TPK; and 8.59 for TPCK; see Table 4]. The

Jonckheere-Terpstra test revealed a significant trend in the data: the more frequently a Webhead interacted with the community the higher their scores were in TCK ($J = 314.50$, $z = 2.42$, $r = .37$), TPK ($J = 363.00$, $z = 2.70$, $r = .41$), and TPACK ($J = 370.00$, $z = 2.88$, $r = .43$; see Table 4).

Table 3. Test of normality of the data

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
TK	.314	44	.000	.587	44	.000
TCK	.256	44	.000	.686	44	.000
TPK	.236	44	.000	.717	44	.000
TPACK	.213	44	.000	.766	44	.000

That there was no significant difference between TK scores of members was not unexpected. Regardless of their level of participation all members reported that they learned how to operate/use certain tools and technologies as a result of their participation whether it be peripheral, active, or core:

> "I learned the blogging […] I learned some things with Google and Google docs" (Sarah, Peripheral member).
>
> "…how to use blogs, how to use Skype, how to use Yahoo groups, I don't know, uhm, how to use wikis […] lots of tools like these ones. Google drive, google docs… You see, I have learned a lot. I mean all I know about technology" (Mary, Active member).
>
> "I can give you tons of examples like blogging, setting up a blog, uhm, podcasting […] How to work with audio using Audacity for example, it's something you know that I learned with the Webheads" (Cecilia, Core member).

Table 4. Kruskal-Wallis and Jonckheere-Terpstra test results comparing TK, TCK, TPK, and TPACK scores of participants across different levels of participation

Participation Level	**N**	**Mean Rank**			
		TK	TCK	TPK	TPCK
Peripheral	27	20.46	18.69	18.22	18.24
Active	14	24.07	28.86	29.21	28.14
Core	3	33.50	27.17	29.67	34.50
Total	44				
Kruskal Wallis Test Statistics					
Chi-Square		3.55	6.54	7.99	8.59
df		2	2	2	2
Asymp. Sig.		.170	**.038***	**.018***	**.014***
Jonckheere-Terpstra Test Statistics					
Observed J-T Statistic		314.50	350.00	363.00	370.00
Mean J-T Statistic		250.50	250.50	250.50	250.50
Standard Deviation of J-T Statistic		39.42	41.13	41.60	41.49
Standard J-T Statistic		1.62	2.42	2.70	2.88
Asymp. Sig. (2-tailed)		.104	**.016***	**.007***	**.004***

"*****" Result is significant at a confidence interval of 95%

Six categories were created to group the technologies that members have learned from the WiA community. These were; 1) web tools; 2) audio tools; 3) video tools; 4) computer mediated communication tools; 5) office applications; and 6) data saving tools (see Table 5).

Table 5. Technology knowledge reported by community members

Category	Tools
Web	Blog, Dreamweaver, Flickr, Makebeliefscomix.com, MOOCs, Moodle, SurveyMonkey.com, Wiki,
Audio	Audacity, Podcast, Voicethread, Voxopop,
Video	Camtasia studio, Screencast-o-matic, Snagit, Touchcast,
Computer Mediated Communication (CMC)	Anymeeting.com, Blackboard Collaborate (Elluminate), Diigo, Google Hangouts, Twitter, Yahoo groups,
Office Applications	Google Docs, Prezi, Skype,
Data saving	Google Drive,

That there was a significant difference between peripheral, active, and core members' scores in TCK, TPK, and TPCK scores suggested a positive relationship between members' participation levels in community activities and their perceived technology professional development (TPD). There are two possible explanations for these results: 1) members who were categorized as active and core members had already possessed a good level of knowledge about integrating technology in their instruction and they participated in community activities more frequently because of that and became active/core members; and 2) members' participation in community activities, in line with the notions of LPP, increased as they learned through their observations in the community thus allowing them to become active/core members. The second hypothesis seemed more appropriate considering the below quotes in which, when asked about the extent to which interviewees would relate their TPD, peripheral members did not seem to relate their perceived TPD to the community whereas active and core members did vice versa:

> "No, I would not say that because I developed my skills mainly by myself […] but in terms of keeping me updated and curious about some tools, yes I would say that" (Trella, peripheral member).
> "I cannot think of something that I actually applied. At the moment I cannot remember" (Havva, Peripheral member).
> "Well, before joining Webheads it was like zero compared to now. […] The only technology I know was the Google search and that's it" (Amal, Active member).
> "…but I think not knowing anything about technology before I became a Webhead means that they are very instrumental […] Everything I have learned has come from the Webheads" Sarah (Active member).
> "I would not say 100 % but 90%. 90% of what I became and what I know […] the skills that I developed in terms of digital competencies are related to the Webheads" (Cecilia, Core member).

In addition, the TPD, as reported by the members, was found to suit the critical approach of integrating technology:

> "We looked at ways of using technology but only if it's the right tool for the job. I think teachers sometimes don't use their critical thinking skills and they jump on technology when, really, the whiteboard or the paper and pencil could do the job better and I think that's one of the good things about the Webheads. They don't push technology; they push the right tool for the right job" (Sarah, Active member)

Moreover, the reported example uses of technology in their teaching supported the existence of technological pedagogical, technological content, and technological pedagogical content knowledge (TPK, TCK, and TPCK). For example, Betty (Active member) reported the use of blogs for writing activities and Voicethread for speaking activities. This demonstrates Betty's awareness of how technology can be used for the representation of content (in this case the teaching of language skills) and can be considered as TCK.

It can be understood from Vania's (Active member) statement below that she adapted the use of technology in her teaching and extended the teaching process to outside the classroom, which can be considered as a manifestation of her technological pedagogical knowledge (TPK):

> "I do blended learning […] Some of my sessions are… we do them distance. So I have face to face classes and I blend them with online interactive learning in the Moodle".

Another example provided by Mary (Active member) can be considered as TPCK since Mary showed her

awareness of how technology can be employed to support the teaching of the simple present tense and vocabulary by taking into consideration her students' age and levels:

> "SwitchZoo is a website about animals, their habitats and other stuff. There is one special link to create 'crazy animals'. My students love it. As there is one unit about animals in our course book, I always use this site as "wrap up". I teach them how to use the site and how to create a crazy animal. The grammar taught here is simple present; so students have to create their animal and write about it. As it is an invented animal, all is crazy and used in the simple present. I use it with second year students".

To summarize, members participation in the WiA seemed led to perceived TK development, regardless of their level of participation. However, there were significant difference between members' level of community participation and their perceived TCK, TPK, and TPCK scores which suggested a positive relationship between TPACK scores and level of participation. The interview data supported the hypothesis that the difference in perceived TPACK of members might be due to members' level of interaction and co-construction of knowledge within the community.

DISCUSSION

The results of the present study suggested that the members of the Webheads in Action (WiA) perceived to have developed a number of skills and knowledge in relation to technology and its integration into the teaching/ learning processes. All members, including peripheral members (who generally observed other members' interactions), active members (who participated and interacted with other members of the community), and core members (who generally helped to organize community activities as well as supported other members) reported to have learned about the use/ operation of a variety of technology tools such as how to use a wiki, blog, and Blackboard Collaborate (Elluminate) from the WiA community. This suggested that members had developed their technology knowledge (TK) out of their participation. This finding is in line with previous studies which have investigated teachers' technology professional development (TPD) through community based approaches and found that community members developed similar operational skills with regards to the use of technology tools (Guzey & Roehrig, 2009; Pachler, et al., 2010; Scott & Scott, 2010; Vavasseur & MacGregor, 2008; Zygouris- Coe & Swan, 2010).

In addition, the Webheads' responses suggested that they had developed an awareness of how different technologies can be used to teach different language skills which can be considered to be technological content knowledge (TCK). Furthermore, examples of how Webheads adapted technology and tried new pedagogical approaches constituted evidence of technological pedagogical knowledge (TPK). Finally, the teaching practices that Webheads reported to have carried out (e.g. the use of SwitchZoo, an application that allows the creation of hybrid animals, in the teaching of present simple tense to young learners) seemed to include the use of technology in pedagogically sound ways, which provided opportunities for learners to practice English and better understand the content. This can, therefore, be considered as technological pedagogical content knowledge (TPCK). These findings suggested that TPACK is mediated within the WiA community which is different from the findings of previous studies, which have investigated TPD through community based approaches in which teachers' reported TPD generally remained at the level of TK (Guzey & Roehrig, 2009; Pachler et al., 2010; Scott & Scott, 2010; Zygouris- Coe & Swan, 2010).

In line with the communities of practice (CoP), it has been observed that members did not participate in community activities equally and thus were categorized as peripheral, active, and core members (Wenger, et al., 2002; Wenger, et al., 2009). As such, a significant difference was observed between members' participation levels and their reported TCK, TPK, and TPCK scores, respectively; the more a Webhead interacted and collaborated with the community the higher their TCK, TPK, and TPACK scores were. Moreover, the interview data supported the observation that this difference was related to members' levels of participation in the community. These findings provide support to the notions of zone of proximal development (ZPD; Vygotsky, 1978) and legitimate peripheral participation (LPP; Lave & Wenger, 1991) of members since peripheral members reported to have extended their knowledge and skills of technology integration through their interaction and collaboration with others in the community. It is possible that those members, who were once peripheral members, began to participate more actively in the community and moved towards the centre as they became active/ core members who seemed to be more knowledgeable than the current peripheral member (Lave & Wenger, 1991). Therefore, these findings highlight the importance of interaction and collaboration among members for developing the practice of the community. It should, however, be acknowledged that in spite of the evidence (questionnaire and interview data) presented to support this argument, there is still a possibility that an individual with a high level of expertise can join the community and stay in the periphery to better understand the workings of the community first and then start participating actively once s/he feels safe and confident to

contribute to the community. Nevertheless, in the light of the evidence presented so far, it can tentatively be concluded that an online community of practice (OCoP) approach might be used as an alternative approach for teacher professional development. Indeed, there are a number of characteristics that the WiA community and its members have which can explain the perceived learning taking place in this OCoP. Those characteristics will be discussed below.

First, the WiA community follows a bottom-up approach since it has been built by the initiative of its members and the moderator (Johnson, 2005). They are free to share the information that they find valuable to the practice of the community and direct questions and get answers to their queries. In addition, in their Learning2gether synchronous sessions, they discuss the issues that they want to discuss about and members do not seem to be restricted. Therefore, it can be interpreted that the community members have the choice to choose the areas of development that they consider necessary for their teaching practice, which is one of the characteristics of effective professional development opportunities (Walter & Briggs, 2012). This also suggests that the teachers are empowered within the WiA community (Putnam & Borko, 1997) and learning is participant driven (Darling-Hammond & McLaughlin, 1995).

Secondly, the WiA community is diverse and consists of members who are teaching languages in different parts of the world, which suggests there is variation in the levels of expertise within the community from which members can benefit. Therefore, we can say that the WiA community brings in expertise from outside each members' own school environment, which has been found to be an additional characteristic of effective professional development (Cordingley, et al., 2005; Walter & Briggs, 2012). It is possible that thanks to this diversity, there is generally someone who can help the other members with their queries and the geographical diversity of the community allows members to receive timely responses to their queries. This situation can be considered to provide "just in time" rather than "just in case" training opportunities for TPD which Hixon and Buckenmeyer (2009) claimed to be effective (see also Hanson-Smith, 2006; Vavasseur & MacGregor, 2008).

Thirdly, in order to be able to interact online, the Webheads need to use technology tools which provide them with opportunities where they are not only communicating with other members but also practicing the use of technologies. In addition, in their Learning2gether synchronous sessions they explore and experiment with the use of new technologies and the members reported to have subsequently utilized those tools in their teaching. Therefore, this experience can be considered to be "hands on", concrete, and situated, which are characteristics that are deemed effective by researchers (Darling-Hammond & McLaughlin, 1995; Lieberman, 1995; Walter & Briggs, 2012).

Fourthly, Webheads' perceived professional development takes place through their participation and interactions within the community. Teachers help each other, collaborate, and engage in collegial dialogue not only in the public Yahoo! group page but also in synchronous Learning2gether sessions. This supports researchers' conclusions that in effective professional development teachers become active participants of the learning process and collaborate with each other (Cordingley, et al., 2005; Darling-Hammond & McLaughlin, 1995; Little, 1993; Putnam & Borko, 1997; Walter & Briggs, 2012). Finally, the learning taking place in the WiA community has been continuous throughout the last 12 years (at the time of research); thus, it can be considered ongoing and sustained over time, which is another characteristic of effective professional development (Darling-Hammond & McLaughlin, 1995; Walter & Briggs, 2012).

CONCLUSIONS

The answer to the research question asked in the present study appears to be "yes"; participation in the WiA community led to EFL teachers' perceived technology professional development (TPD). Regardless of their level of participation in community interactions, all Webheads reported to have developed their TK. A finding that needs to be tentatively highlighted is that; active and core members' more frequent interactions and collaborations with other community members resulted in significantly higher TCK, TPK, and TPCK scores, which suggested a positive relationship between members' perceived professional development and their level of participation. Overall, these findings suggest that an online community of practice (OCoP) approach can be a viable alternative to technology professional development, thanks to the provision of factors such as: allowing teachers control in the selection of areas in which to develop their knowledge/skills; providing "just in time" support; actively engaging teachers in the learning process; and sustaining engagement and interactions over time.

An important limitation of the present study is the generalizability of the findings. As discussed at the beginning of this article, unlike most other online communities, the WiA community has sustained its existence for over 12 years. Therefore, although this research contributes to the body of knowledge regarding theory of OCoP and

EFL teachers' TPD, the findings that have emerged from the study cannot be generalized to all OCoP contexts and/or EFL teacher populations. Thus, further case studies can be conducted with different teacher OCoPs that investigate teachers' professional development. Such studies would contribute to the growing body of knowledge in the field of teacher OCoPs, which in the future can be used for a meta-analysis of that body of knowledge, leading to more generalizable findings. On a different point, all levels of participation (core, active, and peripheral members) were represented in this study and it has been found that core and active members contributed to the community much more than peripheral members. Thus, they can be considered to be the key people and the driving force of the community. Future research can, therefore, further investigate that key role they play for the community (i.e. how and why they contribute to the community).

Through studying the WiA OCoP, it is considered that a better understanding of OCoPs as social learning environments has been reached. The findings indicate that OCoPs can be used in the service of teacher professional development. Therefore, it can be concluded that it is important to encourage teachers to participate in OCoPs for their professional development by, for example, informing them about the potential benefits of such participation. In addition, this form of learning can be acknowledged and the time teachers are engaged with the community can be formally recognized by policy makers. Last but not least, since members can belong to more than one community and the premise of the OCoPs is that teachers will receive support in the areas they need help with, the creation of communities appealing to different areas of professional development could usefully be encouraged and the current OCoPs supported. In conclusion, the present study provided tentative evidence that OCoPs can be used in the service of teacher professional development.

ACKNOWLEDGEMENT
This research was made possible by a scholarship from Turkish Ministry of National Education to the author.

REFERENCES

AoIR. (2012). *Ethical decision-making and Internet research: Recommendations from the AoIR ethics working committee*. Retrieved from http://www.aoir.org/reports/ethics2.pdf.

Barab, S., Kling, R., & Gray, J. (Eds.). (2004). *Designing for virtual communities in the service of learning.* Cambridge: Cambridge University Press.

Blitz, C. L. (2013) *Can online learning communities achieve the goals of traditional professional learning communities? What the literature says*. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Mid-Atlantic.

Bostancıoğlu, A. (2014, May). *EFL-TPACK: The development of a questionnaire to measure technology pedagogy and content knowledge (TPACK) of English as a foreign language (EFL) teachers*. Paper presented at the Paper presented at the Multiple sites for language learning: Educating the new generation of CALL practitioners workshop, Nice, France. Retrieved from https://sites.google.com/site/teacheredsignice/programme/abstracts/efl-tpackquestionnaireforteachers

Bostancıoğlu, A. (2016). Factors affecting English as a foreign language teachers' participation in online communities of practice: The case of Webheads in Action. *International Journal of Languages' Education and Teaching, 4*(3), 20-35. doi: 10.18298/ijlet.1651

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations. *The Turkish Online Journal of Educational Technology, 11*(4), 273-282.

Cordingley, P., Bell, M., Thomason, S., & Firth, A. (2005). The impact of collaborative continuing professional development (CPD) on classroom teaching and learning. Review: How do collaborative and sustained CPD and sustained but not collaborative CPD affect teaching and learning? In: *Research Evidence in Education Library*. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *The Phi Delta Kappan, 76*(8), 597-604.

Field, A. (2009). *Disccovering statistics using SPSS*. London: Sage.

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: Case studies of science teachers' development of technology, pedagogy, and content knowledge. *Contemporary Issues in Technology and Teacher Education, 9*(1), 25-45.

Hanson-Smith, E. (2006). Communities of practice for pre- and in-service teacher education. In P. Hubbard & M. Levy (Eds.), *Teacher education in CALL* (pp. 301-316). Amsterdam: John Benjamins B. V.

Hixon, E., & Buckenmeyer, J. (2009). Revisiting technology integration in schools: Implications for professional development. *Computers in the Schools, 26*(2), 130-146.

Johnson, C. M. (2005). *Establishing an online community of practice for instructors of English as a foreign language*. Unpublished doctoral dissertation. Nova Southeastern University. Fort Lauderdale, Florida.
Kulavuz-Onal, D. (2013). *English language teachers' learning to teach with technology through participation in an online community of practice: A netnography of Webheads in Action*. Unpublished doctoral dissertation. University of South Florida. Florida.
Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology in teaching and learning: Knowns, unknowns and ways to pursue better questions and answers. *Review of Educational Research, 77*(4), 575-614.
Lieberman, A. (1995). Practices that support teacher development: Transforming conceptions of professional learning. *The Phi Delta Kappan, 76*(8), 591-596.
Lindberg, J., & Olofsson, A. (Eds.). (2010). *Online learning communities and teacher professional development: Methods for improved education delivery*. Hershey, PA: Information Science Reference.
Little, J. W. (1987). Teachers as colleagues. In V. Richardson-Koehler (Ed.), *Educators' Handbook: A research perspective* (pp. 491-518). New York: Longman.
Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis, 15*(2), 129-151.
Mertens, D. M. (2010). *Research and evaluation in education and psychology: Integrating diversity with quantiative, qualiutative, and mixed methods*. Thousand Oaks, CA: Sage.
Meskill, C., Anthony, N., Hilliker-VanStrander, S., Tseng, C., & You, J. (2006). Expert-novice teacher mentoring in language learning technology. In P. Hubbard & M. Levy (Eds.), *Teacher education in CALL* (pp. 283-299). Amsterdam: John Benjamins.
Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.
OECD. (2009) *Creating effective teaching and learning environments: First results from TALIS*. Paris: Author.
Pachler, N., Daly, C., & Turvey, A. (2010). Teacher professional development practices: The case of the Haringey transformation teachers programme. In J. Lindberg & A. Olofsson (Eds.), *Online learning communities and teacher professional development: Methods for improved education delivery* (pp. 77-95). Hershey, PA: Information Science Reference.
Putnam, R., & Borko, H. (1997). Teacher learning: implications of new views of cognition. In B. Biddle, T. Good & I. Goodson (Eds.), *International handbook of teachers and teaching* (pp. 1223-1296). Dordrecht, Netherlands: Kluwer Academic.
Rieber, R. W. (Ed.). (1997). *The collected works of L. S. Vygotsky: (Volume 4) The history of the development of higher mental functions*. New York: Plenum Press.
Scott, D., & Scott, S. (2010). Innovations in the use of technology and teacher professional development. In J. Lindberg & A. Olofsson (Eds.), *Online learning communities and teacher professional development: Methods for improved education delivery* (pp. 169-189). Hershey, PA: Information Science Reference.
UNESCO. (2011). Transforming education: The power of ICT policies. Paris, France: United Nations Educational, Scientific and Cultural Organization.
Vavasseur, C. B., & MacGregor, S. K. (2008). Extending content-focused professional development through online communities of practice. *Journal of Research on Technology in Education, 40*(4), 517-536.
Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
Walter, C., & Briggs, J. (2012). What professional development makes the most difference to teachers? *A report sponsored by Oxford University Press*.
Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice*. Cambridge: MA: Harvard Business School Press.
Wenger, E., White, N., & Smith, J. D. (2009). *Digital habitats: Stewarding technology for communities*. Portland, OR: CPsquare.
Yin, R. K. (2014). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.
Zygouris- Coe, V. I., & Swan, B. (2010). Challenges of online teacher professional development communities: A statewide case study in the United States. In J. Lindberg & A. Olofsson (Eds.), *Online learning communities and teacher professional development: Methods for improved education delivery* (pp. 114-133). Hershey, PA: Information Science Reference.

APPENDICES

Appendix 1. Thread examples from the WiA Yahoo! group message history

Category	Message content
Help Requests	**Thread 43- Message 1 of 15** Dear Webheads Since 2012 I am a member of this yahoo group. Many times I have used your suggestions related to study English with the help of modern means. I want to thank you for the great job you do right here, particularly for the teachers who want to improve. I need some advice of how to teach a lesson about Internet better. I am using wikis, thesaurus, e mail writing, PowerPoint. Best wishes from Romania. [Name] **Thread 43- Message 2 of 15** Dear [Name], Great to hear from you! You might want to start by checking this great publication that has some of our dear Webheads. What I like about it is that we have the theoretical background together with case studies. It was edited by [Name] http://www.teachingenglish.org.uk/sites/teacheng/files/C607%20Information%20and%20Communication_WEB%20ONLY_FINAL.pdf - Innovations in Learning Technologies for English Language Teaching Also, sites like http://edutopia.org can give us great insights. I also recommend you take one of our free online sessions happening in the beginning of January, the Electronic Village Online. There will be an amazing variety of topics to explore with educators all over the globe. It is a great way to find new insights to teach English with Technology. I hope this helps. Cheers from Brazil, [Name]
Sharing resources	**Thread 49- Message 1 of 5** Dear All, It's that time of the year again when I get many students' goodies to share. I'm sharing with you a few ezines that my Mass media class have produced for their midterm project. Please have a look. Share with your students- my students would definitely be happy to hear from you/them. Note though: some students have submitted their drafts for editing, some didn't. What you'll see on these pages are their published work presented in class. Some articles are good, some need more polishing. One thing they have learned is- it's always better to double- (or even tripple-) check their work before publishing Here's the padlet site: http://padlet.com/wall/1mcwqdxsk1 Here's the wiki page (see sidebar for rubric and task description) http://massmedia2013.pbworks.com/w/page/70654531/Students_Ezines Thanks! [Name] **Thread 49- Message 2 of 5** These are just great, An --look terrific! Did padlet create the book formats, or was that just a place to store them together? What tools did you use with the students? Cheers **Thread 49- Message 3 of 5** Hi [Name], Padlet was just a wall to 'hang' my students' ezines. Issuu works like that too- but Issuu does not provide a space where all the ezines can be collected and exhibited in one wall. In creating their ezines, they made use a mix of tools: microsoft word, adobe illustrator, photoshop, publisher, Paint, and powerpoint. Some lay-outs were created using Paint and Word- yet the results are impressive. For editing, we used Meetingwords and Word. [Name]

Category	Message content
Learning2gether	**Thread 19- Message 1 of 1** Hi everyone, I believe I pointed you to the archive of last week's Sunday chat with [Name] and [Name] http://learning2gether.net/2013/10/20/learning2gether-with-hora-hedayati-and-susan-marandi-on-impediments-efl-teachers-perceive-in-implementing-call-in-efl-classes-in-iran/ I have since rendered the mp3 from the Elluminate recording in case you would like to simply listen. This Sunday and next we have Learning2gether events designed for EVO moderator training but as always all are welcome to attend. Both events are at 1400 GMT. This week we will explore Elluminate and next week we will explore how you set up and stream hangouts. This week, the plan is to make anyone a moderator who wants to be one and show them the tool kit and explain what you need to know about uploading to the whiteboard and setting number of available mics, and how to register the event so we don't get double bookings, and other such tips and tricks. If there is an another agenda, that is fine too, but I'll be in the background helping those interested with whatever they wish to know about the platform. At the appointed time please join us at http://learningtimesevents.org/webheads/ For more information and to see when that time is where you are, visit: http://learning2gether.pbworks.com/w/page/32206114/volunteersneeded#Nextupcomingevents Vance Stevens

Research on Educational Media: Balancing between Local and Target Language Cultures in English Electronic Textbooks

Dian ERLINA
State Islamic University of Raden Fatah, Indonesia
dianerlina_uin@radenfatah.ac.id

Lenny MARZULINA
State Islamic University of Raden Fatah, Indonesia
hj.lennymarzulina@gmail.com

Nova Lingga PITALOKA
State Islamic University of Raden Fatah, Indonesia
NOvalinggapitaloka@gmail.com

Annisa ASTRID
State Islamic University of Raden Fatah, Indonesia
syahidah0682@yahoo.com

Fikri YANSYAH
State Islamic University of Raden Fatah, Indonesia

Amirul MUKMININ
Jambi University, INDONESI
amirul.mukminin@unja.ac.id

ABSTRACT
The aim of this study was to investigate the proportions of the local and target language cultures in government's English electronic textbooks for junior high school students in Indonesia. The primary data were collected from English textbooks published by the Indonesian government. We analyzed ten English electronic textbooks with 2308 paragraphs and 3079 pictures. The Byram & Morgan's (1994) model was used to analyze the paragraphs and pictures to examine local or target language culture categories. The findings indicated that in terms of paragraphs, of the ten textbooks, four textbooks showed a balanced proportion, while six textbooks were imbalanced in presenting local and target language cultures while for the pictures, only two textbooks promoted a balance proportion between local and target language cultures and eight textbooks presented imbalance proportions. The findings shed important light on the sort of evidence necessary for promoting a balance proportion between local and target language cultures in English electronic textbooks. Suggestions for future research are also discussed.

Keywords: local and target language culture, balanced and imbalanced proportion, English electronic textbooks

INTRODUCTION
Language teaching materials are very essential. Richard (2001) argues that materials are the key components in most language programs while Pardo and Téllez (2009) assume that language learning materials form a crucial feature in constructing an effective teaching and learning environment. For Nguyen, Warren, and Fehring (2014), teaching materials take part in an essential role in endorsing communicative language use. The advantages of language teaching materials contribute a leading influence to the activities of language teaching and learning in language classroom. To construct an effective teaching and learning environments, the foremost aspect that should be presented in language teaching is cultural content (Pulverness, 2003) as it is the basis of understanding other aspects (Pardo & Téllez, 2009). It would be complicated, if not unfeasible, to teach a language without teaching some features of its culture (Hilliard, 2014; Neff & Jr, 2013) as language is one of the products of culture (Yule, 2010).

The presence of cultural elements in language teaching resources is intended to supply many advantages for learners as it can facilitate learners to be capable linguistically and interculturally (Ho, 2009). Language materials that have cultural contents could provide students for broadening students' view with cultures and for

empowering them with multicultural competence (Troncoso, 2010). Moreover, in actual communication, it is not only the characters of language that hands on meaning but also language in its cultural background that constructs meaning (Erfani, 2014). Additionally, Wang (2011) said that the point of English education was to cultivate students' inclusive English competence by learning language and its culture. Mainly, cultural materials will always be tied with the language teaching.

The major materials in language classroom are textbooks (Dweik & Al-Sayyed, 2015; Sorongan, Susanti, & Syahri, 2014) as textbook is an important part or instrument of language learning in the classroom (Heyneman, 2006; Hurst, 2014; Liu & Laohawiriyanon, 2013; Moirano, 2012). Textbooks might give a fundamental function in educational system of every nation (Khajavi & Abbasian, 2011). Moreover, textbook is the main reference of cultural components besides presenting linguistic and relevant contents essentially revealing the intrinsic ideology in the ESL/EFL context of a particular aspect (Heyneman, 2006; Hurst, 2014; Liu & Laohawiriyanon, 2013; Moirano, 2012).

There are two kinds of cultural teaching and learning materials or resources that could be presented in English textbooks. The first is local culture materials and the second is target culture materials (Jiangqiong & Tin, 2010). Local cultural learning materials or resources reflect the norms, symbols, traditions, schemas, and beliefs shared by a specific social group. For instance, when a group of people do a regular activity of something, it will be a habit and raised to be a continuous activity in that locality. Then, people will call it as their culture (Kawar, 2012). While, target culture is related to the cultures that subsist and abide from English speaking countries (Chao, 2011) where people use English as the first language based on the sociolinguistic aspects such as Australia, Canada, New Zealand, UK and USA (Karchu, 1996). When linking cultures to the teaching materials, it should be equivalent. Bell and Gower (1998 as cited in Tomlinson, 2003) said that one of the principles in material development was that the materials should be put in balance consideration, and one of the materials is cultural content (Andarab, 2014; Rubby, 2003). Similarly, Jiangqiong and Tin (2010) said that it was important to combine local and target cultures in teaching materials. Accordingly, many authors have suggested using both local languages and target language cultures to deal with the limitations of exclusively using one of the cultures (Choudhury, 2013) as students need to understand their own cultures and other cultures (Frank, 2013). The unequal proportion of cultural contents in textbooks might lead complicatedness to students during their participation in intercultural interaction (Liu & Laohawiriyanon, 2013).

It is correspondingly important to do an evaluation to the materials of the teaching whether the textbook which is used by the English teacher is balanced or not in terms of cultural contents. The ability to use teaching materials competently is a very vital activity for all EFL educators (McDonough & Shaw, 2003). For the cultural content evaluation, Byram and Morgan (1994) and Kilickaya (2004) proposed a qualitative evaluation checklist with a list of criteria for examining the extent and methods of how culture is presented. There are nine categories from the checklist, namely; social identity and social groups, social interaction, belief and behavior, socio-political institutions, socialization and the life-cycle, national history, national geography, national cultural heritage, stereotypes and national identity (Byram & Morgan, 1994).

However, in Indonesia as a developing and non-English speaking country, research on the proportions of the local and target language cultures in government's English electronic textbooks is rare except for Sorongan, Susanti and Syahri (2014) who analyzed two series of English textbooks (English Zone and Interlanguage) for senior high school and found that some of textbooks in Indonesia were not balanced in promoting local and target language cultures in English textbooks. The aim of this study was to investigate the proportions of the local and target language cultures in government's English electronic textbooks for junior high school students in Indonesia. The following questions guided this study:

1. What is the percentage of local and target cultures proportions in English electronic school textbooks for junior high school in Indonesia?
2. Do English electronic school textbooks for junior high school in Indonesia promote a balanced proportion of local and target language cultures?

LITERATURE REVIEW

Language material

The term of material in language teaching could be interpreted in many assumptions. Materials comprise anything which could be used to make better the learning of a language (Tomlinson, 2014). They could be linguistic, figure, auditory or kinesthetic. Also, they could be produced in printed forms or on tape, CD-ROM, DVD or the internet. They could be instructional as they notify students about the language, they could be trial as they give a contact to the language in use, and they could be elicitative as they encourage the language use, or they could be diagnostic as they seek for innovations about language utility (Mahmood, 2011; Tomlinson, 2014).

Materials are very important in a language program. According to Richard (2001), materials are key component in most language programs, while Pardo and Téllez, (2009) assume that language learning materials form an important component in producing an effective teaching and learning environment. In addition, teaching materials play a vital role in promoting communicative language use. The use of teaching materials has a major impact on the activity of language teaching (Nguyen, Warren, & Fehring, 2014). The materials that could be presented in language teaching are grammar, vocabulary, listening skill, writing skill, reading skill, cultural content, etc. (Pardo & Téllez, 2009). Materials could be presented into (1) written materials (books, workbooks, worksheets, or readers) and (2) non-written materials (video or computers base material), (3) material which include printed and non-print materials (self-access materials and from internet), also non design materials for the teaching for examples, magazine, newspapers and TV materials. Textbook is one of the presentations of the materials (Mahmood, 2011; Nguyen, Warren, & Fehring, 2014; Pardo & Téllez, 2009; Tomlinson, 2014). Textbook is developed on the base of printed curriculum (Mahmood, 2011). Textbooks remain a close within school curriculum universal, presenting teachers and students with the authorized knowledge of school subjects as well as the chosen values, attitudes, skills, and behaviors of experts in those fields.

Language and culture

Culture and language possess an inextricable and reciprocally contingent relationship (Chahak & Basirizadeh, 2012; Choudhury, 2013; Ho, 2009). Tantri (2013) assumes that language is indomitable, decided and inclined greatly by cultures. Languages can put into code more than information. They are also both a way and an utterance of the cultural or ethnic principles of the people that utilize them (Lauder, 2008). People use the word of culture to impart to all the thoughts and postulations about the sort of features and societies that people study when they grow to be members of social groups. It can be defined as socially obtained knowledge (Yule, 2010. This is the kind of knowledge that, like primary language, people firstly gain without intentional awareness. Someone builds up awareness of his knowledge, and hence of his culture, only after having developed language. Therefore, language is the product of culture. Byram (2013) hypothesized that language education concerns on cultures allied with the language in matter in order to accomplish other humanistic objectives, called, appreciative community of other humanities and their cultures, and in order to advance the effectiveness of communication and conversation.

Cultures in ELT

As language and culture are undividable, it is completely essential to take in cultures in language education processes (Cakir, 2006; Moirano 2012; Wang, 2011). Hence, with regards to the indivisible correlation between language and culture, growingly intellectuals and educationalists have highlighted the important function of culture in language teaching and learning (Liu & Lauhawiryanon, 2013) because culture is such a connected part of language, it would be complicated, if not unfeasible, to teach a language without teaching some features of its culture (Hilliard, 2014; Neff & Jr 2013). Therefore, the point of English education is to cultivate students' inclusive English competence by learning language and its culture. In successful instruction and learning of both language and cultural background knowledge, cultural foreword contributes to cultivate students' cultural awareness of target language. Thus, students can advance their English inclusive ability and cultural communication of the target language. This completes the target of foreign language education (Wang, 2011).

THEORETICAL FRAMEWORK

A content analysis of the local and target language cultures in English electronic textbooks for Junior High School students requires a theoretical framework that helps to better understand and describe the proportions of the local and target language cultures in government's English electronic textbooks for Junior High School students in Indonesia. Byram and Morgan's (1994) a qualitative evaluation checklist with a list of criteria was used to examine to which extent that culture is presented in in government's English electronic textbooks. Byram and Morgan's (1994) a qualitative evaluation checklist consists of nine categories consisting of the social identity and social groups, the social interaction, Beliefs and behaviors, Socio-political institutions, Socialization and the life-cycle, National history, National geography, National cultural heritage, Stereotypes and national identity.

We used Byram and Morgan's (1994) a qualitative evaluation checklist with a list of nine criteria for evaluating the local and target language cultures in government's English electronic textbooks for Junior High School students in Indonesia. We assumed that Byram and Morgan's (1994) checklist covers all cultural aspects and more inclusive and comprehensive.

METHODOLOGY

In this study, the content analysis design was used for addressing the purpose of this study since it is a research design used to help researchers make inferences by interpreting and making codes for textual materials and by analytically evaluating texts such as documents, oral communication, and graphics (Mayring, 2014). Mayring (2014) argues that the central idea of the content analysis is to evaluate texts or documents, oral communication, and graphics or pictures through working with many text passages and analyses of frequencies of categories and processing and assigning categories to text passages.

Guided by Byram and Morgan's (1994) evaluation checklist with a list of nine criteria, we evaluated the local and target language cultures in government's English electronic textbooks for junior high school students in Indonesia. We examined the percentage of local and target cultures proportions in English electronic school textbooks for junior high school in Indonesia. Particularly, we searched for whether English Electronic School textbooks promoted a balanced proportion of the local and target language cultures or not. We analyzed the paragraphs and pictures in the ten textbooks published by the government. The following table presents the ten English electronic school textbooks for junior high school in Indonesia.

Table 1: Data of electronic school textbooks for junior high school in Indonesia

Titles	Authors
1. Scaffolding English for Junior High School Students (Grade VII)	Joko Priyana, Riandi, and Anita P Mumpuni
2. Scaffolding English for Junior High School Students (Grade VIII)	Joko Priyana, Arnys R Ijayanti, and Virga Renita Sari
3. Scaffolding English for Junior High School Students (Grade IX)	Joko Priyana, Riandi, and Anita P Mumpuni
4. Contextual Teaching and Learning Bahasa Inggris: Junior High School Students (Grade VII)	Th. Kumalarini, Achmad Munir, Slamet Setiawan, and Helena Agustien
5. Contextual Teaching and Learning Bahasa Inggris: Junior High School Students (Grade VIII)	Utami Widiati, Pratiwi Ratnaningsih, Gunadi H. Sulistyo, Mirjam Anugerahwati, Nunung Suryati Oikurema Purwanti, and Slamet Setiawan
6. English in focus 1: For grade VII Junior High School (SMP/ MTs)	Artono Wardiman, Masduki B. Jahur, M. Sukirman Djusma
7. English in focus: For grade IX Junior High School (SMP/ MTs)	Artono Wardiman, Masduki B. Jahur, M. Sukirman Djusma
8. Bahasa Inggris When English Rings A Bell (VII)	The Ministry of Education and Culture
9. Bahasa Inggris When English Rings A Bell (VIII)	The Ministry of Education and Culture
10. Bahasa Inggris Think Globally Act Locally (IX)	The Ministry of Education and Culture

For the data analysis of the ten English electronic school textbooks for junior high school in Indonesia, we identified, coded, and classified the cultures content into categories and subcategories that had been provided by Byram and Morgan (1994) for paragraphs data, while for the pictures, we simply coded them under the local language categories or target language categories. After we identified, classified and coded the data into the exact categories and subcategories, we displayed the data in the percentages. Furthermore, we presented the findings in the tables to make it easily understandable and we drew inferences based on the results that we found.

FINDINGS

We organized our findings into two parts: (1) the proportions of the local and target language cultures in paragraphs and (2) the proportions of the local and target language cultures in pictures.

The proportions of the local and target language cultures in paragraphs

We analyzed 2308 paragraphs from the ten English electronic school textbooks for junior high school in Indonesia. Our analysis of the texts revealed that each textbook showed a different proportion in presenting local and target language cultures aspects. Five English textbooks namely, Scaffolding English for Junior High School Students (Grade VII), Scaffolding English for Junior High School Students (Grade IX), English in Focus 1: for

Grade VII Junior High School, Bahasa Inggris When English Rings a Bell (VIII), Bahasa Inggris Think Globally Act Locally (IX) promoted a higher proportion in promoting local language cultures.

However, the textbooks such as Scaffolding English for Junior High School Students (Grade VIII), Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII, Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VIII, English in Focus: for Grade IX Junior High School (SMP/ MTs), Bahasa Inggris When English Rings a Bell (VII), presented a higher proportion in target language cultures as presented in the following table.

Unfortunately, the cultural contents in those textbooks did not cover all cultural aspects that had been promoted by Byram and Morgan (1994), the data were dominated under the category national cultural heritage, whereas, some other aspects were not promoted in those textbooks such as social identity and social groups, social interaction, and socio-political institutions.

Table 2: Proportions of the local and target language cultures in paragraphs

Textbooks	Cultural Contents	
	Local	Target
Scaffolding English for Junior High School Students (Grade VII)	7.8%	2.2%
Scaffolding English for Junior High School Students (Grade VIII)	18.5%	20%
Scaffolding English for Junior High School Students (Grade IX)	44.6%	23.2%
Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII	13.1%	14.1%
Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VIII	7.7%	8.7%
English in focus 1: for grade VII Junior High School (SMP/ MTs)	23%	6%
English in focus: for grade IX Junior High School (SMP/ MTs)	15.7%	21.%
Bahasa Inggris When English Rings A Bell (VII)	6.4%	8.4%
Bahasa Inggris When English Rings A Bell (VIII)	27.2%	3.4%
Bahasa Inggris Think Globally Act Locally (IX)	16.9%	4.5%

The proportions of the local and target language cultures in pictures

We analyzed 3079 pictures from the ten English electronic school textbooks for junior high school in Indonesia. The results of our analysis under the picture category are presented in the following table.

Table 3: The proportions of local and target language cultures in pictures

Textbooks	Cultural Contents	
	Local	Target
Scaffolding English for Junior High School Students (Grade VII)	13%	11.2%
Scaffolding English for Junior High School Students (Grade VIII)	32%	24%
Scaffolding English for Junior High School Students (Grade IX)	20.9%	12.4%
Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII	1.8%	15.2%
Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VIII	1.6%	5.9%
English in Focus 1: for Grade VII Junior High School (SMP/ MTs)	29%	10.9%
English in focus: for grade IX Junior High School (SMP/ MTs)	24.3%	22.6%
Bahasa Inggris When English Rings a Bell (VII)	69.4%	3.4%
Bahasa Inggris When English Rings a Bell (VIII)	43.%	10.1%
Bahasa Inggris Think Globally Act Locally (IX)	88.7%	3.2%

The result of the pictures analysis showed the variety of data. The textbooks such as Scaffolding English for Junior High School Students (Grade VII), Scaffolding English for Junior High School Students (Grade VIII), Scaffolding English for Junior High School Students (Grade IX), English in Focus 1: for Grade VII Junior High School (SMP/ MTs), English in Focus: for Grade IX Junior High School (SMP/ MTs), Bahasa Inggris When English Rings a Bell (VII), Bahasa Inggris When English Rings a Bell (VIII), Bahasa Inggris Think Globally Act Locally (IX) promoted the local language cultures proportions higher than the target language cultures proportions.

Meanwhile, textbooks include Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII and Contextual Teaching and Learning Bahasa Inggris: Sekolah

Menengah Pertama/Madrasah Tsanawiyah Kelas *VIII* textbooks promoted a higher proportion of the target language culture.

Inferences

There are some inferences that could be made related to the results of the analysis. First and foremost, we inferred that only some textbooks could promote a balanced proportion in illuminating the cultural contents. We pondered that the textbooks that have a small periphery between the percentages of the local and target language proportions is balanced. Sadly, the number of textbooks which could not maintain the balanced proportion in carrying the cultural materials through paragraphs and pictures were higher than the textbooks which have a balanced proportion.

The textbooks such as Scaffolding English for Junior High School Students (Grade VIII), Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII and Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VIII, Bahasa Inggris When English Rings a Bell (VIII) might portray the balanced proportions of the local and target language cultures proportions while the textbooks such as Scaffolding English for Junior High School Students (Grade VII), Scaffolding English for Junior High School Students (Grade IX), English in focus 1: for grade VII Junior High School (SMP/ MTs), English in Focus: for Grade IX Junior High School (SMP/ MTs), Bahasa Inggris When English Rings a Bell (VII), Bahasa Inggris Think Globally Act Locally (IX) could not organize the balanced proportion in paragraphs data.

There were only two textbooks that seemed to promote a balanced proportion of the cultural content under pictures analysis, the textbooks including Scaffolding English for Junior High School Students (Grade VII) and English in Focus: for Grade IX Junior High School (SMP/ MTs). However, eight textbooks including Scaffolding English for Junior High School Students (Grade VIII), Scaffolding English for Junior High School Students (Grade IX), English in Focus 1: for Grade VII Junior High School (SMP/ MTs), Bahasa Inggris When English Rings a Bell (VII), Bahasa Inggris When English Rings A Bell (VIII), Bahasa Inggris Think Globally Act Locally (IX), Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VII and Contextual Teaching and Learning Bahasa Inggris: Sekolah Menengah Pertama/Madrasah Tsanawiyah Kelas VIII had not promoted a equal proportion of the cultural contents.

Remarking all the data together both under the paragraphs and pictures analyses, we inferred that none of the textbooks have a balanced proportion in promoting the local and target language cultural contents. Our findings confirm the results of Sorongan, Susanti, and Syahri's (2014) who found that the textbooks that were published by the government are imbalanced in promoting the local and target language cultural contents. A number of authors have documented the importance of promoting the local and target cultures in teaching materials (e.g., Choudhury, 2013; Frank, 2013; Jiangqiong & Tin, 2010). The consequences of the imbalanced proportion of the cultural content both in paragraphs and pictures might contribute complexity to students when they participate in teaching and learning processes.

CONCLUSION

Using the content analysis design, this research adds to the body of knowledge on the need to promote the local and target language cultural contents in textbooks for students who learn English as a foreign language in a non-speaking country like Indonesia. Our findings indicated that some textbooks had a higher percentage proportion in local cultural contents while some others had a higher percentage proportion in target language cultural contents. In terms of paragraphs, only four textbooks promoted an equal proportion while the other six textbooks showed an imbalanced proportion. With regards to the pictures, only two textbooks showed a balanced proportion while eight textbooks had an imbalanced proportion. So, it can be concluded that both in paragraphs and in pictures, not even one of the textbooks has a balanced proportion.

The findings of this study potentially contribute the sort of evidence necessary for providing students with an equal proportion of the local and target language cultures both in paragraphs and pictures in every textbook. Particularly, central and local governments through the department of education should work together with publishers and authors to deal with the issue of the unequal proportions of the local and target language cultures in textbooks produced by the governments.

REFERENCES

Andarab, M. S. (2014). Calling for English for specific cultures-based course books in English as an international language era. *International Journal of English Language Education 2*(2).

Bell, J., & Gower, R. (1998). Writing course materials for the world: a great compromise. In B. Tomlinson (ed.), *Materials development in language teaching* (pp. 116-129). Cambridge: Cambridge University Press.

Byram, M. (2013). Language teaching and its contexts. *Iranian Journal of Language Teaching Research 1(1), 1-26*.

Byram, M., & Morgan, C. (1994). *Teaching and learning language and culture*. Clavedon, United Kingdom: Multilingual Matters.

Cakir, I. (2006). Developing cultural awareness in foreign language teaching. *Turkish Online Journal of Distance Education-TOJDE, 7*(3).

Chahak, S. M., & Basirizadeh, F. S. (2012). The study of culture on foreign language teaching. *International Journal of Social Science and Humanity, 2*(6).

Chao, T-c. (2011). The hidden curriculum of cultural content in internationally published ELT textbooks: A closer look at new American inside out. *The Journal of Asia TEFL 8*(2), 189-210.

Choudhury, M. H. (2013). Teaching culture in EFL: Implications, challenges and strategies. *IOSR Journal of Humanities and Social Science (IOSR-JHSS) 13*(1), 20-24.

Dweik, B. S., & Al-Sayyed, S. W. (2015). Analyzing the cultural content of action pack "12". *International Journal of English Language and Linguistics Research, 3*(2), 1-28.

Erfani, S. M. (2014). Source culture, targets or Interculture?: Iranian English language teachers' perception of culture. *International Journal of Language Learning and Applied Linguistics World (IJLLALW), 6*(1), 317-337.

Frank, J. (2013). Raising cultural awareness in the English language classroom. *English Teaching Forum, 4*.

Heynemen, S. (2006). The role of textbooks in a modern system of education: towards high quality education for all. Retrieved from: http://www.vanderbilt.edu/peabody/heyneman/PUBLICATIONS/roleoftextbooks.3.07.pdf

Hilliard, A. D. (2014). A critical examination of representation and culture in four English language textbooks. *Language Education in Asia, 5*(2).

Ho, S. T. K. (2009). Addressing culture in EFL classrooms: The challenge of shifting from a traditional to an intercultural stance. *Electronic Journal of Foreign Language Teaching, 6*(1), 63–76.

Hurst, N. R. (2014). Visual representations in Portuguese produced English language teaching course books. *L i n g va r v m a r e n a,* 5, 21 – 30.

Jiangqiong, Q., & Tin, T. B. (2010). Cultures of learning in three language course books in China: 'read with your heart', 'listen and check', and 'fill the blank and the use of the language.' In Tomlinson, B and Masuhara, H. (Eds.), *Research for materials development in language learning.* (pp. 83-102). London, Great Britain: Continuum.

Kachru, B. B. (1996). World Englishes: Agony and ecstasy. *Journal of Aesthetic Education, Special Issue: Distinguished Humanities Lectures II, 30*(2), 135-155.

Kawar, T. I. (2012). Cross-cultural differences in management. *International Journal of Business and Social Science,3*(6).

Khajavi, Y., & Abbasian, R. (2011). English language teaching, national identity and globalization in Iran: the case of public schools. *International Journal of Humanities and Social Science, 1*(10).

Kilickaya, F. (2004). Guidelines to evaluate cultural content in textbooks. *The Internet TESL Journal, X(12).*

Lauder, A. (2008). The status and function of English in Indonesia: A review of key factors. *MAKARA, Sosial Humaniora, 12*(1), 9-20.

Liu, S & Laohawiriyanon, C. (2013). Cultural content in EFL listening and speaking textbooks for Chinese university students. *International Journal of English Language Education, 1*(1).

Mahmood, K. (2011). Conformity to quality characteristics of textbooks: the illusion of textbook evaluation in Pakistan. *Journal of Research and Reflections in Education, 5(*2).

McDonough, J., & Shaw, C. (2003). *Materials and methods in ELT* (2nd Ed.). London, United Kingdom: Blackwell Publishing.

Moirano, M. C. (2012). Teaching the students and not the book: Addressing the problem of culture teaching in EFL in Argentina. *Gist Education and Learning Research Journal, 6*, 71-96.

Neff, P., & Jr, J. R. (2013). Tasks for integrating language and culture teaching. *English Teaching Forum, 2*, 12-20.

Nguyen, H. T., Warren, W., & Fehring, H. (2014). Factors affecting English language teaching and learning in higher education. *English Language Teaching, 7*(8), 94-105.

Pardo, N. A., & Téllez, M. F. (2009). ELT materials: The key to fostering effective teaching and learning settings. *PROFILE Issues in Teachers' Professional Development, 11*(2), 171-186.

Pulverness, A. (2003). Materials for cultural awareness. In B. Tomlinson (Ed.), *Developing materials for language teaching* (pp. 107-129). London, United Kingdom: Continuum.
Richards, J. C. (2001). *Curriculum development in language teaching.* New York, NY: Cambridge University Press.
Rubby, R. (2003). Selection of materials. In B. Tomlinson (Ed.), *Developing materials for language teaching* (pp. 37-57). London, United Kingdom: Continuum.
Sorongan, D. A., Susanti, R., & Syahri, I. (2014). An analysis of local and target culture integration in English textbooks. *Lingua, Jurnal Bahasa & Sastra, 15*(1).
Tantri, N. R. (2013). English as a global language phenomenon and the need of cultural conceptualizations awareness in Indonesian ELT. *IJ-ELTS: International Journal of 1 English Language & Translation Studies, 1.*
Tomlinson, B. (2003). Developing principled frameworks for materials development. In Tomlinson, B. (Ed.). *Developing materials for language teaching* (pp. 107-129). London, United Kingdom: Continuum.
Tomlinson, B. (2014). Materials development. In R. Carter & D. Nunan (Eds), *The Cambridge guide to teaching English to speakers of other languages* (pp. 66-71). London, United Kingdom: Cambridge University Press.
Troncoso, C. R (2010). The effect of language materials on the development of intercultural competence. In Tomlinson, B and Masuhara, H. (Eds.), *Research for materials development in language learning.* (pp. 83-102). London, United Kingdom: Continuum.
Wang, J. (2011). Culture differences and English teaching. *English Language Teaching, 4*(2).
Yule, G. (2010). *The study of language (4th Ed.).* New York, NY: Cambridge University Press.

Appendix

The Examples of Paragraphs in the Textbooks

Local Language Culture

Indonesia is a big country. It is between two continents, Asia and Australia, and between two oceans, the Pacific ocean and the Indian Ocean. It is the largest archipelago in the world. There are more than seventeen thousand islands in Indonesia (p. 150)
When English Rings A Bell VIII

Pempek is a very popular food from the South Sumatera. It is made of fish and tapioca starch. Fish, tapioca starch, and water are mixed to make thick dough. In diferent shapes and sizes, the dough is boiled until it foats. The cooked pempek is then deepfried. Pempek is served with very thin sauce called 'cuko'. Cuko Is made of water, palm sugar, chilly, garlic, tamarind, and salt (p. 205).
Think Globally Act Locally IX

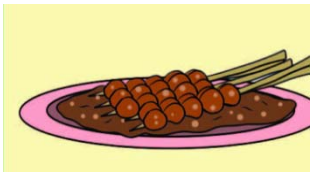
Target Language Culture

In the English culture, people send get-well notes when somebody is ill or hospitalized. They do not usually visit the patients. Sometimes they send flowers and attach a getwell note/card on them. The flower and cards show their support and love (p. 60).
Contextual Teaching and Learning VII

Sydney Opera House is a large performing art place. It becomes an Australian Icon. It was established in 1973. It is located in Sydney, New South Wales, Australia (p. 49).

Scaffolding (Grade VIII).

The Examples of Pictures in the Textbooks
Local Language Culture



Think Globally Act Locally IX

When English Rings A Bell VIII

Target Language Culture

Scafolding IX

English in Focus VII

School Counselors' Intention to Use Technology: The Technology Acceptance Model

Catharina Tri ANNI
Department of Guidance and Counseling, Faculty of Education, Universitas Negeri Semarang, Semarang, Indonesia
catharina_ta@mail.unnes.ac.id

SUNAWAN
Department of Guidance and Counseling, Faculty of Education, Universitas Negeri Semarang, Semarang, Indonesia
sunawan@mail.unnes.ac.id

HARYONO
Department of Curriculum and Educational Technology, Faculty of Education, Universitas Negeri Semarang, Semarang, Indonesia
fransharyono@mail.unnes.ac.id

ABSTRACT
This study assessed school counselors' intention to use computer technology to support school counseling services. A total of 125 school counselors (74.8% female) completed an online questionnaire that assessed the main constructs of the Technology Acceptance Model (TAM). Confirmatory factor analysis and alpha technique results provided evidence of the validity and reliability of this measure. Structural equation modeling provided support for the TAM. Specifically, school counselors who perceived ICT to be easy to use were more likely to perceive ICT as useful and to have a positive attitude about ICT; perceived usefulness also predicted positive attitudes toward ICT; and positive attitudes toward ICT predicted intention to use these technologies. The results are discussed in terms of school counselors' technology acceptance in the Indonesian context.

Keywords: Intention to use technology; school counselor; Technology Acceptance Model

INTRODUCTION

Information and communication technologies (ICT) provide many benefits in the educational system, such as classroom management, educational research, teaching and learning processes, multimedia and hypermedia learning, and school administration. Previous studies documented the systematic use of ICT to enhance students' academic achievement (Carle, Jaffe, & Miller, 2009) through application multimedia (Schweppe, Eitel, & Rummer, 2015) and hypermedia (Chrisman & Harvey, 1998), classroom and workload management (Lai and Pratt, 2008), improving school administration and management (Baskin & Williams, 2006), and support research (Birnbaum, 2004).

In the school counseling services context, ICT has many potential applications such as electronic discussion forums, accessing students' information, delivering individual and group counseling sessions, and depositing student information for research (Oraegbunam, 2009). Multimedia, hypermedia, and websites are important to optimize school counseling services (Beidoglu, Dinçyürek, & Akıntug, 2015). Unfortunately, many school counselors do not apply ICT to support school counseling services. For example, Steele, Jacoke and Stones (2014) showed that only 28% of school counselors perceived that ICT can be used to support the school counseling core curriculum services. Thus, most school counselors (72%) had the perception that the application of ICTs would make little contribution to their work. Owen and Weikel (1999) also reported that although around 88% of school counselors in one U.S. state were already using computers, most of them only used the routine applications such as word processing, record keeping, and class scheduling. It seems that even school counselors who do accept ICT do not apply them in the development of school counseling services.

To date, there have been no studies on school counselors' intention to use ICT in school counseling services. The Technology Acceptance Model (TAM) provides a framework for predicting ICT use based on users' beliefs and attitudes about technology (Handayani, et al., 2016; Teo, Lee, Chai, & Wong, 2009). However, there are only a few studies of the TAM in the education context. For example, the TAM model has been tested in studies on the intention to use hypermedia (Gao, 2005) and e-learning (Alsofyani, Aris, Eynon, & Majid, 2012; Cheung & Vogel, 2013), and in a study of pre-service teachers' intentions to use ICT (Teo, Lee, Chai, & Wong, 2009). The current study makes a unique contribution to the literature by assessing ICT acceptance among Indonesian

school counselors, and testing whether perceptions of ICT predict the intention to use ICT in providing school counseling services.

The Technology Acceptance Model

The TAM originally was developed by Davis (1989) based on the Theory of Reasoned Action (TRA; Ajzen & Fishbein, 1980), which holds that individuals' beliefs and attitudes predict their intention to perform a behavior. According to the TRA, attitude toward a behavior is determined by beliefs about the consequences of the behavior and the affective evaluation of those consequences. Beliefs, in this case, are defined as the individual's prediction that performing a given behavior will produce a given consequence (Ajzen & Fishbein, 1980). However, compared to the TRA, the TAM makes more specific predictions because it applies to computer usage behavior, not behavior in general (Davis, Bagozzi, & Warshaw, 1989).

The TAM describes a pathway in which personal beliefs shape attitudes about ICT use, which in turn shape intentions to use ICT. In this model, the two beliefs that are critical are perceived usefulness and perceived ease of use. Perceived usefulness is the user's subjective belief that using ICT will increase his/her performance and productivity. Perceived ease of use refers to the user's belief that the use of ICT will not take much effort. Recent studies employing the TAM as the conceptual framework have shown that perceived usefulness and perceived ease of use are significant predictors of attitude towards technology use and intention to use it (Ducey & Coovert, 2016; Teo, Lee, Chai, & Wong, 2009).

The Current Study

This is the first test of the TAM in a sample of school counselors, an important step in understanding school practitioners' perspectives on ICT use. As a first step in testing this model, we tested the validity and reliability of the measure used to assess the core constructs of the TAM in our sample of Indonesian school counselors, extending earlier psychometric tests of this measure in other samples (Gao, 2005; Hu, Griffin, & Bertuleit, 2016). We then used structural equation modeling to test the following hypotheses: (H1) perceived ease of use will positively predict perceived usefulness and (H2) positive attitudes toward computer use; (H3) perceived usefulness will also predict positive attitudes toward computer use; and (H4) attitude toward computer use will have a positive influence on intention to use ICT.

METHODS

Participants

Data were collected from 125 school counselors. They were from several cities in Central Java, Indonesia. They were invited to voluntarily participate by responding to an online questionnaire. Participants' demographic information is provided in Table 1.

Table 1: Participants' demographic information

Demographic information		**%**
Gender	Male	25.2
	Female	74.8
Working experience	0-5 years	42
	6-15 years	51.3
	16-25 years	4.2
	> 25 years	2.5
Work school level	Junior high school	46.6
	Senior high school	53.4

Measurement

A 17-item questionnaire was used to assess technology acceptance, particularly Perceived Usefulness (PU; 3 items), Perceived Ease of Use (PEU; 6 items), Attitude toward Computer Use (ATCU; 3 items), and Intention to Use (ITU; 2 items). Items were rated on five-point Likert Scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale was translated into Bahasa Indonesia by applying back-translation procedures; one Indonesian-English interpreter translated the English language measure into Bahasa Indonesia, and a second Indonesian-English interpreter back-translated the measure into English to determine the accuracy of the version to be used in the study. Any discrepancies were rectified through discussion.

RESULTS

Descriptive Data, Validity and Reliability

As seen in Table 2, the means for perceived ease of use (PEU), perceived usefulness (PU), attitude toward computer use (ATCU), and intention to use (ITU) were 4.07 (SD = 0.61), 4.53 (SD = 0.56), 4.29 (SD = 0.71),

and 4.11 (SD = 0.62), respectively. Table 2 also shows the intercorrelations among study variables. All correlations were positive, and moderate to strong in magnitude.

Table 2: Intercorrelations, means, and standard deviations of study variables

	M	SD	1	2	3
1. PEU	4.07	.61			
2. PU	4.53	.56	.66**		
3. ATCU	4.29	.71	.66**	.70**	
4. ITU	4.11	.62	.33**	.38**	.43**

Notes: N = 125; PEU = Perceived ease of use; PU = Perceived usefulness; ATCU = Attitude toward computer use; ITU = Intention to use
** p < .01

Confirmatory factor analysis (CFA) was then used to test the measure's construct validity and alpha technique to test reliability, to determine if it was appropriate for use in an Indonesian sample. Table 3 presents the results of confirmatory factor analysis, showing the average variance extracted (AVE) and reliability coefficient of each subscale. All items had factor loadings above .50, suggesting good construct validity. The alpha coefficients of reliability indicated that the scale had good reliability (PEU = .88; PU = .93; ATCU = .86; and ITU = .81) in a sample Indonesian participant.

Table 3: Construct validity and alpha reliability coefficient of the measure of the TAM constructs

	Factor Loading*)	Average Variance Extracted	α
Perceived Ease of Use (PEU)		.78	.86
PEU1	.63		
PEU2	.87		
PEU3	.69		
PEU4	.66		
PEU5	.82		
PEU6	.70		
Perceived Usefulness (PU)		.84	.93
PU1	.74		
PU2	.86		
PU3	.89		
PU4	.81		
PU5	.83		
PU6	.76		
Attitude toward Computer Use (ATCU)		.85	.85
ATCU1	.75		
ATCU2	.83		
ATCU3	.88		
Intention to Use (ITU)		.85	.81
ITU1	.76		
ITU2	.89		

*) Goodness of fit indices of CFA: χ^2 = 186.37; df = 108; χ^2/df = 1.73; CFI = .94; SRMR = .06

Model Testing

The structural equation modeling technique was implemented to test the Technological Acceptance Model (TAM) for Indonesian school counselors. To evaluate the match between the data and the model, we used χ^2, df, CFI, and SRMR as goodness-of-fit indexes (Hu & Bentler, 1999). Because χ^2 is highly sensitive to sample size, the ratio of χ^2 to its degrees of freedom (df) was used. The model is acceptable when the value of the ratio of χ^2 to its df is less than 3. Following recommendations by Hu and Bentler (1999), the standardized root mean square residual (SRMR) was used as the measure of absolute fit and the Comparative Fit Index (CFI) as the index of incremental fit. From the literature (e.g., Hair, Anderson, Tatham, & Black, 1999), values of .90 or more for the CFI, and values of .08 or less for the SRMR, reflect a good fit between the model and the data. The conceptual model showed a good fit with the data: χ^2 = 186.68, df = 110, p < .01, χ2/df = 1.70, CFI = .95, SRMR = .06.

The figure 1 shows that the hypotheses of the present study were fully supported. The school counselors' intention to use information technology was predicted by perceived ease of use, perceived usefulness, and

positive attitude toward computer use. These variables together explained 29% (R^2 = 0.29) of the variance in intention to use. Attitude toward computer use was predicted by perceived ease of use and perceived usefulness; together, these variables explained 68% (R^2 = 0.68) of the variance in attitude. Finally, perceived of usefulness explained 55% (R^2 = 0.55) of the variance in perceived ease of use.

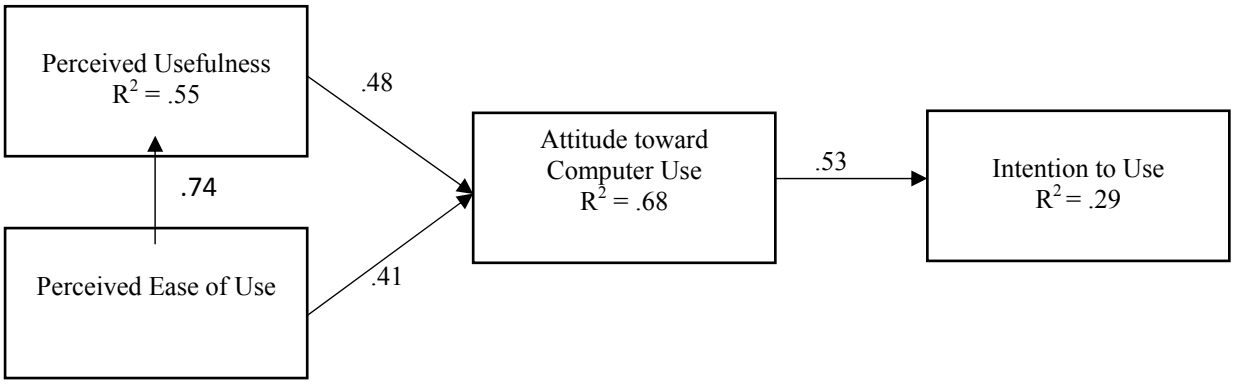


Figure 1. Parameter estimates of the Technological Acceptance Model (TAM) for school counselors

DISCUSSION

The present study tested the validity and reliability of the measure of the Technology Acceptance Model in a sample of Indonesian school counselors, and then tested the hypothesized associations among these constructs using structural equation modeling. The measure had good reliability and validity when implemented in an Indonesian sample. The study hypotheses were fully supported. Specifically, perceived ease of use and perceived usefulness positively predicted attitude toward ICT and intention to use ICT. Perceived ease of use also positively predicted perceived usefulness. These results are consistent with other studies showing support for the TAM in different types of samples (Ducey & Coovert, 2016; Gao, 2005; Teo, Lee, Chai & Wong, 2009).

The results have clear implications for the implementation of ICT in school settings. Developing school counselor competencies in the use of ICT should be oriented toward helping school counselors build familiarity with ICT applications and awareness of the potential contributions of ICT in school counseling services. The resulting positive beliefs about ease of use and usefulness lay the groundwork for positive attitudes about ICT and, in turn, increased motivation to use ICT in school counseling services.

Several limitations are of note. First, data were collected only through self-report, and all constructs were assessed by the same questionnaire. This shared method variance may have inflated the correlations reported in the current study. Second, it will be important in future research to take into account the influence of volition and a sense of choice as influences on the link between attitude and intention (Venkatesh, Morris, Davis, & Davis, 2003). Third, data were collected only in Central Java Province, and further study should be conducted in other provinces of Indonesia as a test of the generalizability of our findings.

CONCLUSION

The present study showed that the measure used to test the TAM was reliable and valid for use in assessing Indonesian school counselors' beliefs, attitude and intention with regard to ICT use. Support was also found for the TAM itself. School counselors who perceived ICT to be easy to use as well as useful had a more positive attitude about ICT and in turn, a stronger intention to use ICT in the context of providing counseling.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Alsofyani, M.M., Aris, B., Eynon, R., & Majid, N.A. (2012). A preliminary evaluation of short blended online training workshop for TPACK development using technology acceptance model. *Turkish Online Journal of Educational Technology*. *11*(3), 20-32.

Baskin, C., & Williams, M. (2006). ICT integration in schools: Where are we now and what comes next? *Australasian Journal of Educational Technology*. *22*(4), 455-473.

Beidoglu, M., Dinçyürek, S., & Akıntug, Y. (2015). The opinions of school counselors on the use of information and communication technologies in school counseling practices: North Cyprus schools. *Computers in Human Behavior*. *52*, 466-471.

Birnbaum, M. H. (2004). Human research and data collection via the internet. *Annual Review of Psychology*. *55*, 803–832.
Carle, A. C., Jaffee, D., & Miller, D. (2009). Engaging college science students and changing academic achievement with technology: A quasi-experimental preliminary investigation. *Computers & Education*, *52*, 376–380.
Cheung, R., & Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computers and Education*. *63*, 160-175.
Chrisman, N.R., & Harvey, F.J. (1998). Extending the classroom: Hypermedia-supported learning. *Journal of Geography in Higher Education. 22*(1), 11-18.
Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13,* 319-340.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*. *35*(8), 928-1003.
Ducey, A.J., & Coovert, M.D. (2016). Predicting tablet computer use: An extended Technology Acceptance Model for physicians. *Health Policy and Technology*. doi: 10.1016/j.hlpt.2016.03.010.
Gao, Y. 2005. Applying the Technology Acceptance Model (TAM) to educational hypermedia: A field study. *Journal of Educational Multimedia and Hypermedia*. *14*(3), 237-247.
Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1999). *Multivariate data analysis.* New Jersey, NJ: Prentice-Hall International, Inc.
Handayani, P.W., Hidayanto, A.N., Pinem, A.A., Hapsari, I.C., Sandhyaduhita, P.I., & Budi, I. (2016). Acceptance model of a hospital information system. *International Journal of Medical Informatics.* doi: 10.1016/j.ijmedinf.2016.12.004.
Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling. 6*(1), 1-55.
Hu, X., Griffin, M.A., & Bertuleit, M. (2016). Modelling antecedents of safety compliance: Incorporating theory from the technological acceptance model. *Safety Science*. *87*, 292-298.
Lai, K.-W., & Pratt, K. (2008). Positive to a degree: The effects of ICT use in New Zealand secondary schools. *Computers in the Schools. 24*, 95–109.
Oraegbunam, N.M. (2009). Applying information and communication technology in counselling practice. *Procedia Social and Behavioral Sciences*. *1*, 1749–1752.
Owen, D. W., & Weikel, W. J. (1999). Computer utilization by school counselors. *Professional School Counseling. 2*, 179–182.
Schweppe, J., Eitel, A., & Rummer, R. (2015). The multimedia effect and its stability over time. *Learning and Instruction. 15*, 24-33.
Steele, T.M., Jacoke J.E., & Stones, C.B. (2014). An examination of the role of online technology in school counseling. *Professional School Counseling*. *18*(1), 125-135.
Teo, T., Lee, C.B., Chai, C.S., & Wong, S.L. (2009). Assessing the intention to use technology among pre-service teachers in Singapore and Malaysia: A multigroup invariance analysis of the Technology Acceptance Model (TAM). *Computers and Education*. *53*, 1000-1009.
Venkatesh, V., Morris, M., Davis, G., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*. *27*(3), 425-478.

The Effect of Science, Technology, Engineering and Mathematics-Stem Educational Practices on Students' Learning Outcomes: A Meta-Analysis Study

Hakan SARAÇ
Ministry of National Education (MoNE), Physics Teacher, Ph. D.
hknsrcmv@gmail.com

ABSTRACT
In the study, a meta-analysis study was conducted in order to determine the effects of STEM educational practices on the learning outcomes of the students in the education-training process. The articles were made in national and international context with statistical data that could be included in the meta-analysis study in accordance with the research problem between 2010-2017, literature review was conducted using Turkish and English key words. As a result of the survey, 23 articles on the effect of STEM educational practices on the learning products of students and 2 postgraduate theses meta-analyses were included and a total of 58 effect size values were obtained. A total of 6535 students in the experimental groups and a total of 6373 students in the control groups were included in the meta-analysis included studies. As a result of the study, it was determined that the effects of STEM educational practices on students' academic achievement were 0.442, the attitude effect was 0.620 and the effect on scientific process skills was 0.820. These results are middle effect on students' academic achievement and attitude towards the course according to the effect size classification and a large level of effects on scientific process skills. Of the 58 effect size values obtained in the study, 56 have a positive effect and 2 have a negative effect. Moderator analyses were carried out according to the researches examined, the academic achievement of the learning outcomes, the attitude towards the course and the scientific process skills subscale, the lesson types in which the research was conducted, and the learning levels of the students participating in the research.

Keywords: STEM, Meta-analysis, Learning outcomes

INTRODUCTION

In the present century, on the one hand, technological changes are affecting education, on the other hand, increasing knowledge accumulation affects education (Williams & Kingham, 2003). It would not be wrong to state that education researchers and scientists are in a consensus on the need to use technology in education to achieve permanent and effective learning in individuals by increasing the quality of education (Komis, Ergazakia & Zogzaa, 2007). Use of technology in education; incorporating computers for teaching purposes, or bringing technology products to class, and using technological products in the teaching process (Isman, 2002). The use of technology in education should not be perceived only as computer use or internet access. Technology should at the same time be seen as a means of enhancing the professional productivity of teachers and enhancing the learning of students (Hernandez-Ramos, 2005). In terms of education, technology can be defined as a phenomenon of information exchange and human interaction, which is used in a purposeful way that includes all sorts of systems, techniques, and help to improve the learning process beyond the use of technology as a tool (Girginer & Ozkul, 2004).

The area in which technology-based education is inevitable is waiting for the individuals to be producers and inventors; this suggests that they can bring together the knowledge in the fields of Science, Technology, Engineering and Mathematics (STEM) to enable individuals to demonstrate their productivity (Akgunduz, Ertepinar, Ger, Kaplan Sayi & Turk, 2015). STEM is an abbreviation of the initials of the words Science, Technology, Engineering and Mathematics. This technology-based education, termed STEM in the United States, is understood to be an integral part of math and science courses at school level, but it is also understood to be teaching engineering and technology with in-class and out-of-class activities (Sahin, Ayar & Adiguzel, 2014). STEM is an abbreviation of the initials of the words Science, Technology, Engineering and Mathematics. All the disciplines that make up the STEM play an important role in the development of twenty-first century skills such as adaptability, communication, social skills, problem solving, creativity, self-control and scientific thinking (NRC 2012). The aim of STEM education is to achieve an approach that focuses on the integration of learning by establishing a relationship between the disciplines, rather than being separate from each other (Guzey, Harwell & Moore, 2014). All the disciplines that make up STEM; It also plays an important role in the

development of twenty-first century skills such as critical thinking, problem solving, co-operation, leadership ability, scientific thinking, adaptability, entrepreneurship, curiosity and imagination, communication, access to information and use (Bybee, 2010).

STEM; science, technology, engineering and mathematics as a field of work that bridges the disciplines (Meng, Idris & Kwan, 2014). Technology and engineering design-based STEM foresees the integration of knowledge and skills related to these areas in teaching mathematics and science subjects (Bybee, 2010; Guzey, Harwell & Moore, 2014). STEM; is an educational approach aimed at providing students with the ability to communicate in an inter disciplinary way, to do team work, to think creatively, to research, to produce and to solve problems, focusing on the integration of knowledge and skills of science, technology, mathematics and engineering on an engineering design based teaching (Dugger, 2010). STEM education; is important because it is a method by which students gain knowledge and skills by approaching problems from a multidisciplinary point of view and also provide opportunities for students to gain twenty-first century skills and opportunities for these four field specializations. For this reason, if the method is applied, it will serve to close the qualified labor force in the labor market, production, AR-GE, innovation, technical infrastructure and process development (TUSIAD, 2014). STEM education in general; engineering, and mathematics disciplines by establishing a relationship between a unit or lesson of real life problem and content (Altan, Yamak & Kirikkaya, 2016; Moore, Stohlmann, Wang, Tank & Roehrig, 2013; Riechert & Post, 2010).

In many developed and developing countries, particularly in the USA, the STEM education model has begun to be implemented in curricula, standards and in-school and out-of-school activities. In 2014, the Turkish Industrialists' and Businessmen's Association (TUSIAD) organized the "*STEM Summit*" in order to emphasize the importance of STEM education and the need for STEM workforce. This meeting was attended by researchers, teachers and students, as well as lucrative companies that have shown progress in the field of industry. It is argued at this meeting that STEM education practices can increase the level of economic and welfare of the community, as is the case in the US and other countries. Researchers who advocate an integrated approach in STEM education argue that with the topics that present problems in current life, learners will be able to increase the interest, motivation and achievement of the course and thus increase the number of students planning a career related to STEM (Honey Pearson & Schweingruber, 2014). The aims of our country's 2023 vision and the strategic documents of the Ministry of National Education (MoNE) indicate that science-technology-engineering-mathematics (STEM) education should be defined on the scale of our country (Corlu, Capraro & Capraro, 2014). However, work done in this area is still in its infancy. Therefore, to develop a generation capable of innovation, the scope, theory and practice of science-technology-engineering and mathematics education, which is at the center of reforms, should be studied at the level of schools and universities (Cavas, Bulut, Holbrook & Rannikmae, 2013; Marulcu & Sungur, 2012). The integration of the STEM areas, which are understood as the result of the international literature search, and that many studies have been conducted and the education of the schools has begun to be started, has not been wide spread in Turkey yet (Gulhan & Sahin, 2016).

The aim of the research is to determine the effect of the use of STEM educational practices on the academic achievement of the students, on the related course and on the development of scientific process skills by meta-analysis. For this, the effect sizes of studies using STEM educational practices in the national and international education and training process have been analysed.

According to this research; The question was searched "*How is STEM Educational Practices Affecting Students' Learning Outcomes*?" Sub-problems identified in this direction are as follows.

- Is there any effect on the academic achievement of students using STEM educational practices?
- Is there any effect on the attitude of students using STEM educational practices?
- Is there any effect on the scientific process skills of students using STEM educational practices?

Literature Review

As a result of the national literature review on the integration of STEM educational practices, it appears that the work on STEM, which has a central position in educational reform movements in recent years, is on the rise (Akaygun & Aslan-Tutak, 2016; Aslan-Tutak, Akaygun & Tezsezen, 2017; Ayar, 2015; Ayar & Yalvac, 2016; Baran, Bilici & Mesutoglu, 2015; Bozkurt, Yamak, Bulus Kirikkaya & Kavak, 2013; Buyruk & Korkmaz, 2016; Cinar, Pirasa, Uzun & Erenler, 2016; Haciomeroglu & Bulut, 2016; Yamak, Bulut & Dundar, 2014; Yildirim & Altun, 2015). In the international of integration of STEM educational practices, it is observed that STEM activities are mainly concentrated at primary and secondary level, and higher education is mostly coding and software based projects, where laboratory activities are mainly developed (Apedoe, Reynolds, Ellefson & Schunn, 2008; Barnett, Connolly, Jarvin, Marulcu, Rogers, Wendell & Wright, 2008; Brophy, Klein, Portsmore

& Rogers, 2008; Bybee, 2010; Meng, Idris & Kwan, 2014; Strong, 2013). The use of robotic applications in education has provided significant gains to students and rapid development in robotic technologies has led to an increase in the number of such studies both nationally and internationally (Daugherty, 2012; Ercan, 2014; Felix, 2010; Harkema, Jadrich & Bruxvoort, 2009; Householder & Hailey, 2012; Hynes, Portsmore, Dare, Milto, Rogers, Hammer & Carberry, 2011; Kucuk & Sisman, 2017).

Within the context of the use of technological materials in science and mathematics education, as a national and international meta-analysis study; Work on smart board use, use of instructional technologies, computer based and assisted instruction, dynamic geometry software, mobile learning and project based learning in science teaching (Ayaz & Soylemez, 2015; Ayaz, Sekerci & Oral, 2016; Batdi, 2015; Dikmen & Tuncer, 2017; Dincer, 2015; Gunhan & Acan, 2016; Guzeller & Ustunel, 2016; Kablan, Topan & Erkan, 2013; Sarac, 2017; Yesilyurt, 2011). The results obtained from these studies are shown in Table 1 in general.

Table 1. Meta analysis studies in the field of technology in science and mathematics education

Researchers	Research Content	Learning Outcomes	Effect size value	Effect size level *
Sarac (2017)	Use Smart Boards	Academic achievement	1.009	Large
		Attitude	0.809	Large
Dikmen & Tuncer (2017)	Using Computer Aided Animation	Academic achievement	1.073	Largel
Ayaz, Sekerci & Oral (2016)	Use of Teaching Technologies	Academic achievement	0.950	Large
Gunhan & Acan (2016)	Dynamic Geometry Software	Academic achievement	0.849	Large
Guzeller & Ustunel (2016)	Mobil Learning	Academic achievement	0.849	Large
Ayaz & Soylemez (2015)	Project Based Learning in Science Teaching	Attitude	0.997	Large
Batdi (2015)	Computer Based Instruction	Academic achievement	1.130	Very Large
Dincer (2015)	Computer Aided Instruction	Academic achievement	1.210	Very Large
Kablan, Topan & Erkan (2013)	Use of Classroom Technological Material	Academic achievement	1.270	Very Large
Yesilyurt (2011)	Computer Aided Instruction	Academic achievement	3.170	Excellent

* According to Thalheimer and Cook (2002) classification

In the literature, there was no meta-analysis study about the effect of students' learning products (academic achievement, attitudes and scientific process skills) using STEM educational practices. It is believed that this work will contribute to the literature, will shed light on the researchers about STEM education in terms of researchers, and will reinforce the importance of developing STEM educational practices.

METHOD

Research Model

The meta-analysis method was used to determine the effectiveness of STEM educational practices in the national-international and in the education-training process. The meta-analysis method is the calculation of the effect of independent variables on the dependent variable by using statistical methods to evaluate, compare and combine the quantitative data obtained from experimental-quasi-experimental studies made in any area. (Cohen, Manion & Marrison, 2007).

Collection of Data

The studies included in the study consist of published and statistically evaluated articles and post-graduate theses with necessary quantitative data made using STEM educational practices in the national-international education process between 2010-2017. Postgraduate theses without permission are not included in the search.

Scanning of work done on the national subclause and internationally conducted studies from ASOS, Journel Park Academic, Google Academic, ULAKBIM and National Center for Higher Education websites in Turkish and English Academic Search Complete, Elsevier, ERIC, Google Scholar, ProQuest Desertions and Thesis and Web

of Science from 1 September 2017 to 31 October 2017. During the screening, the names and keywords of the graduate theses as Turkish; "*FeTeMM*", "*FeTeMM eğitimi*", "*FeTeMM etkinlikleri*" and "*FeTeMM uygulamalari*" and as English;"*STEM*", "*STEM education*", "*STEM events*" and "*STEM applications*" were taken into consideration.

As a result of the survey, 74 articles in the national, 72 articles in the international, 8 thesis in the national and 2 theses in the national were found. 14 national articles, 1 master's thesis, 9 international articles and 1 doctoral thesis were included in the national subdivision in accordance with the criteria when they were examined for the purpose of the investigations (Appendix 1). In the study, a total of 58 effect size values were calculated, totaling 52 from 23 national-international articles and 6 from 2 national-international postgraduate theses. 27 effect sizes were obtained from national articles, 25 effect sizes from international articles, 4 effect sizes from national theses and 2 effect sizes from international theses.

A total of 6535 students in the experimental groups and a total of 6373 students in the control groups were included in the meta-analysis included studies. When the studies are divided into subgroups, in the area of learning outcomes; In the area of discipline in which the STEM educational practices were applied in the area of academic achievement, 27 in the area of the attitude effect, 13 in the area of scientific process skills, 23 in the science area, 17 in the area of mathematics, 3 in the area of technology, 13 in the general sense in which scientific process skills are examined, and 2 in other areas; there were 27 studies in the primary and secondary schools, 25 in the secondary school, and 6 in the higher education university.

Coding of Data

The appropriate coding form for the purpose of the study was developed by the researcher in order to examine the inclusion of the studies found in the research into the meta-analysis method and its suitability, to compare the studies, and to determine the statistical information used in the research.

The filling of the coding form created for the purpose of the meta-analysis method is crucial for coding reliability. In the area of studies determined for this, at least two experts must be examined and the coding forms must be filled in (Acikel, 2009). In the study, the coding forms of the studies were filled by two experts who completed the doctorate in the area of educational sciences. After coding, the forms of both experts were evaluated mutually. As a result of the evaluation, the credibility of the codes was calculated to be 90% according to the security level formula developed by Miles and Huberman (2002). According to the reliability level formula, results of 70% or more are sufficient for reliability (Yildirim & Simsek, 2011). According to this, it can be said that the coding made for the studies determined for the purpose of the research is reliable.

Dependent and Independent Variables

In the studies included in the meta-analysis method in the study, the calculated effect sizes for the learning outcomes constitute the dependent variable of the study. The independent variable of the research is lecture method (use of materials prepared according to STEM educational practices and traditional teaching methods).

Analysis of Data

The quality problem was tried to be solved by considering the published national and international publications and postgraduate theses in the research. Effective size values obtained in the field of learning outcomes were analysed by SPSS in terms of academic achievement, attitude to the course and scientific process skills. In the meta-analysis method, the results of the identified studies must be statistically combined. First, which statistical model should be used should be decided. For this, Q statistics developed by Hedges and Olkin (1985) are used. According to the Q statistics, there are two models; Fixed Effect Model (FEM) and Random Effect Model (REM). In FEM, there is one actual effect size for each run. REM is a model that estimates the average of the magnitude of the effects of studies participating in the study (Borenstein, Hedges, Higgins & Rothstein, 2013).

In the meta-analysis method, which statistical model is used, it is checked whether the effect sizes are homogeneous. If the *p* value of the homogeneity test Q is greater than .05, then the random effect model (REM) is used if the distribution is homogeneous and the fixed effect model (FEM) is below .05 (Ellis, 2010).

The effect sizes of the studies determined in the meta-analysis method are calculated as Cohen's *d* suggested by Thalheimer and Cook (2002) and Hedges' *g* proposed by Hedges and Olkin (1985). Classification is used when the magnitudes of effect sizes calculated in the meta-analysis method are interpreted. When the scale of the effect size values obtained in the research is large, the level classifications specified by Thalheimer and Cook (2002) are used. If According to this, if the effect size value is less than 0.15, it is insignificant, between 0.15 and

0.40 is at a small level, between 0.41 and 0.75 is at medium level, between 0.76 and 1.10 is at large level, between 1.11 and 1.45 is at very large level, if it is bigger than 1.45, it is excellent.

Positive effect size values indicate that the assessed performance dimension is in favor of the experimental group, and a negative effect size value indicates that the assessed performance dimension is in favor of the control group (Wolf, 1988).

The Orwin method and the funnel graph method are used to determine the publication bias of the studies identified in the meta-analysis method. In the Orwin method, the number of runs with a mean effect size of zero is calculated to reduce the value of the general effect size to zero (Lipsey & Wilson, 2001). Funnel Plot can also be used to get an idea of broadcast bias. The funnel graph is constructed to show the magnitude of the effect of each work participating in the X-axis survey, and the sample size, variance, or standard error on the Y-axis. If the studies participating in the survey according to the graph show a symmetrical distribution according to the general effect size, it is decided that the study is reliable, that is, the publication bias does not exist (Ustun & Eryilmaz, 2014).

Finally, in the meta-analysis method, various sub-groups were identified in which the effectiveness of the use of STEM educational practices in the education-training process could change. These groups are; the types of publications of the studies, the discipline of the study, and the level of learning of the students involved in the study. Analyses of these subgroups were made and their results reported.

FINDINGS

Firstly, the appropriateness of the normal distribution of the data obtained in order to assess whether the aggregation of the effect sizes of the identified studies is appropriate is examined. The results of SPSS-Shapiro-Wilk normal distribution analysis showing the normal distribution suitability of the effect sizes of the studies are given in Table 2.

Table 2. Shapiro-Wilk normal distribution analysis results

Learning Outcomes	N	Mean	Ss	p*
Academic achievement	27	.51	.43	.254
Attitude	18	.61	.42	.195
Scientific process skills	13	.83	.62	.101

*p< .05

As seen in Table 1, the results obtained from the effect sizes obtained in the field of learning outcomes (p> .05) are within the normal distribution. According to this, it is determined that the studies that are determined have a normal distribution. In this case, as mentioned in Rosenberg et al., (2000), it can be said that the combination of meta-analysis-forming studies is statistically appropriate if the distribution is normal. The results of the study were examined in the field of learning outcomes at the level of sub-problems where the effect size values of the 58 studies were homogeneous.

Findings of the first subproblem

The first subproblem of the research is; "*Is there any effect on the academic achievement of students using STEM educational practices?*" The findings of the questionnaires were first investigated. It is shown in Table 3 that the effect size values of the 27 detected workers are homogeneous.

Table 3. Findings of academic achievement impact sizes of studies

Model	N	ES	Df	(Q)	Std. Error	Z	p	I^2	% 95 confidence intervals	
									Lower Limit	Upper Limit
FEM	27	.217	26	143.709	0.021	9.954	.00	81.908	.176	.259
REM	27	.442			0.061	6.804	.00		.322	.561

The homogeneity of the studies included in the study was Q = 143.709 and p = 0.00 according to the fixed effect model (FEM). The *p* value was found to be statistically significant between the 95% significance level and the independent variables, which were less than 0.05. For this reason, it is seen that the effect size values of the studies are heterogeneous. Therefore, the analyses in this study are based on the random effects model (REM).

The mean effect size was found to be 0.442 with a standard error of 0.061 as a result of the analysis based on the random effects model (REM). In the 95% confidence interval, the lower limit of the effect size is 0.322, and the upper limit is calculated as .561. The positive effect of the mean effect size value indicates that academic achievement is more effective than traditional methods in the courses taught using STEM educational practices. This effect has moderate effect on the Thalheimer and Cook (2002) classification. The forest chart showing the distribution of the impact size values of the academic achievements included in the studies is shown in Figure 1.

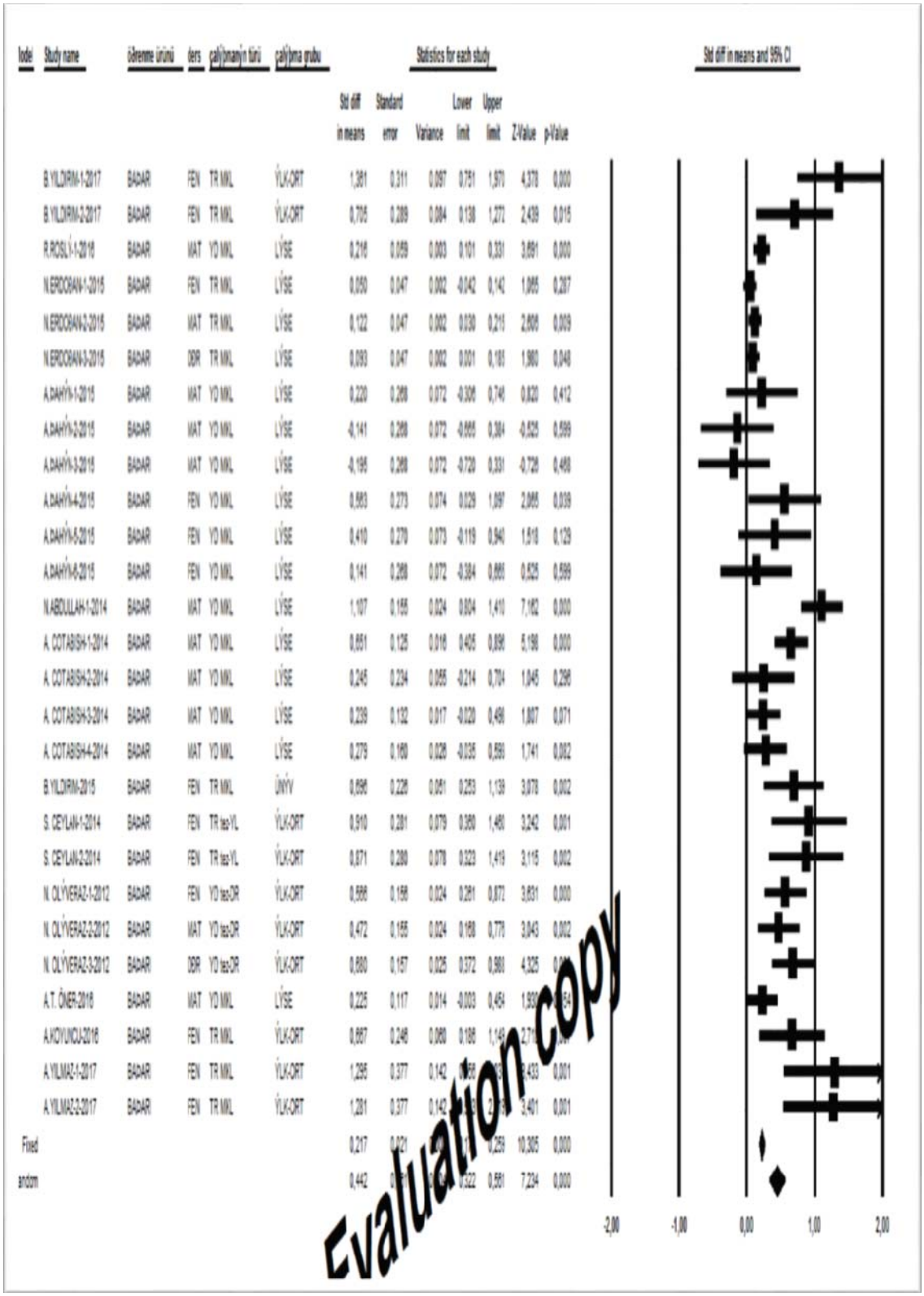


Figure 1. Forestry chart of the academic achievement effect studies included in the survey

The position of the black squares in the graph relative to the vertical vertical line shows the magnitude of the effect of the academic achievement studies, the lines on both sides of the squares indicate the upper and lower limits of the 95% confidence interval. The size of the squares reflects the weight of the studies they belong to within the overall magnitude of effect. The diamonds at the bottom of shaplin, the rhombus, show the magnitude of the overall effect according to the random effects model of work (REM).

When the effect sizes of the academic achievement studies are examined, it is determined that the smallest effect size value is -0.195 (Sahin, 2015) and the highest effect size value is 1.361 (Yildirim, 2017). Given the magnitude of the effects of the studies, 25 of the 27 effect sizes have a positive value and 2 have a negative effect value.

One of the issues that should be considered in meta-analysis studies are publication bias. It was determined that the required number of works with effect sizes 0 (zero) is 1202 to reduce the value of 0.442 effect size obtained by the Orwin method to zero effect size value. This is normally a high number and shows that the bias is low. However, whether or not the broadcast bias exists can be interpreted by the Funnel Plot (REM) given in Figure 2.

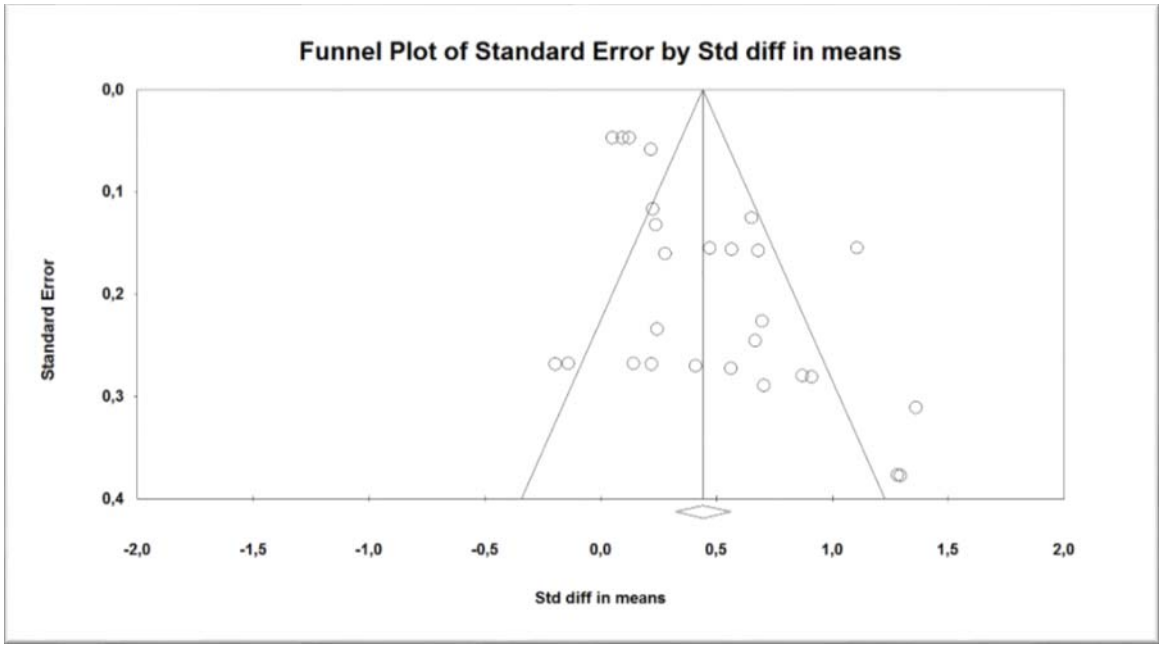


Figure 2. Funnel graph of the academic achievement studies included in the research-REM

In case of broadcast bias in the funnel graph, the effect sizes will be asymmetrically. In the case of no publication bias, they show a symmetrical distribution. As seen in figure-2, the funnel obtained from the works shows an almost symmetrical structure. Accordingly, it can be said that there is no bias in the study. The effect sizes obtained in the area of academic achievement were subdivided according to the various characteristics of the studies and the analysis results are shown in Table 4.

Table 4. Statistical analysis according to study characteristics in academic achievement area

Operating Characteristics	Homogeneity between groups(Q_B)	p	N	Effect Size (ES)	ES (%95 CI)		Standard Error(SE)
					Lower	Upper	
Publication Type	8.289	0.040	3				
National Article			9	0.441	0.253	0.629	0.096
National Thesis			2	0.891	0.505	1.279	0.198
International Article			13	0.331	0.157	0.505	0.089
International Thesis			3	0.572	0.395	0.748	0.090
Lesson Type	5.180	0.075	2				
Science			13	0.689	0.408	0.969	0.143
Math			12	0.315	0.156	0.474	0.081
Other			2	0.367	-0.207	0.941	0.293
Level of Education	23.049	0.000	2				
Basic Teaching			10	0.766	0.588	0.943	0.090

(Primary/Secondary School)					
Secondary education (High school)	16	0.272	0.145	0.379	0.060
Higher Education (University)	1	0.696	0.253	1.139	0.226

p<.05

There was a statistically significant difference in the publication type (QB = 8.289, p <.05) and the level of education (QB = 23.049, p <.05). This difference is in the form of the publication type in which the study was conducted, with nationally articles, international postgraduate theses, basic education and higher education students. In other words, it is seen that the academic achievements of STEM educational practices are more effective in publications published in national and in postgraduate theses published internationally and in students of basic education and higher education level. There was no statistically significant difference in the sub-dimension of the lesson types (QB = 5.180, p> .05) of the studies carried out in the subgroup analyses. In other words, there is no statistically significant difference between the academic achievement effect sizes of the courses studied using STEM educational practices.

Findings from the second subproblem

The second subproblem of the research is; "*Is there any effect on the attitude of students using STEM educational practices?*" The findings of the questionnaires were first investigated. It is shown in Table 5 that the effect size values of the 18 detected workers are homogeneous.

Table 5. Findings related to the effects of the attitudes of the studies on the course

Model	N	ES	Df	(Q)	Std. Error	Z	p	I^2	% 95 confidence intervals	
									Lower Limit	Upper Limit
FEM	18	.595	17	73.722	0.049	11.193	.00	76.940	.498	.692
REM	18	.620			0.111	5.217	.00		.403	.836

The homogeneity of the studies included in the study was Q 73.722 and p = 0.00 according to the fixed effect model (FEM). The *p* value was found to be statistically significant between the 95% significance level and the independent variables, which were less than 0.05. For this reason, it is seen that the effect size values of the studies are heterogeneous. Therefore, the analyses in this study are based on the random effects model (REM).

The mean effect size was found to be 0.620 with a standard error of 0.111 as a result of the analysis based on the random effects model (REM). In the 95% confidence interval, the lower limit of the effect size is 0.403, and the upper limit is calculated as .836. The positive effect of the mean effect size value indicates that attitude is more effective than traditional methods in the courses taught using STEM educational practices. This effect has middle effect on the Thalheimer and Cook (2002) classification. The forest chart showing the distribution of the impact size values of the attitudes included in the studies is shown in Figure 3.

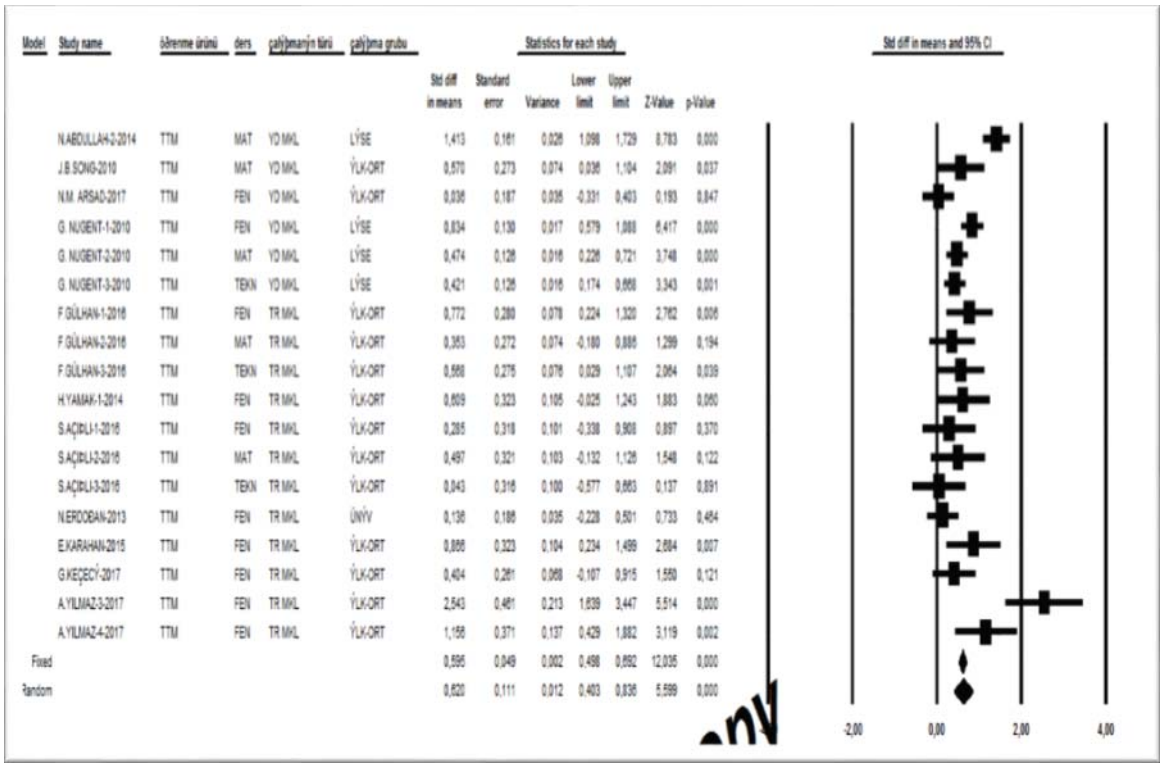


Figure 3. Forestry chart of the attitude effect studies included in the survey

The position of the black squares in the graph relative to the vertical vertical line shows the magnitude of the effect of the attitudesstudies, the lines on both sides of the squares indicate the upper and lower limits of the 95% confidence interval. The size of the squares reflects the weight of the studies they belong to within the overall magnitude of effect. The diamonds at the bottom of Shaplin, the rhombus, show the magnitude of the overall effect according to the random effects model of work (REM).

When the effect sizes of the attitudestudies are examined, it is determined that the smallest effect size value is 0.036 (Arsad, 2017) and the highest effect size value is 2.543 (Yilmaz, 2017). All of the 18 effect sizes have a positive impact value when the effect sizes of the studies are examined.

One of the issues that should be considered in meta-analysis studies are publication bias. It was determined that the required number of works with effect sizes 0 (zero) is 602 to reduce the value of 0.620 effect size obtained by the Orwin method to zero effect size value. This is normally a high number and shows that the bias is low. However, whether or not the broadcast bias exists can be interpreted by the Funnel Plot (REM) given in Figure 4.

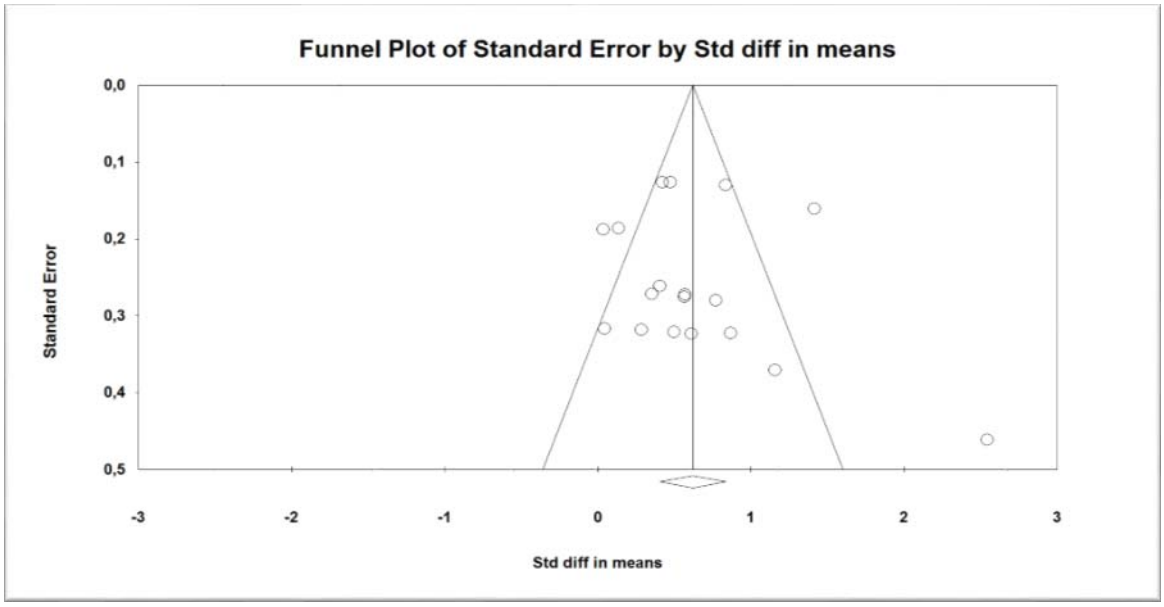


Figure 4. Funnel graph of the attitudes to the course included in the study-REM

In case of broadcast bias in the funnel graph, the effect sizes will be asymmetrically. In the case of no publication bias, they show a symmetrical distribution. As seen in figure 4, the funnel obtained from the works shows an almost symmetrical structure. Accordingly, it can be said that there is no bias in the study. The effect sizes obtained in the area of attitude were subdivided according to the various characteristics of the studies and the analysis results are shown in Table 6**.**

Table 6. Statistical analysis according to study characteristics in attitude area

Operating Characteristics	Homogeneity between groups(Q_B)	p	N	Effect Size (ES)	ES (%95 CI)		Standard Error(SE)
					Lower	Upper	
Publication Type	0.004	0.949	1				
National Article			12	0.615	0.329	0.901	0.146
International Article			6	0.630	0.276	0.983	0.180
Lesson Type	2.598	0.273	2				
Science			10	0.681	0.347	1.014	0.170
Math			5	0.683	0.224	1.142	0.234
Other			3	0.400	0.189	0.611	0.108
Level of Education	6.101	0.047	2				
Basic Teaching (Primary/Secondary School)			13	0.600	0.329	0.871	0.138
Secondary education (High school)			4	0.777	0.368	1.185	0.209
Higher Education (University)			1	0.136	-0.228	0.501	0.186

p<.05

In the subgroup analyses, there is a statistically significant difference between the attitude effect sizes in the relevant lesson in the learning level of the educations (QB = 6.101, p <.05). This difference is favored by students with basic education and secondary education. In other words, it is seen that STEM educational practices are more effective in the attitudes of the elementary education and secondary education students towards the relevant course. There was no statistically significant difference between publication type (QB = 0.004, p> .05) and lesson types (QB = 2.598, p> .05) subscales. That is to say, there is no statistically significant difference between the type of publication done in the lessons that are processed using STEM educational practices and the attitude effect sizes in the lesson types where the work is done.

Findings from the third subproblem

The third subproblem of the research is; "*Is there any effect on the scientific process skills of students using STEM educational practices?*" The findings of the questionnaires were first investigated. It is shown in Table 7 that the effect size values of the 13 detected workers are homogeneous.

Table 7. Findings related to the effects of the scientific process skills of the studies on the course

Model	N	ES	df	(Q)	Std. Error	Z	p	I^2	% 95 confidence intervals	
									Lower Limit	Upper Limit
FEM	13	.756	12	165.766	0.045	16.737	.00	92.760	.667	.844
REM	13	.820			0.172	4.760	.00		.482	1.157

The homogeneity of the studies included in the study was Q 165.766 and p = 0.00 according to the fixed effect model (FEM). The p value was found to be statistically significant between the 95% significance level and the independent variables, which were less than 0.05. For this reason, it is seen that the effect size values of the studies are heterogeneous. Therefore, the analyses in this study are based on the random effects model (REM).

The mean effect size was found to be 0.820 with a standard error of 0.172 as a result of the analysis based on the random effects model (REM).In the 95% confidence interval, the lower limit of the effect size is 0.482, and the upper limit is calculated as 1.157. The positive effect of the mean effect size value indicates that scientific process skills are more effective than traditional methods in the courses taught using STEM educational practices. This effect has large level effect on the Thalheimer and Cook (2002) classification. The forest chart showing the distribution of the impact size values of the scientific process skills included in the studies is shown in Figure 5.

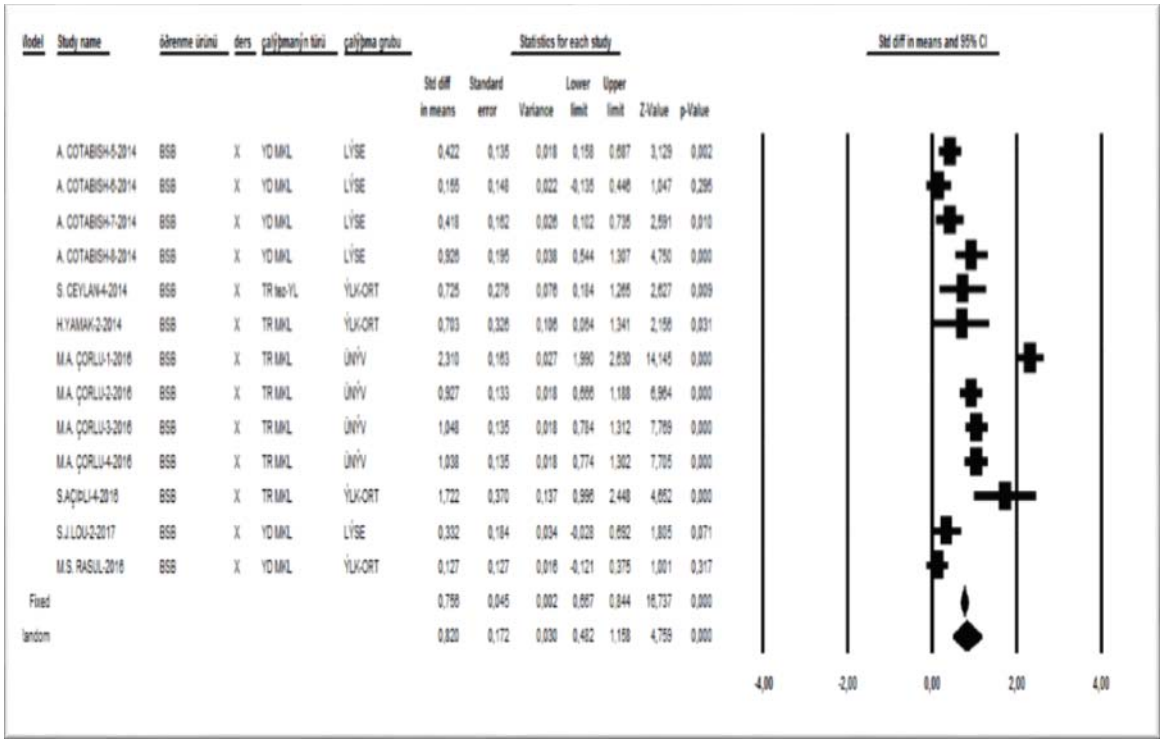


Figure 5. Forestry chart of the scientific process skills effect studies included in the survey

The position of the black squares in the graph relative to the vertical vertical line shows the magnitude of the effect of the scientific process skillsstudies, the lines on both sides of the squares indicate the upper and lower limits of the 95% confidence interval. The size of the squares reflects the weight of the studies they belong to within the overall magnitude of effect. The diamonds at the bottom of Shaplin, the rhombus, show the magnitude of the overall effect according to the random effects model of work (REM).

When the effect sizes of the scientific process skillsstudies are examined, it is determined that the smallest effect size value is 0.127 (Rasul, 2016) and the highest effect size value is 2.310 (Corlu, 2016). All of the 13 effect sizes have a positive impact value when the effect sizes of the studies are examined.

One of the issues that should be considered in meta-analysis studies are publication bias. It was determined that the required number of works with effect sizes 0 (zero) is 935 to reduce the value of 0.820 effect size obtained

by the Orwin method to zero effect size value. This is normally a high number and shows that the bias is low. However, whether or not the broadcast bias exists can be interpreted by the Funnel Plot (REM) given in Figure 6.

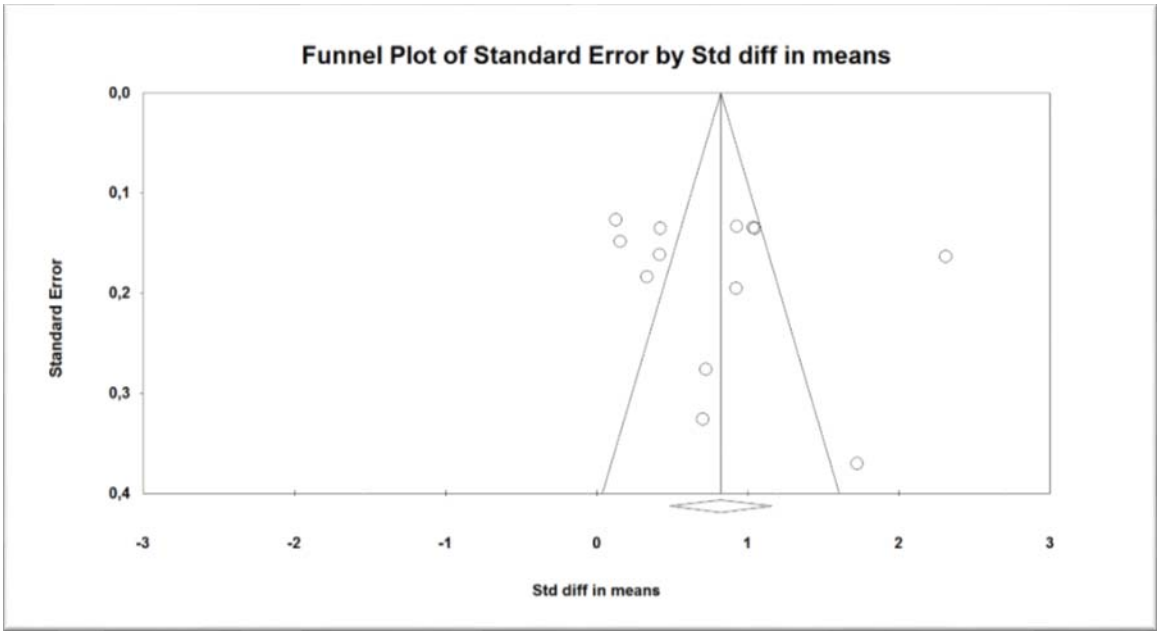


Figure 6. Funnel graph of the scientific process skills to the course included in the study-REM

In case of broadcast bias in the funnel graph, the effect sizes will be asymmetrically. In the case of no publication bias, they show a symmetrical distribution. As seen in figure 6, the funnel obtained from the works shows an almost symmetrical structure. Accordingly, it can be said that there is no bias in the study. The effect sizes obtained in the area of scientific process skillswere subdivided according to the various characteristics of the studies and the analysis results are shown in Table 8.

Table 8. Statistical analysis according to study characteristics in scientific process skills area

Operating Characteristics	Homogeneity between groups(Q_B)	p	N	Effect Size (ES)	ES (%95 CI)		Standard Error(SE)
					Lower	Upper	
Lesson Type	12.397	0.002	2				
Science			6	1.288	0.814	1.763	0.242
Math			1	0.725	0.184	1.265	0.276
Other			6	0.376	0.167	0.884	0.106
Level of Education	8.281	0.016	2				
Basic Teaching (Primary/Secondary School)			4	0.765	0.118	1.412	0.330
Secondary education (High school)			5	0.434	0.207	0.661	0.116
Higher Education (University)			4	1.325	0.747	1.903	0.295

p<.05

There was a statistically significant difference in the lesson types (QB = 12.397, p <.05) and the level of education (QB = 8.281, p <.05). This difference is in the form of the lesson types in which the study was conducted, with science and math lesson, basic education and higher education students. In other words, it is seen that the scientific process skills of STEM educational practices are more effective in lesson types in science and in math and in students of basic education and higher education level.

DISCUSSION

In the study, the academic achievement of the students was reached to a middle level with a positive score of 0.442, with a middle level of 0.620 in the positive direction of the students' attitude towards the course, and a large level effect size of 0.820 in the positive process in the students' scientific process skills.

In meta-analysis studies in which the use of technological materials in science and mathematics education is investigated, the effects of smart board use (Sarac, 2017), use of instructional technologies (Ayaz, Sekerci & Oral, 2016; Kablan, Topan & Erkan, 2013), computer-based and assisted instruction (Batdi, 2015; Dikmen & Tuncer, 2017; Dincer, 2015; Yesilyurt, 2011), dynamic geometry software (Gunhan & Acan, 2016) and mobile learning (Guzeller & Ustunel, 2016) are generally broad. The results obtained from the above studies and the results obtained from this study partially overlap in the literature. When the results obtained from the meta-analysis method in the study are examined at the level of sub-dimensions of the effects of STEM educational practices on academic achievement, it was found that there was a statistically significant difference between the publication types and the level of educationand no statistically significant difference was found among the lesson types where the studies were conducted. This difference is favored by university students with higher education level, primary school and secondary school which are the basic teaching level and postgraduate theses made in the national.

When the studies examined were evaluated according to the publication type in academic achievement, it was seen that the highest effect size value was small in the master's thesis (ES = 0.891) in the national and the smallest effect size value was small in the international study (ES = 0.331). Within the scope of researches on the use of technological materials in science and mathematics education in the literature; the highest effect size values in publication types were found to be broad at 0.919 in the study of Sarac (2017), broad at 1.073 in the study conducted by Dikmen and Tuncer (2017), Ayaz et al., (2016) were found to be in a very broad range of work with 1.247, and in the study of Gunhan and Acan (2016), they were in a very broad range of doctoral studies with 1,335. In this case, according to the results obtained in the meta-analyses carried out by Sarac (2017), Ayaz et al., (2016) and Gunhan and Acan (2016), the results obtained according to the types of publications and the results of the study using STEM educational practices the result obtained is similar.

In the academic achievement, the studies examined are evaluated according to the type of lesson; it is seen that there is no statistically significant difference between the effect sizes of the lesson types. In the literature, in the type of lesson in which studies are carried out within the scope of researches on the use of technological materials in science and mathematics education; it was found that there was no statistically significant difference between the use of smart board (Sarac, 2017), the use of instructional technologies (Ayaz, Sekerci & Oral, 2016), the use of computer-based teaching (Batdi, 2015), the use of computer-assisted teaching (Dincer, 2015) and the use of in-class technological material among students (Kablan, Topan & Erkan, 2013). In this case, the meta-analysis results (Ayaz, Sekerci & Oral, 2016; Batdi, 2015; Dikmen & Tuncer, 2017; Dincer, 2015; Kablan, Topan & Erkan, 2013; Sarac, 2017) obtained from the type of lesson and the academic achievement of the use of STEM educational practices in the study are similar to the results obtained according to the lesson type of the study.

When the studies examined are evaluated according to the level of educationin academic achievement; it is seen that the highest effect size value is small in elementary and secondary school students (ES = 0.766), which is the basic education level, and the smallest effect size value is in the high school students (ES = 0.272), which is the secondary education level. Within the scope of researches on the use of technological materials in science and mathematics education in the literature; the highest effect size value of the level of educationwas found to be very wide at the level of 1.057 in the study conducted by Ayaz et al., (2016) and at the level of 1.327 in the study conducted by Kablan et al., (2013) work. In this case, the meta-analysis of Ayaz et al., (2016) and Kaban et al., (2013) shows that the results obtained according to the students' learning levels and the use of STEM educational practices in this research are obtained according to the learning levels of students' the result is similar. It was seen that the highest effect size value of the students at the learning levels was found to be wide in the high school students whose education level was 1,024 with Sarac (2017), university students with higher education level and 1,014 with Gunhan and Acan (2016) study. According to this, the results of the meta-analyses carried out by Sarac (2017) and Gunhan and Acan (2016) according to the level of education and the results obtained according to the level of education effects on the academic achievement of the students using STEM educational practices in this research do not overlap.

In the meta analysis studies in which the use of technological materials in science and mathematics education has been investigated, the effect of using intelligent board (Sarac, 2017) and project based learning (Ayaz & Soylemez, 2015) in science teaching is wide. The results obtained from the above studies (Ayaz & Söylemez, 2015; Sarac, 2017) and the results obtained from this study partially overlap in the literature. When the results obtained from the meta-analysis method in the study are examined at the level of the subordinate effects of STEM educational practices on the relevant course, it was found that there was a statistically significant difference between the level of educationand no statistically significant difference between the types of

publications and lesson fields where the studies were made. This difference is favored by the primary school, primary school and secondary school, and high school students with secondary education.

When the studied studies are evaluated according to the publication type in the attitude of the related course, it is seen that there is no statistically significant difference between the effect sizes of the publication types. In the literature, it is seen that there is no statistically significant difference between the size of Sarac's (2017) smart board use and the effect of the students' attitude effect on the related course within the scope of researches on the use of technological materials in science and mathematics education. In this case, the result obtained according to the publication type in Sarac's (2017) meta-analysis study and the result obtained according to the publication type of the study effect of the use of STEM educational practices in this research are similar.

When the studies examined are evaluated according to the lesson fields in the field of attitude which is the lesson, it is seen that there is no statistically significant difference between the effect sizes of the lesson field types. Within the scope of researches on the use of technological materials in science and mathematics education in the literature; There is no statistically significant difference student's attitude effect sizebetween the size of Sarac's (2017) smart board usage and Ayaz and Soylemez's (2015) science-based project-based. In this case, the result obtained according to the lesson fields in Sarac (2017) and Ayaz and Soylemez (2015) and the result obtained according to the study of the study effect of using the STEM educational practices in the study are similar.

When the studies examined are evaluated according to thelevel of education in the area of attitudes to the lesson, it is seen that the highest effect size value is at a high level in secondary school students (ES = 0.777) and the smallest effect size value is at a small level in university students with higher education level (ES = 0.136). Within the scope of researches on the use of technological materials in science and mathematics education in the literature; it was seen that the value of the highest effect size in the level of education was in the middle school students with Sarac's (2017) study at 1.057 and university students with Ayaz and Sekerci (2015) at 0.844. In this case, the results obtained according to the the level of educationin the meta-analysis studies that Sarac (2017) and Ayaz and Soylemez (2015) did have do not agree with the level of education in the study on the effect of using the STEM educational practices in this study.

When the results obtained from the meta-analysis method in the study are examined in terms of the effects of STEM educational practices on scientific process skills at sub-dimensions, it was found that there was a statistically significant difference between the types of publications and the level of education. This difference is in favor of primary school and junior high school students with university education and basic education level with university studies and master's theses and higher education level. When the studies are evaluated according to the publication type, it is seen that the highest effect size value is small in the nationally published articles (ES = 1.288) and the smallest effect size value is small with the internationally published articles (ES = 0.376). When the scientific process skills are evaluated according to the level of education, it is seen that the studies are moderate with the university students with higher education level (ES = 1.325) and the smallest effect size value with the secondary education students with secondary education level (ES = 0.434).

SUGGESTIONS

In this meta-analysis study, the effects of STEM educational practices on the learning outcomes of students were examined in the categories of academic achievement, course attitude and scientific process skills and the remaining effects were excluded from the study. After that, the researchers who will work on these topics will be able to learn STEM education practices during the education period; gender and anxiety on factors such as the effect on different topics can perform meta-analysis studies. Moreover, studies conducted in this meta-analysis have been mostly focused on students' academic achievement and the effect of course attitude. It is suggested that STEM education practices in researchers should focus more on the effect of learned knowledge on permanence.

REFERENCES

Acikel, C. (2009). The place of meta-analysis and blood-based analysis. *Journal of Klinik Psikofarmoloji*, *19*(2), 164- 172.

Akaygun, S., & Aslan-Tutak, F. (2016). STEM images revealing stem conceptions of pre-service chemistry and mathematics teachers. International Journal of Education in Mathematics, *Science and Technology, 4*(1), 56-71.

Akgunduz, D., Ertepinar H., Ger M. A., Kaplan Sayi A., & Turk Z. (2015). *STEM Training Workshop Report A Comprehensive Assessment on Turkey STEM Training.* Istanbul Aydin University STEM Center and Education Faculty.

Altan, E. B., Yamak, H., & Kirikkaya, E. B. (2016). STEM education in pre-service teacher education: Design based science education. *Trakya University Education Faculty Journal*, *6*(2), 212-232.

Apedoe, X. S., Reynolds, B., Ellefson, M. R., & Schunn, C. D. (2008). Bringing engineering design into high school science classrooms: the heating/cooling unit. *Journal of Science Education and Technology, 17*(5), 454-465.

Aslan-Tutak, F., Akaygun, S., & Tezsezen, S. (2017). Cooperative STEM Teaching Practice: Examination of STEM Awareness of Chemistry and Mathematics Teacher Candidates. *Hacettepe University Education Faculty Journal*, *32*(4), 794-816.

Ayar, M.C. (2015). Engineering design at first-hand and career interest in engineering: An informal STEM education case study. Educational Sciences: *Theory and Practice*, *15*(6), 1655-1675.

Ayar, M.C., & Yalvac, B. (2016). Lessons Learned: Authenticity, Interdisciplinarity, and Mentoring for STEM Learning Environments. *The International Journal of Education in Mathematics, Science and Technology*, *4*(1), 30-43.

Ayaz, M. F., & Soylemez, M. (2016). The Effect of Project Based Learning on Students' Attitudes Towards Science Courses: A Meta-Analysis Study. *Adiyaman University Journal of Educational Sciences*, *6*(1), 112-137.

Ayaz, M. F., Şekerci, H., & Oral, B. (2016). The Effect of Using of Instructional Technology to Elementary School Students' Academic Achievement: A Meta-Analysis Study. *Journal of the Faculty of Education*, *17*(1), 35-54.

Baran, E., Canbazoğlu Bilici, S.,& Mesutoglu, C. (2015). Science, technology, engineering and mathematics (STEM) spot development activity. *Research Based Activity Journal*, *5*(2), 60-69.

Barnett, M. Connolly, K. G., Jarvin, L., Marulcu, I.Rogers, C., Wendell, K. B., & Wright, C. G. (2008). *Science through LEGO engineering design a people mover: Simple machines*. Retrieved from http://www.legoengineering.com/wpcontent/uploads/2013/05/LEcom_Compiled_Packet_Machines_Low Res.pdf.

Batdi, V. (2015). The success of students using the conceptual map technique and the traditional learning method, its effect on the persistence and attitudes of the knowledge: A meta-analysis study. *Dumlupinar University Journal of Social Sciences,42*(2), 93-102.

Borenstein, M., Hedges, L.V., Higgins, J.P.T., & Rothstein, H.R. (2013). *Introduction to meta analysis*. United Kingdom: John Wiley and Sons, Ltd. Publication.

Bozkurt, E., Yamak, H., Buluş Kirikkaya, E., & Kavak, N. (2013). Engineering design applications in pre-service science teacher training. *The International Organization for Science and Technology Education (IOSTE) Eurasian Regional Symposium & Brokerage Event Horizon 2020*, Antalya, Turkey.

Brophy,S., Klein, S., Portsmore, M., & Rogers, C. (2008). Advancing engineering education in P-12 classrooms. *Journal of Engineering Education, 97*(3), 369-387.

Buyruk, B., & Korkmaz, O. (2016). FeTeMM Awareness Scale (FFA): Validity and Reliability Study. *Part B: Turkish Science Education Journal*,*13*(2), 61-76.

Bybee, R. W. (2010). Advancing STEM education: A 2020 vision. *Technology and Engineering Teacher*, *70*(1), 30-35.

Cohen, J., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th Edition). New York: Routledge.

Cavas, B., Bulut, C., Holbrook, J., & Rannikmae, M. (2013). An engineering oriented approach to science education: ENGINEER project and its applications. *Journal of Science Teaching*, *1*(1), 12-22.

Cinar, S. Pirasa, N., Uzun, N., & Erenler, S. (2016). The effect of STEM education on pre-service science teachers' perception of interdisciplinary education. *Journal of Turkish Science Education*, *13*(special issue), 118-142.

Corlu, M.S., Capraro, R.M., & Capraro, M.M. (2014). Introducing STEM education: Implications for educating our teachers in the age of innovation. *Education and Science*, *39*(171), 74-85.

Daugherty, J. (2012). Infusing engineering concepts: Teaching engineering design. *National Center for Engineering and Technology Education*. Publications Paper 170, 1-11.

Dikmen, M., & Tuncer, M. (2017). *The impact of using computer aided animation on academic achievement: A meta-analysis study.* 1st International Symposium on Computer and Instructional Technologies. May 24-27, Inonu University, Malatya.

Dincer, S. (2015). Impact of computer-assisted instruction in Turkey on student achievement and comparison with other countries: A meta-analysis study. *Journal of Turkish Science Education*, *12*(1), 99-118.

Dugger, W. E. (2010). *Evolution of STEM in the United States*. Presented at the 6th Biennial International Conference on Technology Education Research, Gold Coast, Queensland, Australia.

Ellis, P. D. (2010). *The essential guide to effect sizes: Statistical power, meta-analysis, and the interpretation of research results*. Cambridge: Cambridge University Press.

Ercan, S. (2014). *Use of engineering applications in science education: Design based science education.* PhD thesis, Marmara University, Institute of Educational Sciences, Istanbul.
Felix, A. L. (2010). *Design-based science for STEM Student recruitment and teacher Professional development.* Mid-Atlantic ASEE Conference, Villanova University.
Girginer, N., & Ozkul, A. E. (2004). Technology selection in distance education.*The Turkish Online Journal of Educational Technology, 3*(3),155-164.
Guzey, S.S., Harwell, M., & Moore, T. (2014). Development an instrument to assess attitudes toward science, technology, engineering, and mathematics (STEM). *School Science and Mathematics* , *114*(6), 271-279.
Gunhan, B. C., & Acan, H. (2016). The Impact of Using Dynamic Geometry Software on Geometry Success: A Meta-Analysis Study. *Turkish Journal of Computer and Mathematics Education Vol*, *7*(1), 1-23.
Gulhan, F., & Sahin, F. (2016). Impact of science-technology-engineering-mathematics integration (STEM) on the perceptions and attitudes of Grade 5 students. *International Journal of HumanSciences*, *13*(1), 602-620.
Guzeller, C. O., & Ustunel, F. (2016). Effects Of Mobile Learning On Academic Achievement: A Meta Analysis Study. *Adiyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *1*(2), 528-560.
Haciomeroglu, G., & Bulut, A.S. (2016). The validity and reliability study of the Turkish version of the integrated STEM teaching orientation scale. *Theory and Practice in Education*, *12*(3), 654-669.
Harkema, J., Jadrich, J., & Bruxvoort, C. (2009) Science and engineering: Two models of laboratory investigation. *The Science Teacher, 76*(9), 27-31.
Hedges, L.V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. New York: Academic Press.
Hernandez-Ramos, P. (2005). If not here, where? Understanding teachers' use of technology in silicon valley schools. *Journal of Research on Technology in Education, 38(1)*, 39-64.
Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research.* Washington D.C.: The National Academies Press.
Householder, D. L.,& Hailey, C. E. (2012). Incorporating engineering design challenges into STEM courses. *NCETE Publications.* Paper 166, 1-67.
Hynes, M., Portsmore, M., Dare, E., Milto, E., Rogers, C., Hammer, D., & Carberry, A. (2011). Infusing Engineering Design into High School STEM Courses. *National Center for Engineering and Technology Education*. 7-13.
Isman, A. (2002). Sakarya province teachers' competencies in terms of educational technologies. *The Turkish Online Journal of Educational Technology, 1*(1), 72-91.
Kablan, Z., Topan, B., & Erkan, B. (2013). Effectiveness of material use in classroom teaching: A meta-analysis study. *Educational Sciences in Theory and Practice*, *13*(3), 1629-1644.
Komis, V., Ergazakia, M., & Zogzaa, V. (2007).Comparing computer-supported dynamic modeling and "paper & pencil" concept mapping technique in students' collaborative activity. *Computers & Education, 49*(4), 991-1017.
Kucuk, S., & Sisman, B. (2017). Behavioral patterns of elementary students and teachers in one-toone robotics instruction, *Computers & Education*, 111, 31-43.
Lipsey, M., & Wilson, D. (2001). *Practical meta-analysis*. Beverly Hills, CA: Sage Publications.
Marulcu, I., & Sungur, K. (2012). Investigation of engineer and engineering perceptions of science student candidates and engineering-design aspects as a method. *Afyon Kocatepe University Science Journal*. 12, 13-23.
Meng C. C., Idris N., & Kwan L. (2014). Eurasia Journal of Mathematics. *Science & Technology Education*, *10*(3), 219-227.
Miles, M. B., & Huberman, A. M. (2002). *The qualitative researcher's companion*. California: Sage Publications.
Moore, T.J., Stohlmann, M.S., Wang, H.-H., Tank, K.M., & Roehrig, G.H. (2013). *Implementation and integration of engineering in K-12 STEM education*. In J. Strobel, S. Purzer, & M. Cardella (Edt.), *Engineering in precollege settings: Research into practice*. Rotterdam, the Netherlands: Sense Publishers.
National Research Council [NRC]. (2012). *A Framework for k-12 science education: practices, crosscutting concepts, and core ideas*. Washington DC: The National Academic Press.
Riechert, S. E., & Post, B. K. (2010). From skeletons to bridges & other STEM enrichment exercises for high school biology. *The american biology Teacher*, *72*(1), 20-22.
Rosenberg, M.S., Adams, D.C., & Gurevitch, J. (2000). *Meta Win.* Sunderland, MA: Sinauer Associates.
Sarac, H. (2017). The Effect of Smart Board Usage in Turkish Education System on Students' Learning Outcomes: Meta- Analysis Study*, TURKISH STUDIES -International Periodical for the Languages, Literature and History of Turkish or Turkic*, ISSN: 1308-2140, Volume *12*/4, p. 445-470.
Strong, M. G. (2013). *Developing elementary math and science process skills through engineering design instruction*. Hofstra University.

Sahin, A., Ayar, M.C., & Adiguzel, T. (2014). Post-school activities with science, technology, engineering and mathematics and their effects on students. *Educational Sciences: Theory ve Practice*, *14*(1), 297-322.
Thalheimer, W., & Cook, S. (2002). How to calculate effect sizes from published research: A simplified methodology. *Work-Learning Research*, (August), 1-9.
TUSIAD. (2014). *A survey of demand and expectations for the workforce trained in STEM.* TUSIAD-Istanbul.
Ustun, U., & Eryilmaz, A. (2014). A research method for effective research synthesis: Meta-analysis. *Education and Science*, 1-32.
Williams, H. S., & Kingham, M. (2003). Infusion of technology into the curriculum. *Journal of Instructional Psychology*, *30*(3), 178.
Wolf, F. M. (1988). *Meta-analysis quantitative methods for research synthesis (Third edition)*. California: Sage Publications.
Yamak, H., Bulut, N., & Dündar, S. (2014). The Impact of STEM Activities on 5th Grade Students' Scientific Process Skills and Their Attitudes Towards Science. *Gazi University Gazi Education Faculty Journal*, *34*(2), 249-265.
Yeşilyurt, M. (2011). Meta-analysis of the computer assisted studies in physics: A sample of Turkey. *Energy Education Science and Technology Part B: Social and Educational Studies*, *3*(2), 173-182.
Yildirim, B., & Altun, Y. (2015). Investigation of the effects of STEM education and engineering applications in the science laboratory course. *El-Cezeri Journal of Science and Engineering*, *2*(2), 28-40.
Yildirim, A., & Simsek, H. (2011). *Qualitative research methods in the social sciences*. Ankara: Seçkin Publishing House.

APPENDIX 1.
STEM Educational Practices Investigations Included In The Meta Analysis Study

Abdullah, N., Halim, L., & Zakaria, E. (2014). VStops: A Thinking Strategy and Visual Representation Approach in Mathematical Word Problem Solving toward Enhancing STEM Literacy. *Eurasia Journal of Mathematics, Science & Technology Education*. *10*(3), 165-174.
Acisli, S. (2016). Investigation Of The Effect Of Robotic Applications In Elementary Education. *The Eurasia Proceedings of Educational & Social Sciences (EPESS). Volume 4***,** 391-394
Arsad, N. M., Osman, K., & Embi, M. A. (2017). Impact Of Stem-5e Learning Cycle (Am-Stem Kids Module) In Fostering Noble Values Among Elementary School Children. *The Eurasia Proceedings of Educational & Social Sciences*. *6*, 160-166.
Ceylan, S. (2014). A Study For Preparing An Instructional Design Based On Science, Technology, Engineering And Mathematics (Stem) Approach On The Topic Of Acids And Bases At Secondary School Science Course. *Unpublished master's thesis, Uludağ University Educational Sciences Institute, Bursa*.
Corlu, M. A., & Aydin, E. (2016). Evaluation of Learning Gains through Integrated STEM Projects. *International Journal of Education in Mathematics, Science and Technology*, *4*(1), 20-29.
Cotabish, A., Dailey, D., Robinson, A., & Hughes, G. (2013). The effects of a STEM intervention on elementary students' science knowledge and skills. *School Science and Mathematics*. *113*(5), 215-226.
Erdogan, N., & Stuessy, C. (2016). Examining the Role of Inclusive STEM Schools in the College and Career Readiness of Students in the United States: A Multi-Group Analysis on the Outcome of Student Achievement. *Educational Sciences: Theory and Practice*. *15*(6), 1517-1529.
Erdogan, N., Oner, A. T., Cavlazoglu, B., Capraro, R. M., & Capraro, M. M. (2013). A case study: The effect of STEM activities on students' attitudes toward science. In *annual meeting of European Educational Research Association, Istanbul, Turkey*.
Erdogan, N., Sencer Corlu, M., & Capraro, R. M. (2013). Defining Innovation Literacy: Do Robotics Programs Help Students Develop Innovation Literacy Skills? *International Online Journal of Educational Sciences*. *5*(1), 1-9.
Gulhan, F., & Sahin, F. (2016). The Impact of Science, Technology, Engineering, Mathematics Integration (STEM) on the Perception and Attitudes of the 5th Grade Students. *International Journal of Human Sciences*. *13*(1), 602-620.
Karahan, E., Canbazoglu Bilici, S., & Unal, A. (2015). Integration of Media Design Processes in Science, Technology, Engineering, and Mathematics (STEM) Education. *Eurasian Journal of Educational Research*. *60*, 221-240.
Kececi, G., Alan, B., & Kirbag Zengin, F. (2017). STEM Educational Practices with Grade 5 Students. *Journal of Kirsehir Education Faculty*. *18*(1), 1-17.
Koyuncu, A., & Kirgiz, H. (2016). Impact of Science Centers on International Students' Achievement in International Examinations. *Journal of Informal Media Research. 1*(1), 52-60.

Lou, S. J., Chou, Y. C., Shih, R. C., & Chung, C. C. (2017). A Study of Creativity in CaC2 Steamship-derived STEM Project-based Learning. *Eurasia Journal of Mathematics, Science & Technology Education*. *13*(6), 2387-2404.

Nugent, G., Barker, B., Grandgenett, N., & Adamchuk, V. I. (2010). Impact of robotics and geospatial technology interventions on youth STEM learning and attitudes. *Journal of Research on Technology in Education*. *42*(4), 391-408.

Olivarez, N. (2012). *The impact of a STEM program on academic achievement of eighth grade students in a South Texas middle school* (Doctoral dissertation, Texas A&M University-Corpus Christi).

Oner, A. T., Capraro, R. M., & Capraro, M. M. (2016). The Effect Of T-STEM Designation On Charter Schools: A Longitudinal Examination Of Students' Mathematics Achievement. *Sakarya University Journal of Education*. *6*(2), 80-96.

Rasul, M. S., Halim, L., & Iksan, Z. (2016). Using Stem Integrated Approach To Nurture Students'interest And 21st Century Skills. *TheEurasia Proceedings of Educational & Social Sciences (EPESS). Volume 4*, 313-319.

Sahin, A., Oren, M., Willson, V., Hubert, T., & Capraro, R. M. (2015). Longitudinal Analysis of T-STEM Academies: How Do Texas Inclusive STEM Academies (T-STEM) Perform in Mathematics, Science, and Reading?. *International Online Journal of Educational Sciences*. *7*(4), 11-21.

Song, J. B., Shin, S. B., & Lee, T. W. (2010). A Study on effectiveness of STEM integration education using educational robot. *Journal of The Korea Society of Computer and Information*. *15*(6), 81-89.

Sunyoung, H. A. N., Rosli, R., Capraro, M. M., & Capraro, R. M. (2016). The Effect of Science, Technology, Engineering and Mathematics (STEM) Project Based Learning (PBL) on Students' Achievement in Four Mathematics Topics. *Journal of Turkish Science Education*. *13*(3), 381-391.

Yamak, H., Bulut, N., & Dündar, S. (2014). The Impact of STEM Activities on 5th Grade Students' Scientific Process Skills and Their Attitudes Towards Science. *Gazi University Gazi Education Faculty Journal*. *34*(2), 249-265.

Yildirim, B., & Altun, Y. (2015). Investigation of the effects of STEM education and engineering applications in the science laboratory course. *El-Cezeri Journal of Science and Engineering*. *2*(2), 28-40.

Yildirim, B., & Selvi, M. (2017). An Experimental Research on Effects of STEM Applications And Mastery Learning. *Journal of Theory and Practice in Education*. *13*(2), 183-210.

Yilmaz, A., Gulgun, C., & Caglar, A. (2017). Teaching with STEM Applications for 7th Class Students Unit of "Force and Energy": Let's Make a Parachute, Water Jet, Catapult, Intelligent Curtain and Hydraulic Work Machine (Bucket Machine) Activities. *Journal of Current Researches on Educational Studies*. *7*(1), 97-116.

The Effect of Twitter Activities in a Blended Learning Classroom Guided by Activity Theory on Students' Achievement and Attitudes

Assistant Professor Dr. Aicha Amry, PhD
Department of Educational Technology, Faculty of education, Taibah University, Kingdom of Saudi Arabia
barhoumichokri@yahoo.fr

ABSTRACT
Purpose – This research paper explores the effect of using Twitter activities to support a blended learning course (75% in-class and 25% Twitter activities) on the achievement and attitudes of female students compared to 100% in-class learning.

Design/methodology/approach – In the 2016 academic year, the researcher compared an experimental group (34 students) and a control group (34 students). The learning process of the experimental group was based on continuity between 2 hours of in-class learning and 1 hour of learning activities that were mediated by Twitter activities each week. The control group's experience was 100% in-class with no app mediation.

Findings – The principal results of the study are that the students in the experimental group performed better than those in the control group on the achievement test, learning tracks and attitudes. Learning track analysis shows that the students in the experimental group had greater participation in different topics of discussion in the Twitter space than did the control group.

Originality/value – This research paper is useful for readers, parents, students and schools in exploring the effectiveness of Twitter activities to support blended courses in higher studies.

Keywords: Twitter, mobile teaching, mobile learning, mobile tools, activity theory

INTRODUCTION

Web 2.0 is new web technology that is recognized and widely used by all Internet users (Uzunboylu, Bicen & Cavus, 2011; Lenhart & Madden, 2007; Hussein, 2010). Web 2.0 users have an active role in communication and in co-operatively sharing information and generating attraction to their shares (Buzzi & Buzzi, 2011).

With their crowded rows of students, large lecture classes can make it difficult for both instructors and students to engage in social interaction through discussions, which can cause students to feel a sense of isolation (Geske, 1992). Gardiner (1994, 1998) endorsed the need for classroom change to allow students to acquire more significant kinds of cognitive learning, particularly critical thinking skills. Collins (1999) noted that students and teachers react to new educational technologies with varied emotions, ranging from enthusiasm to disabling fear. Presently, the information and communication technologies shared between online students through social interactions on mobile tools promote opportunities for online cooperation and collaboration (Barhoumi & Rossi, 2013). New educational technology based Web 2.0 is frequently used in online instruction in universities worldwide (Jimoyiannis, Tsiotakis, Roussinos & Siorenta, 2013). It offers students increased choices and opportunities in the context of online instruction. Web 2.0 is the second generation of web and Internet services. It depends on the support of communication between users of the Internet to maximize the user role in enriching digital content on the Internet and on cooperation between the various Internet users in building electronic societies; additionally, it depends on configurations of social networks and social network applications that have characteristics of Web 2.0 such as Facebook, Twitter, and blogs. As one of the leading forms of communication, social networking sites (SNSs) are maintaining user popularity worldwide. Boyd & Ellison (2007) define SNSs as web-based services that provide an opportunity for individuals to build and display either public or private profiles.

Web 2.0 applications used in online teaching and learning provide online learners with opportunities to communicate and share knowledge (Nelson, Christopher, & Mims, 2009).Tutors and instructors in online teaching and learning are using Web 2.0 applications in online courses. Thus, in this field, the pertinent question to answer is the following: How do we use mobile technologies such as Twitter in online communities? Is it

better to use Web 2.0 applications such as Twitter to perform online learning activities in a blended learning strategy?

Additionally, graduate students such as those working toward a master's degree need effective blended online learning to pursue blended courses. For these reasons, the present study is conducted with female students pursuing a master's degree in educational technology to explore the effectiveness of a blended learning strategy in a course using Twitter activities compared to 100% in-class learning. This study explores the effectiveness of the blended learning strategy in terms of enhancing students' cognitive and attitudinal levels in the context of a course titled Computers in instruction.

The overall aims of the study are very important, particularly considering the focus on using a Web 2.0 application (Twitter) to pursue learning activities, to which great potential for supporting blended learning processes has been attributed. In the present study, the effectiveness of the blended learning process based on continuity between in-class learning and learning activities mediated by Twitter is explored through a comparative study between the face-to-face course and the blended online course.

THEORETICAL FRAMEWORK

In this study, activity theory guides the data analysis and interpretation of the study to explore the factors that influence students' participation in online discussions through Twitter. **Twitter**

In 2006, Twitter was created within the framework of a research project conducted within the open society of the US in the city of San Francisco. Then, after its success, the application was officially launched by the company in the same year. Afterward, this site spread, and the number of Twitter employees has been rising since 2007. Twitter is recognized as a Web 2.0 social networking application currently available to users, and it allows users to send updates, tweets, which have a maximum length of 140 characters per message and appear on the user page.

The Twitter system allows users to register on the main page. Twitter has drawn the desire of millions of users and many companies working in the media and Internet education fields. The blogging process on Twitter is based on the use of Internet technologies to write short messages of up to 140 characters, including links to other information available through the Internet. Twitter limits all user messages, status updates, replies to status updates, and private messages to 140 characters (Fox & Lenhart, 2009).

Users of Twitter have opportunities to reply to a special message or to retweet what other users have published (Gao, Luo, & Zhang, 2012). In fact, Twitter is the most famous tool used by people in the Middle East and the Arab world, especially in the Kingdom of Saudi Arabia (We are social, 2015). Twitter can be considered both a communication centre and an affiliation space, where virtual communities with shared interests are formed (Casal, 2017)

Twitter is used by researchers at academic conferences, with a conference hashtag being established by the conference's organizers or attendees. Attendees and others following the hashtag can engage in social cooperation and collaboration in social conversations, share content or simply follow the happenings at the conference.

Popular collaborative sites such as Twitter appear alternately as successful tools for learning or as sources of information and knowledge. In the education frame, collaborative learning platforms based on Web 2.0 technologies such as Twitter can become real vectors for opening the flexible knowledge or flexible learning process (Barhoumi & Rossi, 2013; Barhoumi & Amry, 2015), provided that teachers agree to enter into flows with their students. In this case, the teacher no longer has a monopoly. The teacher is no longer the sole holder of knowledge because each of the students participates in the construction and sharing of knowledge, for example, by proposing textual references. Then, teacher instead becomes rather a facilitator of learning.

The general benefits of using Twitter in a blended course are as follows:

- Accessible and fast: Twitter is free and available on one's computer, mobile, or tablet and registration is fast.
- Ease of sharing messages (retweets, the equivalent of sharing): Sharing messages on Twitter is faster than it is on Facebook.
- Important visibility: More than 100 million members post tweets every day, and Twitter is worldwide. An important acquisition of traffic is at stake; this traffic can be transformed in the future into potential customers and, thus, into sales.

- Entertainment: Twitter allows the possibility of organizing quizzes to positively point out to users and to create some commitment, sharing and the audience.
- Twitter facilitates online collaboration and cooperation between online students connected from school or home in a blended course.
- Twitter is a free application that is easy for online users to use in order to cooperate and collaborate together.
- Groups connected to Twitter can share comments, text and message. Discussions are related to the course content taught 100% in-class.
- Twitter provides students with the ability to create a class publication and thereby publish their work in the group.
- Knowledge is easily constructed and shared through Twitter.
- Despite its numerous advantages, Twitter presents certain inconveniences.
  Strict volume of characters: One cannot post messages that include more than 140 characters. It is thus necessary to be brief and effective.
- Twitter is considered the 2nd most popular social network after Facebook because the community that users wish to contact is maybe not on Twitter. Although it is well known, Internet users use Facebook more.
- On Twitter, the tweets of users can mix with those of other groups whom their followers follow. Users thus have no certainty that all their tweets are seen at the exact same time and hour.

Learning communities and activity theory

Learning communities

A learning community is established by a group of individuals who work together in a time determined to succeed at a task and to understand a new phenomenon or complete a collaborative task (Riel & Polin, 2004; Cross, 1998). Gagnon (2003) specifies that a learning community is established within the framework of training for purposes of learning to answer needs and very precise purposes. At the school level, a learning community would be defined as a group of students and at least one educator or online tutor who, lasting for some period of time and animated by a common vision and will, pursue the construction and sharing of knowledge, skills or attitudes. Attention, dialogue and mutual aid are fundamental in this type of learning community (Benoît, 2000). McNeil (2010) found that students were more interested in using social networking tools such as Facebook over Twitter because their friends and family were already on this SNS.

The principal objective of this community is to advance the construction and sharing of knowledge between groups through collaborative learning activities (Bielaczyc & Collins, 1999).

The activity theory

Activity theory emerges in the Russian school of human developmental psychology from the historico-cultural thesis defended by L. Vygotsky. Before a consideration of the fact of human beings as isolated individuals, learning is initially a social phenomenon because it occurs in contexts that are culturally determined, printing their specific marks on human groups in their most everyday behavior. Human activity becomes organized there and spreads by means of the tools that individuals have there, which are the language or present artifacts in the circles where they evolve.

As an outcome of the works of theorists and Soviet psychologists (Leontiev, Vygotsky, etc.), activity theory postulates that consciousness is not a discrete set of cognitive disembodied acts such as decision-making or classification. It is also different from intellectual activity.

Activity theory places consciousness in everyday practice and asserts that actions are always inserted into a social matrix composed of individuals and artifacts. Thus, as the spirit works through artifacts, its work cannot be connected unconditionally or exclusively either to the brain or to the individual; it should be perceived as distributed in the connected artifacts. The aforementioned artifacts bind (connect) individuals and actions in a permeable, changeable and factual way.

Therefore, a consideration of the context and the artifact for understanding activity and collective interaction is the fundamental characteristic of activity theory. Rather than individuals, complex systems of cooperation - at least of interaction – are the object of this theory. While certain approaches favor external representation, activity theory places great importance to the insourcing of artifacts (e.g., the IT medium within the framework of computer-aided cooperative work [cf. Engestrom] and the hand for a child who learns to count on his or her fingers) and processes of mediation.

In the filiation of the Vygotsky's ideas, Has. Leontiev (1976) suggests distinguishing three levels within activities by which borders would be left porous and unstable.

- Operations constitute the basis and correspond to actions the production of which was automated by means of successive realizations. However, an operation can be a source of new conceptualizations in unusual situations.
- Regarding actions, in the second level of the model proposed by Leontiev, they are a matter of making contact with the knowledge and the know-how achieved by individuals in the face of given situations and of answering a precise, conscious purpose. Regarding vaster motives, activities include them within specific contexts in order to answer.
- Additionally, an action can rise at the level of an activity, or an activity can correspond to an action in an activity of a more general reach .

Engeström (1987) developed an extension of the activity theory model that adds the component of community sharing of the same object. The model established by Y. Engeström (1987) ultimately constitutes one of the last major evolutions of this theoretical framework of activity theory: the "basic structure of an activity" appears, then, under a bi-triangular shape the angles of which count the various parameters of human activities, thus taking into account the social or collective dimension of activities as well as the mediatization of actions by tools mobilized in the observed contexts.

This simplistic representation thus involves seven poles: the subject the relations of which to the community are mediatized by rules and the division of labor, as well as the objective or purpose toward which the subject aims and realizes by means of specific tools. The seventh pole concerns the result of the observed activity. This model is accompanied by more than a series of "contradictions" or tensions that observe and that allow the evolution of activityResearchers frequently use activity theory to analyze human-computer interactions (Nardi, 1996). This theory seeks to analyze the cultural and technical aspects of human action (Bertelsen & Bodker, 2003).

In this suggested model of activity theory, Engestrom added rules that mediate the learning community and the subject and that create a division of labor between the community and the object.
Activity theory is based on six related principles:

- The subject: This is the individual or subgroup that the observer chose to analyze the activity. This principle is considered the individual level of activity theory, and examples include the teacher and the learner.
- Object orientedness: This is the transformation of the environment at which the activity aims (tries to realize, the objective to reach (affect, achieve)); examples include the use of the Internet in education.
- Tools: These are material or symbolic tools that mediatize the activity; examples include the Internet, software, and new educational media.
- Community: This principle involves subjects (or subgroups) that share the same object and thereby distinguish themselves even from other communities; examples include administrative staff, technicians in the department, students, graduate students, and that which is going to be created.
- Division of labor: This principle simultaneously involves the horizontal distribution of the actions between the subjects/members of the community and the vertical hierarchy of the powers and the statutes.
- Rules are the conventions and guidelines regulating activities in the system, such as the rules of discussion between students in collaborative learning.

Figure 1 shows the three levels of activity theory: the technological level, the individual level, and the community level.

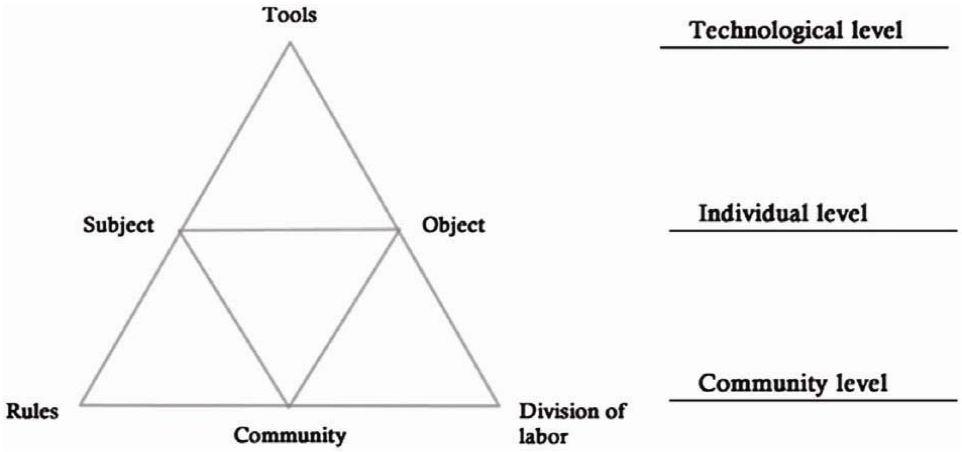


Figure 1. Three levels of factors that influence online participation

In their research related to learning communities, Strijbos and Fischer (2007) noted that collaborative learning strategies are very useful for constructing and sharing knowledge among students in collaborative and cooperative online courses in the presence of an instructor or tutor. The collaborative and cooperative learning activities achieved by students in the activity system help researchers find the cognitive outcomes of a learning activity and the processes of knowledge creation and sharing during the learning process. Activity theory stimulates professionals to renew knowledge (Tillema & Orland-Barak, 2006).

Mercier and Higgins (2013) examined the adoption of online cooperative and collaborative learning strategies in online communities to support mathematics learning activities and found that a number of factors influence students' participation in cooperative and collaborative communities. Students are motivated and positively oriented to participate in online communities to share knowledge related to mathematics courses.

Further, we cannot forget the principal role of the instructor in online learning activities. In this context, a recent study by Lu and Churchill (2014) stated that the teacher plays a principal role in guiding students in online lectures. This study showed that social interaction that helps students construct and share knowledge is achieved through the pertinent role of the instructor; a decrease in the frequency of interactive messages in online communities is triggered when the online tutor or teacher is not present with the group in the online community. Other research in the field of mobile learning has found that online learners are using mobile educational technologies and are integrating them in online learning through learning communities and that the usefulness and ease of use of the mobile technology are the principal factors influencing students' participation and adoption of online interaction (Litchfield et al. 2007). The social presence of students in online communities is a pertinent factor that influences student's participation in online communities (Cheung et al. 2008).

In an article published in Contemporary Educational Technology, Tennyson (2010) noted that in the 1990s, the integration of the media artifact by the tutor or teacher in an e-learning system was the technological factor that improved online social interaction among group members in learning communities. Social online interaction in online learning communities and its analysis became an important domain of research (Tennyson, 2010).

Baran (2010) recommended the integration of auditive and visual representations of knowledge through calculators and audiovisual media, which are considered an effective tool for solving online students' learning difficulties. These technologies may have positive results in teaching and learning.

A study conducted by Yu, Tian, Vogel, and Kwok (2010) reported that online discussions between students through social learning communities networked through an artifact, such as mobile learning communities, clearly improved students' social connections, improved their self-esteem and boosted their learning performance.

Preston and his colleagues (2010) found that nearly 70% of students stated that they learn just as well in online learning communities, such as WhatsApp groups, Facebook communities, Twitter chats and Google+ communities, as they do in lectures that are held in the classroom in the presence of other students.

RESEARCH HYPOTHESES OF THIS STUDY

The present experimental study aims to determine the effectiveness of blended learning technology based on continuity between in-class learning and Twitter learning activities in student achievement and in students'

attitudes toward it compared to 100% in-class learning with no app mediation. The same course, Computer in instruction, was taught with the control and experimental groups.
The hypotheses guiding the present study are as follows:
Hypothesis 1: There is a significant difference between the control group and the experimental group at the 5% level regarding the achievement test scores of students.
Hypothesis 2: There is a significant difference between the control group and the experimental group at the 5% level regarding the attitudes of students after the experimental period.

METHOD

In the present study, the researcher used an experimental research approach based on identifying the impact of the use of the blended learning process combining in-class activities and Twitter learning activities compared to the learning process that occurred entirely in the classroom.

Population and sample

During the 2016 academic year, the researchers completed a study of the blended learning process based on continuity between in-class learning and a Twitter learning community to achieve learning activities compared to in-class learning only. The study sample was composed of two groups of female students in the college of education at Taibah University. The first group was an experimental group and contained 37 students. With this first group, the researcher applied the learning process based on continuity between face-to-face learning and a Twitter learning community to discuss the course taught in person in the classroom. The second group was a control group containing 37 students where learning occurred entirely in the classroom. The use of a Twitter learning community in learning activities and discussions was new educational technology to the students.

Tools used for collecting data

The researcher adopted the post-achievement test and the questionnaire method to collect the data for this study.

- The first set of study data was based on the students' scores on the post-test taken after completing the experimental course.
- The second set of study data was based on the questionnaire method. The questionnaire was constructed using content validity, as established by a group of teachers at the university level. A first questionnaire was distributed in person to the experimental group to evaluate their attitudes toward the learning resource-based blended course. The control group questionnaire measured these students' attitudes toward the course conducted in the classroom without any use of a Twitter learning community.

The two questionnaires were distributed by email to a sample of teachers to measure their content validity.

Justification of measures

The researcher began the experiment by explaining the rules for using the Twitter learning community in the blended course (e.g., do not include publications that are unrelated to the course, connect to the group at the appropriate time, be respectful). The first measures in the present study were based on the scores obtained by students on the post-test.

- Students' cognitive performance was based on their scores on the post-test. This measure was used to accept or reject Hypothesis 1.
- The measurement of the attitudes of the experimental sample toward the learning process was based on the questionnaire method. This measure was used to accept or reject Hypothesis 2. A three-point Likert scale (agree, neutral, disagree) (Likert, 1932) was used for the questionnaire distributed to the control group.

The Statistical Package for Social Sciences (SPSS) software was used to analyze the study data.

Presentation of the learning environment

The research process in the learning environment of the control and experimental groups

The blended learning course was based on continuity between in-class learning and a learning community created by the researcher on Twitter to discuss on a weekly basis the learning resource taught in person. The blended course based on Twitter learning activities designed with activity theory was studied with the experimental group. The 100% in-class learning was studied with the control group.
Figure 2 shows the experimental processes of the experimental and control groups.

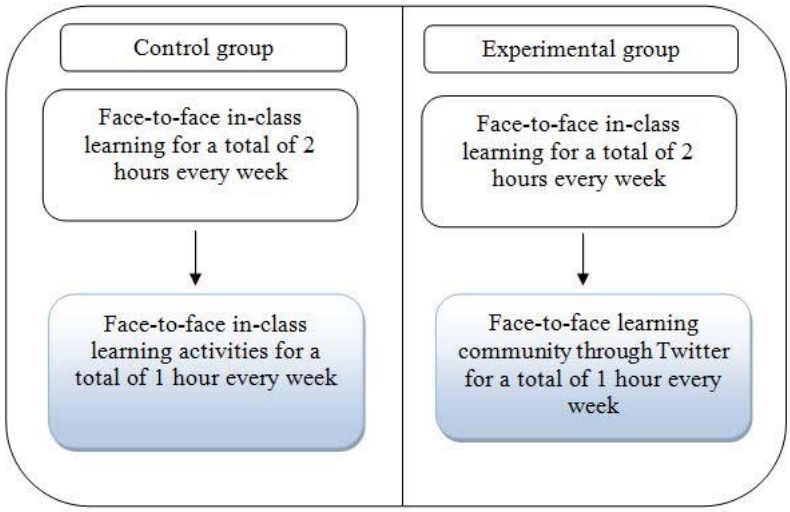


Figure 2. The experimental processes of the experimental and control groups

Print screens of the learning environment of the experimental group

Figure 3 shows the learning environment of the experimental group based on Twitter learning activities using activity theory.

Figure 3. The learning environment of the experimental group

Figure 4 shows collaborative activities of the experimental group based on activity theory and the online instructor guiding students in the learning process by answering questions and discussing the course taught in person in the classroom using the Twitter group.

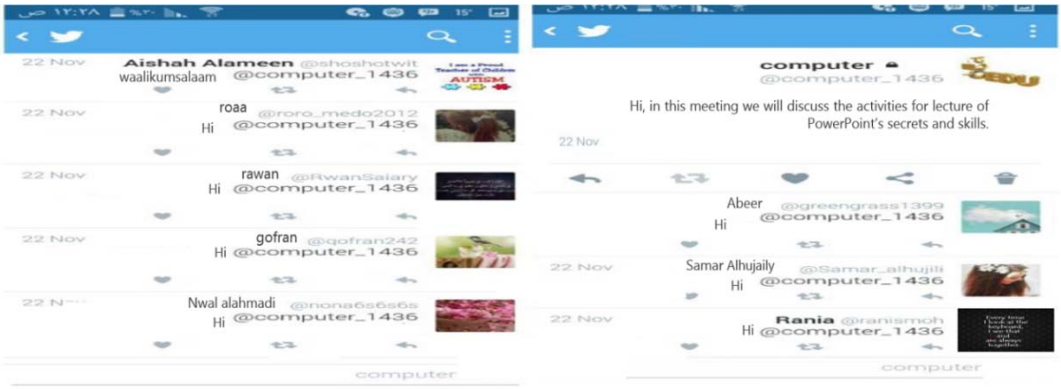


Figure 4. Print screen showing social interaction between students and their teacher in the learning community

FINDINGS

Test results

Table 2 shows the means of the experimental and control groups and the standard deviation scores derived from statistical tests.

Table 2. The means and standard deviation of the scores on the test achieved by the control and experimental groups after the experiment

Group Statistics			
Group	N	Mean	Std. Deviation
Control group	36	2.58	1.142
Experimental group	36	3.72	1.195
Total	72	3.18	1.260

Table 2 shows that the mean of the control group on the achievement test is 2.58 and that the mean of the experimental group is 3.72 (see Table 2). The results of comparison between the means of the experimental group and the control group show that the mean of the experimental group (3.79) is greater than the mean of the control group (2.58). In the next paragraph, the researcher will use the t-test to explain the difference between the values of the means of the two groups in Table 3 below.

Figure 5 is a graphic showing the difference between scores of the experimental and control groups with a clear visual representation of the information.

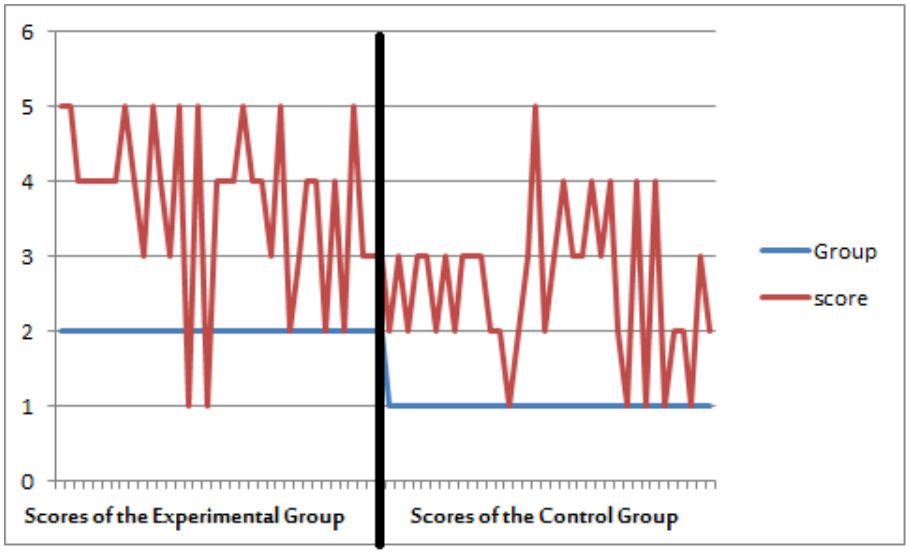


Figure 5. Graphic of the scores of the experimental and control groups

Table 3. Values of t-test obtained from independent-samples t-test used for the equality of means on the achievement test

		T	Df	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	*Upper*
Achievement test	Equal variances assumed	4.578	70	1.139	.249	1.635	.643
	Equal variances not assumed	4.578	65.93	1.139	.249	1.635	.643

The results of Table 3 help the researcher to validate or reject the first hypothesis, and we note the following:
Hypothesis 1: There is a significant difference between the control group and the experimental group at the 0.05 level regarding the achievement test scores of the students after the experiment.

The results of comparison between the means of the experimental group and the control group show that the mean of the experimental group (3.79) is greater than the mean of the control group (2.58) (see Table 2). Based on the results obtained in Table 3, the researcher used the t-test to explain the difference between the values of the means of the two groups. The value of the t-test of the table for 70 DF is 2.00, and the value of the t-test in Table 3 is 4.57, which is greater than the value of table, which is equal to 2.00. This result shows that Hypothesis 1 is accepted based on the rules of an independent-samples t-test. There is a significant difference between the control group and the experimental group at the 0.05 level regarding the achievement test scores of the students after the experiment.

Attitudes of the experimental and control groups toward the experimental learning processes
Table 4 shows the structure of the questionnaire designed by the researcher and distributed to both the control and experimental groups. The questionnaire described in Table 4 shows the variables, course, items and sample of the questionnaire of the attitudes of the experimental group in the course, Computers in Education. The questionnaire distributed to both the control and experimental groups was based on three levels (the technological level, the individual level, the social level).

Table 4. Variables, course, items and sample of the questionnaire of the attitudes of the experimental group in the course, Computers in Education

Items	Technological level
	The blended learning process (70% in person + 30% Twitter) is easy to use.
	The blended learning process (70% in person + 30% Twitter) is useful in my academic life.
	In the blended learning process, the Twitter interface and its components are easy for me to use.
	In the blended learning process, Twitter gives me the opportunity to communicate with the learning community.
	Individual level
	In the blended learning process, I believe that Twitter is an integrated system to share instructional information for transferring knowledge.
	In the blended learning process, Twitter makes it easy to tweet, share information, and discuss with others.
	In the blended learning process, Twitter gives me the opportunity to discuss learning resources and to interact with the learning community.

	In the blended learning process, Twitter responds to my special instructional needs.
	Social level
	In the educational groups, I believe that good social relations have a positive impact on the use of social networks.
	In the blended learning process, based on my experience in the use of Twitter in education, I believe that there is a high standard of social presence, and I believe that this application further strengthens social interaction in the educational group.
	In using Twitter, I believe that students not only share information but also create a favorable environment for social interaction.
	I take it that we are capable of participating in the educational group without the presence of the supervisor and that we respect the roles and laws with regard to using Twitter.
Course	Computers in education
The learning process	Blended learning process (70% in person + 30% Twitter)
Items	I agree, Neutral, I disagree
N	36

Table 5 describes the questionnaire distributed to the students in the control group to explore their attitudes toward the use of the learning process based on 100% face-to-face learning.

Table 5. Structure of the questionnaire of the attitudes of the control group in the course, Computers in Education.

Items	Technological level
	The blended learning process (70% in person + 30% discussion in person) is easy to use.
	The blended learning process (70% in person + 30% Twitter) is useful in my academic life.
	In the blended learning process (70% in person + 30% discussion in person), discussion in person is easy for me to use.
	In the blended learning process (70% in person + 30% discussion in person), discussion in person give me the opportunity to communicate with the learning community.
	Individual level
	In the blended learning process (70% in person + 30% discussion in person), I believe that discussion in person is suitable for sharing instructional information for transferring knowledge.
	In the blended learning process (70% in person + 30% discussion in person), it is easy to share information and to discuss with others.
	In the blended learning process (70% in person + 30% discussion in person), discussion in person give me the opportunity to discuss learning resources and to interact with the learning community.
	In the blended learning process (70% in person + 30% discussion in person), discussion in person responds to my special instructional needs.
	Social level
	In the blended learning process (70% in person + 30% discussion in person), in discussion in person, I believe that good social relations have a positive impact on the use of social networks.

	In the blended learning process (70% in person + 30% discussion in person), based on my experience in the use of discussion in person in education, I believe that there is a high standard of social presence, and I believe that this application further strengthens social interaction in the educational group.
	In the blended learning process (70% in person + 30% discussion in person), I believe that students not only share information but also create a favorable environment for social interaction.
	In the blended learning process (70% in person + 30% discussion in person), I take it that we are capable of participating in the educational group without the presence of the supervisor and that we respect the roles and the laws of communication.
Course	Computers in Education
The learning process	Blended learning process (70% in person + 30% discussion in person)
Items	I agree, Neutral, I disagree
N	36

Table 6 describes the means of the attitudes of the experimental and control groups.

Table 6. Means of the group statistics in the attitudes of the students of the control and experimental groups toward the learning process

	Group	*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*
Attitude	Control Group	36	22.06	5.143	.857
	Experimental Group	36	25.47	6.073	1.012

The results of the attitudes of the students of the control group and of the students of the experimental group toward the experimental learning processes show that the mean of the control group in the attitudes toward the learning process was 22.06. The mean of the attitudes of the experimental group toward the learning process based on continuity between in-class learning and Twitter learning activities was 25.47. The results show that the attitudes of the experimental group toward the learning processes are greater than those of the control group. To interpret the difference between the means, the researcher used the value of the t-test described in Table 7.

Table 7. T-test for the equality of means in the attitudes of students toward the experimental learning processes

		t	*Df*	*Mean Difference*	*Std. error Difference*	*95% Confidence Interval of the Difference*	
						Lower	*Upper*
Attitude	Equal variances assumed	2.576	70	3.471	1.326	6.062	.771
	Equal variances not assumed	2.576	68.152	3.471	1.326	6.063	.770

Hypothesis 2: There is a significant difference between the control group and the experimental group at the 5% level regarding the attitudes of students after the experimental period.The results of the t-test in Table 7 show that the t-test calculated for the equality of means is 2.54, which is greater than the t-test value of the table (2.00). This result shows that the hypothesis 2 is validated and that there is a significant difference between the control group and the experimental group at the 0.05 level regarding the attitudes of students after the experimental period. The difference between the attitudes of the experimental and control groups is in favor of the experimental group; the attitudes of the students in the experimental group toward using the blended course (70% face-to-face course work + 30% Twitter discussions) are more effective from the students' viewpoint.Figure 6 shows the attitudes of the students of the experimental and control groups based on the questionnaire method.

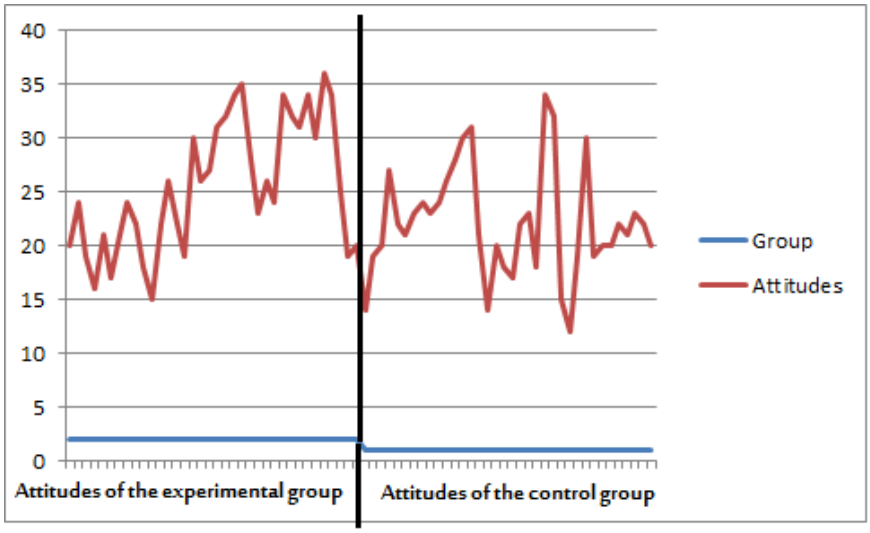


Figure 6. Results of the attitudes of the experimental and control groups

DISCUSSION OF RESULTS AND IMPLICATIONS OF THEORY

This study explores the effectiveness of a learning process based on continuity between 70% in-class learning and Twitter learning activities based on activity theory compared to a learning process based on continuity between 70% in-class learning and 30% in-class learning activities. The experimental results show that the blended learning process based on continuity between 70% in-class learning and 30% learning activities in a group to discuss the course taught in-class is more effective based on the scores of students and their attitudes toward this blended learning process.

The scores of the students of the experimental group after course completion show the cognitive performance of this sample through these students' achievement tests scores compared to the control group.

The results of the attitudinal data from the questionnaire distributed to the control and experimental groups show that the students of the experimental group are more motivated to adopt the learning process based on continuity between 70% in-class learning and 30% Twitter learning activities to discuss the course taught in person. The attitudinal data based on the questionnaire method show the following: The learning process of the experimental sample (70% in person + 30% discussion on Twitter) facilitates learning, it is useful in the academic life of students, and Twitter give students the opportunity to communicate with the learning community, students believe that Twitter is an integrated system for sharing instructional information for transferring knowledge.

The learning process based on continuity between 70% in-class learning and 30% Twitter learning activities helps the students of the experimental group effectively discuss the course content taught in-class and find answers regarding concepts that are unclear to them. Twitter learning activities can be powerful and effective tools for students to discuss unclear concepts of the Computers in Education course taught for graduate students.

In the domain of habits and usability, the researcher notes that Twitter is an easy-to-use interface for the students, many of whom are familiar with its use from everyday life. This study shows the effectiveness of social networking tools based on Twitter learning activities for sharing knowledge with a familiar tool for social interaction and the rapid sharing of ideas.

Some factors influence the students' motivation to interact with their peers online in course discussions through Twitter. Activity theory is a suitable theoretical framework through which to examine the factors influencing student participation in online discussion and social interaction. These factors are examined at the technological, individual and community levels. The factors of the technological level of activity theory are concerned with the habits and usability of students. The individual level concerns the affordances of the tool as perceived by the students. The social presence, sense of community, and community roles and rules operate on the community level.

In the next section on theoretical implications, the researcher concentrates on the factors that influence students' participation in and motivation to use Twitter learning activities in online discussions of the course taught in person to explain the difference in the achievement and attitudinal results in favor of the experimental group.

Technological level: usability and habits

The use of social networking tools has increased in facilitating online communication and the sharing of information and knowledge.

A usability study based on, first, the technological level (usability and habits) was conducted with students in a blended online course based on continuity between in-class learning and Twitter learning activities to determine the ease of use and satisfaction with the tool. First, students' habits and past experiences using Twitter and the app's perceived ease of use shape their attitudes toward this social networking technology.

Based on the results of the technological level, the blended learning process (70% in person + 30% Twitter learning activities) is easy to use. The results also show that the blended learning process is useful in the academic life of students. In the blended learning process, the Twitter interface and its components are easy for online students to use to pursue the learning activities of the Computers in Education online course. In the blended learning process, Twitter gives students opportunities to communicate with the learning community. It is clear from the results of the technological level that the experimental students' attitudes are positive and oriented toward the learning process integrating Twitter learning activities to discuss the course taught in person.

Twitter makes the social media site faster and easier to use. Many of the changes are fairly subtle, but they are aimed at creating a more uniform experience for users on different platforms. Twitter learning activities provide an easy-to-use interface coupled with a news feed feature, allowing online students to be quickly informed of updates within the community and to respond in a timely manner.

Technologically, Uzunboylu, Cavus and Ercag (2009) observed that mobile phones are small, portable and easy to use to connect to Twitter. Thus, students carry cell phones with them (Cavus & Ibrahim, 2009), and they use Twitter on their mobile phones. Many researchers have stated that the personal use of mobile phones has increased in recent years (Chen et al., 2000; Lundby, 2002; Roschelle & Pea, 2002).
In this respect, the findings of the present study confirm those of previous research projects that underscore the effectiveness of using Twitter in online instruction. In the study by Preston and his colleagues (2010), nearly 70% of the students stated that they could learn just as well from online lectures as they do from face-to-face lectures.

Individual level: perceptions

Students held different beliefs regarding the affordances of the two learning processes (that is, the objective that can be achieved by using the tools). The results of the individual level show that in the blended learning process, the students of the experimental group believe that Twitter is an integrated system for sharing instructional information for transferring knowledge. Additionally, in the blended learning process, on Twitter, it is easy to tweet, share information, and discuss with others. Twitter gives all students opportunities to discuss learning resources and to interact with the learning community. From experimental students of the sample, Twitter responds to their special instructional needs. The learning process of the control group based on 70% in-class learning and 70% in-class learning activities is a formal academic learning process that is mostly used to disseminate information rather than to enhance interaction. The students of the experimental group consider the learning process based on continuity between 70% in-class learning and 30% Twitter learning activities to be a valuable process for sharing knowledge to improve learning, exchange experiences and ideas, discuss various academic and social issues and seek help and support during their learning activities.

Community level: social presence, roles, and rules

The results of the community factors of activity theory show that in the educational group, the students of the experimental group believe that good social relations have a positive impact on the use of social networks. Based on students' experience in the use of Twitter in education, students believe that there is a high standard of social presence, and they believe that this application further strengthens social interaction in the educational group. The experimental students of the sample believe that they not only share information but also create a favorable environment for social interaction. The students of the experimental sample are capable of participating in the educational group without the presence of the supervisor, and they respect the roles and laws with regard to using Twitter. The presence of the teacher in the learning process is very helpful for students in constructing and sharing knowledge. A recent study by Lu and Churchill (2014) published in the Australian Journal of

Educational Technology showed that the social interaction in online learning was teacher-centered; the teacher played a central role in collaborative learning.

Strijbos and Fischer (2007) argued that research on collaborative learning, both face-to-face and computer-supported, has thrived in the past 10 years. They argued that the impact of social interaction on learning processes affects motivation and organizing collaboration and that it helps students construct and share knowledge.

Daugherty and Funke (1998) indicate that the issue of isolation is an important criterion for student satisfaction with web-based online courses. This feeling is often 'based on the physical separation between student and instructor' and is one that educators may be able to ameliorate but are unlikely to ever be able to successfully eradicate (Daugherty & Funke, 1998).

The results of this study based on the technological, individual and community factors of activity theory support a blended learning process based on continuity between 70% in-class learning and 30% online Twitter activities to discuss the course taught in person. The blended learning classroom gives opportunities to students to interact together and to share knowledge through the Twitter tool.

LIMITATIONS

The limitations of the present study are as follows:

- The present experimental study occurred in the context of a single course, Computers in Education, and should be replicated in other online disciplines.

CONCLUSION AND RECOMMENDATIONS

Social networking websites, such as Facebook, Myspace, and Twitter, have become an indispensable part of the lives of numerous students (junco, 2011). The number of Individuals using Twitter is increasing significantly each day. Twitter allows students to connect with each other and to create uninterrupted communication (Dunlap & Lowenthal, 2009). Elavsky, Mislan and Elavsky (2011) noted that the impact of Twitter on social interaction remains a fertile area for research.

There is a general growing research interest in collaborative learning activities and the sense of learning communities in the educational context, and affective benefits of collaboration and social interaction between online students have been found.The goal of this usability test was to assess user-friendliness, user satisfaction, and the perceptions of Twitter by first-time users. It is anticipated that through the subsequent and recurring use of Twitter, user performance will improve over the results found in this study. However, it should be noted that first impressions are vital to whether users will use the website in the future. Issues found within this usability test may discourage novice users from returning to Twitter and using its services.

Based on the results of this study, the researchers advise teachers and actors in online education to use Twitter to pursue learning activities in a blended course integrating both face-to-face learning and Twitter learning activities. Twitter proved to be an effective tool for educational development and for collaboration with students that can change the rules of the course and model good pedagogical responsiveness to the learning needs of students (Grosseck & Holotescu, 2008).

The benefits of Twitter in a blended lecture environment based on continuity between in-class learning and a Twitter group to discuss the course taught in person in the classroom are as follows:

- Twitter facilitates online discussion and social interaction in a blended course.
- Twitter is a tool that is easy to use for all students.
- Twitter is a useful tool for sharing knowledge.
- In a blended course, students can easily discuss different topics related to the course taught in the classroom.

REFERENCES

Barhoumi , C. (2016a). Studying the impact of blended learning that uses the online PBwiki guided by activity theory on LIS students' knowledge management. *Reference Services Review*, *44* (3), 341 - 361.

Barhoumi, C. (2016b). User acceptance of the e-information service as information resource: A new extension of the Technology Acceptance Model. *New Library World*. *117*(9 /10), 626-643.

Barhoumi, C., & Rossi, PG. (2013).The Effectiveness of the Instruction Oriented Hypertext Systems compared to Direct Instruction in e-learning Environment. *Contemporary Educational Technology*, *4* (4), 281-308.

Barhoumi, C., Amry, A. (2015). *Effective Flexible e-learning Resource Based Cognitive Flexibility Hypertext Theory from learners viewpoint*. 4th – International Conference For e-learning & Distance Education, Riyad, 2015, 1-11.

Buzzi, C., & Buzzi, M. (2011). *Web 2.0: Twitter and the blind*. In Proceedings of the 9th ACM SIGCHI Italian Chapter International Conference on Computer-Human Interaction: Facing Complexity, 1(1), 151-156.
Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, 13(1).
J. C., & P. R from http://jcmc.indiana.edu/vol13/issue1/boyd.ellison.html.
Casal, SS. (2017). Conversations, Debates and Affiliation Networks on Twitter. *TOJET: The Turkish Online Journal of Educational Technology* . 16 (3)., 47-59.
Cavus, N., & Ibrahim, D. (2009). M-learning: an experiment in using SMS to support learning new English language words. *British Journal of Educational Technology*, 40(1), 78-91.
Chen, F., Myers, B., & Yaron, D. (2000). *Using handheld devices for TESTs in classes*. Retrieved from http://www.cs.cmu.edu/pebbles/papers/CMU-CS-00-152.pdf .
Collins, M. (1999). I know my instructional technologies: It's these learners that perplex me! *The American Journal of Distance Education*, 13(1), 8 – 23. Geske, J. (1992). Overcoming the drawbacks of the large lecture class. College Teaching. 40(4), 151-154.
Dunlap,. Lowenthal. (2009). Tweeting the night away: using Twitter to enhance social presence. *Journal of Information Systems Education*, 20(2), 129-35
Daugherty, M., & Funke, B. (1998). University faculty and student perceptions of Web-based instruction. *Journal of Distance Education*, 11 (1), 21-39.
Elavsky, C. M., Mislan, C., & Elavsky, S. (2011).When talking less is more: exploring outcomes of Twitter usage in the large-lecture hall. *Learning, Media and Technology*, 36(3), 215-233.
Gardiner, L. (1994). Redesigning higher education: *Producing dramatic gains in student learning*. ASHE-ERIC Higher Education Report 7. Washington, DC.: George Washington University.
Gardiner, L. (1998). Why We Must Change: The research evidence. *Thought and Action*, 14(1), 71 – 88.
Grosseck, G, Holotescu, C. (2008). *Can we use Twitter for educational activities*. the fourth international conference e-learning and software for education, Bucharest April 17-18, 2008
Hussein, G., (2010). The Attitudes of Undergraduate Students Towards Motivation and Technology in a Foreign Language Classroom. *International Journal of Learning and Teaching*. 2(2).14-24.
Riel, M., and Polin, L. (2004). Online learning communities: Common ground and critical differences in designing technical environments. In Barab, S.A., Kling, R. and J.H. Gray (Eds.), Designing for virtual communities in the service of learning. *Cambridge, UK: Cambridge University Press*. 16-50
Roschelle, J., & Pea, R. (2002). *A walk on the WILD side: how wireless handhelds may change CSCL*. In Proceedings of computer support for collaborative learning. 1-10, Germany: Lawrence Erlbaum & Associates, Hillsdale, NJ.
Lenhart, A., & Fox, S. (2009, February 12). *Twitter and Status Updating*. Retrieved from http://www.pewinternet.org/Reports/2009/Twitter-and-status-updating.aspx.Like this? Share It:
Lenhart, A., & Madden, M. (2007). *Social networking websites and teens: an overview. (Pew Internet and American life project)*. Retrieved from http://www.pewinternet.org/PPF/r/198/report_display.asp
Preston, G., Phillips, R., Gosper, M., McNeill, M., Woo, K., & Green, D. (2010). Web-based lecture technologies: Highlighting the changing nature of teaching and learning. *Australasian Journal of Educational Technology*, 26(6), 717-728.

The Studies on Educational Digital Games Regarding Children: A New Word Analysis Approach

Serdar ÇİFTCİ
Adnan Menderes University, Faculty of Education, Computer Education and Insructional Technology, Turkey
serdar.ciftci@adu.edu.tr.

ABSTRACT
The aim of this research is to investigate, through data analysis, the studies conducted on the use of educational digital games by children. As part of this study, a search of the Science Direct, Web of Science, and ERIC databases was performed to identify the studies on this topic published within the last decade (2007 and 2017). From this database search, a total of 403 studies related to educational science and including the keywords "child" and "game" were retrieved. Proceedings and book reviews were omitted from the scope of the study. The articles were downloaded in PDF document format and then extracted as text to the MySQL database through the Python programming language. The articles that were not related to digital games, that used physical games, or that were inconsistent with the purposes of this study in terms of target group were excluded. After the elimination process, a total of 103 articles constituted the sample of the study. In the data analysis, the most repeated words, word pairs, and abbreviations were tallied using Python programming language. In addition, the keywords *qualitative*, *quantitative*, *experimental study*, and *control group*, which were preselected by the researcher, were searched and recorded. The results revealed that different descriptions were applied for the concept of educational digital games (e.g., digital games, computer games, game-based learning, video games, and serious games). A prodigious number of studies were listed in the search of the current databases, a situation which can result in significant time loss for researchers.

Keywords: educational digital games, child, data mining, big data analysis

INTRODUCTION
The use of games in education has a long history. The latest type of games, that is, digital games, have gained a significant place in today's society as a result of the growing influence the internet has had in the lives of people. Looking at the facts that individuals, who are accustomed to playing games, play games for approximately 10 thousand hours before they reach the age of 21 and that this period of time partly coincides with the time spent in education from primary to elementary school, provides significant insight about the place of digital games in individuals' lives (McGonigal, 2011).

Since being first designed, computer games have been considered as educational tools (Egenfeldt-Nielsen, 2011). In these games, players encounter cases requiring short- and long-term decision-making skills, and they need to plan problem-solving strategies for complex missions or nested sub-missions (Johnson, 2006). Computer games can serve as an effective learning tool by facilitating opportunities for interaction and learning through practice (Kirriemuir & McFarlane, 2004). McFarlane, Sparrowhawk and Heald (2002) maintained that playing games is related to the skills of decision making, design, strategy, collaboration, and problem-solving. Playing games is also thought to develop cognitive skills (Robertson & Howells, 2008), in addition to the aforementioned skills (Ebner & Holzinger, 2007).

Digital games for learning are widely used (Martín-SanJosé, Juan, Gil-Gómez & Rando, 2014). O'Neil, Wainess and Baker (2005) described the learning potential through computer games as "striking". The relevant literature has revealed that children use computers every day to play games (Mumtaz, 2001), that learning through games is motivating (Virvou, Katsionis & Manos, 2005) and supports collaborative learning (Hoda, Henderson, Lee, Beh & Greenwood, 2014), that computer game playing improves mental rotation abilities in children between the ages of 8 and 9 (Lisi & Wolford, 2002), that playing games improves their thinking skills (Furió, González-Gancedo, Juan, Seguí & Costa, 2013), and that games can stimulate children's attention and memory as well as support their language development (Garaigordobil, 2005). The literature generally shows that games have a positive influence on learning. Lee, Wong and Fung (2010) pointed out a gap in the literature on how, precisely, computer games facilitate learning.

The amount of data stored in databases has reached an incredible size today. Investigating this data and transforming it into meaningful findings and information attracts the attention of researchers, with the data mining concept operating at the forefront of this matter. Data mining or knowledge discovery in databases is the automatic extraction of implicit and interesting patterns from large data collections (Klösgen & Zytkow, 2002). In other words, data mining is producing useful data by analyzing big data. Data mining is a multi-disciplinary field involving various computer paradigms. Some of the most useful data mining tasks and methods are statistics, visualization, clustering, classification and association rule mining (Romero, Ventura & García, 2008). Both specially designed and general tools are available for data mining. There also exist data mining tools for educational purposes (Romero et al., 2008). Text mining, one of the concepts closely related to data mining, deals with the investigation of structured or semi-structured full-text documents (Feldman & Sanger, 2006).

Another concept related to data analysis is "big data". More recently, big data and big data analytics have been used to describe the datasets and analytical techniques in applications that are very large (from terabytes to exabytes) and complex (from sensor to social media data), requiring advanced and unique data storage, management, analysis, and visualization technologies (Chen, Chiang & Storey, 2012). Big data is currently a major issue of interest for the business, government and healthcare sectors due to the growing abundance of data collected and stored in these environments (Daniel, 2015). Baker & Inventado (2013) indicated that predictive models used in the educational data mining context are intended to reduce, through inference, the data down to a single factor (the predicted variable, similar to dependent variables in traditional statistical analysis) from some combination of other aspects of the data (predictor variables, similar to independent variables in traditional statistical analysis). Recent studies have been conducted in the field of education using the data analysis concepts mentioned above (e.g., Mitchell, Keast, Panizzon & Mitchell, 2017; Prinsloo, Archer, Barnes, Chetty & van Zyl, 2015; Selwyn, 2015; Thompson, 2017). The University of Washington in Seattle and Northwestern University in Chicago, for example, have each announced the development of new educational programs focused on introducing how big data works (Horn, 2016).

Bibliometric analysis is another concept within the field of data. Leeuwen (2004) described bibliometric analysis as "the field of science that deals with the development and application of quantitative measures and indicators for sciences and technology, based on bibliographic information" (p. 374). With bibliometric methods, qualitative data can be obtained from the existing data of publications. However, this approach has been heavily criticized because it mostly deals with qualitative presentations (Hung, 2012). Therefore, there have been efforts to come up with different approaches in the field. Attempts have been made to achieve useful analysis by classifying the data obtained or by visualizing the data through relational network maps.

Data analysis techniques to sort through big data, such as bibliometry and data mining, attract attention on account of the fact that databases can store large amounts of data, with computer-assisted analysis able to be applied on this data. The data collection procedures of these techniques differ from the classical statistical techniques. The interpretation of the data is similar to document analysis. The data collection tools generally used in classical methods, such as scales, questionnaires, and interviews, are not used in the new data analysis techniques. The ultimate aim is to generate useful meanings from texts and datasets. This study aims to perform a similar data analysis by applying a new technique that involves counting words and word pairs. To carry out this aim, the studies on educational digital games for children (EDGC) were examined. The following research questions were developed for the study.

1. How are the studies distributed according to publication year?
2. How are the studies distributed according to journals in which they are published?
3. What are the findings according to the data analysis based on the most frequently used words?
4. What are the findings according to the data analysis based on the most frequently used word pairs?
5. What are the findings according to the data analysis based on the most frequently used abbreviations?
6. What are the findings regarding the data analysis used in this study?

Within the scope of these research questions, a trend analysis of the studies on EDGC was conducted and the effectiveness of the performed method was investigated.

METHODOLOGY

Data collection and sample selection

Science Direct, Web of Science, and ERIC databases were searched to collect data. These databases were preferred for the magnitude of their data. The articles published in these databases within the last decade (2007-2017) were included in the study. A total of 403 studies related to educational science and including the keywords "child" and "game" were retrieved by the end of the database search in July 2017. The studies that

included both the keywords “game” and “child” in their heading, abstract, or full-text were listed. Proceedings and book reviews were left out of the scope of the search to ensure the quality of the downloaded studies. Target audience constituted one of the exclusion criteria; that is, the studies with target audiences of kindergarten, early school, nursery, or toddler were excluded. Only those articles cited in the relevant publication search indexes were included. The language criterion for the chosen articles was set to English. The use of a single language in data mining helps to provide a more effective analysis. After the elimination process, a total of 103 articles constituted the sample of the study. Eliminations were made based on the intent to frame the study according to a particular theme and for the purpose of excluding the studies that were irrelevant in terms of the aim and sample of this study.

Data analysis

The articles were downloaded in the PDF document format. Only those publications related to educational digital games were included in the study. Some studies regarded games as leisure or physical games, and although such studies were listed in the dataset, they were nonetheless excluded by the researcher.

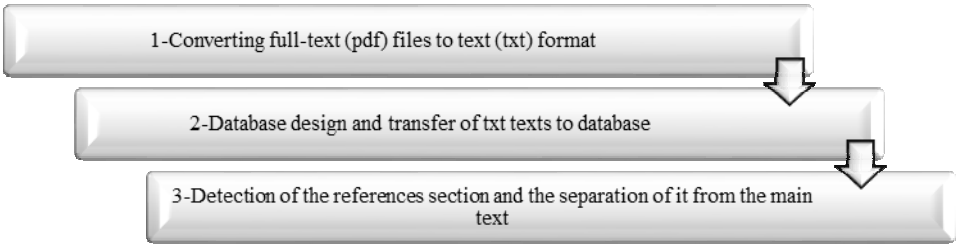


Figure 1– The transformation process of the articles to data

The transformation process of the articles to data is depicted in Figure 1. The full-text PDF documents were converted to text using scripts prepared through the Python programming language and stored in the MySQL database. The stored data were grouped under the following headings. These headings are listed under ‘Column names’ in the paper table below.

Table 1 – The column names of the paper table

Column names	Data type	Explanation
`id`	auto_increment, unique	Identification of number set for each publication
`fulltext`,	text	Full text of the publication
`eligible`	Boolean (True/False)	The data regarding the elimination result
`filename`	varchar	The physical name of PDF file
`year`	varchar	Publication year
`game count`	int	The number of the word Game
`child`	int	The number of the word Child
`primary`	int	The number of the word Primary
`student`	int	The number of the word Student
`article`	varchar	The name of the journal
`title`	varchar	The publication heading
`authors`	varchar	Author names
`references`,	text	References

The simplification of the full-text articles that were transferred to the database was carried out in the following stages:

1. *Separation of the reference section:* The references section of the full-text was transferred as a single piece to another area of the table using the prepared scripts. Therefore, the words in the references section were excluded in the word count.
2. *Word count and the recording of them in tables*: All of the words in each article were counted using the prepared Python scripts. The words counted were recorded on a separate table under the headings of *word_name, count* and *paper_id.* A total of 155,416 records were retrieved by the end of the counting operation. During the counting operations, the most frequently used words in English that did not yield meaningful results for the analysis (e.g., "the", "and", "are", "for", "was", "not", "from", "have", "only", "they", "such", "all", "our", "then", "thus", "once", "that", "with", "them", "also", "one", "two", "same", "more", "can", "used", "because", "there", "what", "more") were excluded.
3. *Counting the predefined data:* The frequency of the words in the text that had been purposefully determined by the researcher was calculated. These words were selected on the basis of them being

amenable to a deep investigation of words/word pairs thought to be useful in the analysis. These words/word pairs were: "questionnaire", "augmented reality", "learning outcome", "serious game", "thematic analysis", "experimental group", "quasi-experimental", "scale", "design recommendation", "theory driven", "data driven", "case study", "interview ", "explorative design", "log ", "participatory design", "pre-test", "post-test", "pretest", "posttest", "control group", "k-12", "qualitative", "quantitative", "primary school", "elementary school", and "junior school".

4. *Counting word pairs and recording them on a separate table:* All the operations performed in the 2nd step were repeated in counting word pairs. A total of 78,066 records were retrieved by the end of the counting activities.
5. *Counting abbreviations*: The abbreviations used in the publications were counted because abbreviations were given in parenthesis for some concepts, and these abbreviations were used in the text. For example, “serious games” is abbreviated as “SG” and the longer version is not used anymore. Making a count of the abbreviations was considered necessary to guarantee the accuracy of the numbers. A total of 1,315 abbreviations were identified and recorded in the database table.

The data stored in the database were listed through SQL, and the words were counted using the prepared scripts.

FINDINGS

Publication time trends

The number of studies published between the years 2007-2017 is depicted in graph form in Figure 2. Looking at the trend in terms of publication year, it can be seen that there was a significant dip in 2009 and then an increasing tendency as of 2010, followed by a pronounced decreasing trend after an increase in 2015.

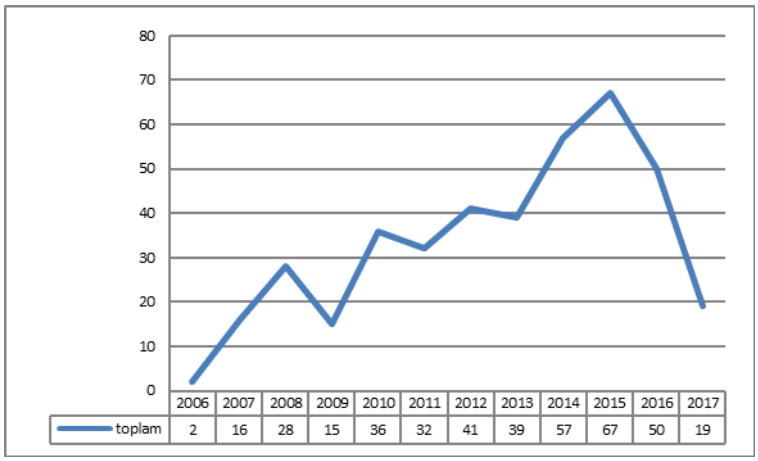


Figure 2 - Publication trends from 2007 to 2017

Prolific journals

Examining the publication numbers presented in Table 2 below, the *British Journal of Educational Technology* and *Computer & Education* published the most in the field. The journals that were at the forefront, quantitatively, in the dataset fall under the type that publishes educational studies.

Table 2 – The article distribution according to journals

Journal	n	%
British Journal of Educational Technology	33	32.04
Computers & Education	25	24.27
International Journal of Child-Computer Interaction	9	8.74
Computers in Human Behavior	5	4.85
Developmental Review	2	1.94
Entertainment Computing	2	1.94
Other (journals with less than two articles)	27	26.21
Total	**103**	

Findings regarding the game used in the studies

The following table (Table 3) was created considering the word pairs that were most frequently used with the word "game. Video games, computer games, educational games and serious games were among the most frequently used word pairs. The word pairs were grouped as general concept, game-related concept, game type, behavior, and classification.

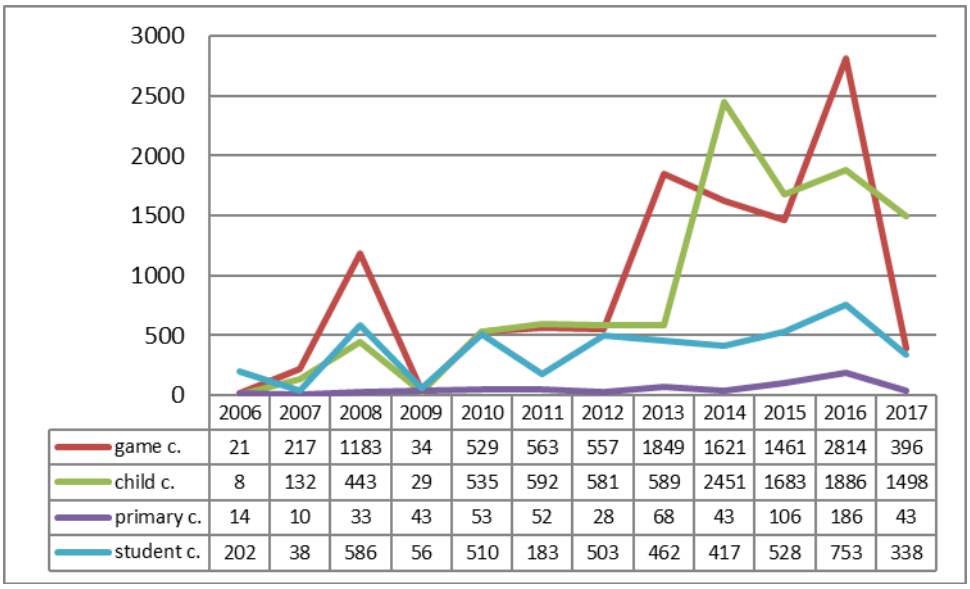
Table 3 – Word pairs regarding the game concept

Word pair	General concept	Game-related concept	Game type	Behavior	Classification	n
video games	✓		✓		✓	71
computer games	✓				✓	53
educational games	✓				✓	46
serious games	✓		✓			44
game design		✓				37
game play				✓		37
game-based learning	✓					34
digital games	✓					25
simulation games	✓		✓		✓	12
game environment		✓				9
game consoles		✓				8
game world		✓				8
game development		✓				7
board game	✓		✓		✓	6
game mechanics		✓				6
online game	✓				✓	6
teaching games	✓				✓	6
game elements		✓				5
games design		✓				5
electronic games	✓					4
game designers		✓				4
game levels		✓				4
reality games			✓			4
scenario-based games	✓		✓			4
commercial games	✓		✓			3
commercial off the shelf (cots) games	✓		✓			3
edutainment games	✓				✓	3
game characters		✓				3
game features		✓				3
game performance				✓		3
game scenario		✓				3
mobile games	✓		✓			3
olympic games			✓			3
game components		✓				2
game engine		✓				2
game experience				✓		2
game literacy		✓				2
game logic		✓				2
game object		✓				2
game preferences				✓		2
iphone game			✓		✓	2

negotiation game	✓	2
notable games	✓	2
persuasive games	✓	2
traditional games	✓	2
training game	✓	2

Findings according to the word count

The words *game*, *child*, *primary*, and *student* were counted in the dataset within the scope of the study in order to secure more in-depth analysis results. The distributions of word count according to publication year are presented in Figure 3 below. The results revealed that the words *game* and *child* were frequently used. The word *student* was counted because the studies that were conducted with students were intended to be included in this study. The word counting operation highlighted the high-use frequency of the word *student*. The word *primary* was therefore also included in the study, considering the word pairs *primary student* or *primary school*. These word pairs were found to be used at varying degrees of frequency according to publication year.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
game c.	21	217	1183	34	529	563	557	1849	1621	1461	2814	396
child c.	8	132	443	29	535	592	581	589	2451	1683	1886	1498
primary c.	14	10	33	43	53	52	28	68	43	106	186	43
student c.	202	38	586	56	510	183	503	462	417	528	753	338

Figure 3- Selected word counts

There was a steady increase in the use of the words *game* and *child* together in studies from 2008, 2014, and 2016. Moreover, there was an increasing tendency by studies to use the words *game*, *child*, and *student* together in 2008 and 2016.

The most frequently used words are presented in Table 4, where it can be seen that game, child, learning, study, and students were among the words most often used. The table also shows a noteworthy use of terminology specific to academic language (e.g., research, design, results, data, participants, significant).

Table 4 –The most frequently used words in the studies

Word	n	Word	n
game	8370	results	1191
child	8072	different	1166
learning	5890	social	1042
study	3584	information	973
students	2884	data	955
group	2323	development	840
educational	2285	digital	826
computer	2229	level	811
research	2011	content	795
play	1937	experience	794
education	1918	participants	759
teachers	1909	control	747
school	1704	scores	746
technology	1587	age	744

design	1403	found	731
time	1337	test	726
knowledge	1336	questions	725
skills	1299	video	724
activities	1209	significant	719

Computer game, educational technology, video game, educational research, educational game, and young children were among the most frequently used words. As seen in Table 5, there was a significant use of terminology specific to academic language (e.g., significant differences, control group, experimental group, data collection). Augmented reality and serious games express a specific kind of game or technology. In addition, these concepts are popular among the studies conducted in the field and give clues about the target audience, educational level, educational environment, and scientific research method of the relevant studies.

Table 5 – The most frequently used word pairs in the studies

Word pair	Count	Word pair	Count
computer game	492	primary school	117
educational technology	443	augmented reality	115
video game	368	game play	111
educational research	282	digital games	106
educational game	268	child-computer interaction	105
young children	265	special education	101
research association	264	active gaming	97
game design	253	game-based learning	97
control group	251	serious games	97
virtual world	231	working memory	96
learning environment	228	multiplicative reasoning	90
learning outcomes	194	interactive music	89
social skills	167	digital media	81
experimental group	145	educational software	81
significant differences	145	science learning	81
learning activities	139	educational communications	80
mobile learning	126	technology agency	80
television viewing	126	data collection	77
educational computer	119	elementary school	77

Another word group investigated within the scope of the study was abbreviations. Some researchers in their studies prefer to use abbreviations instead of long noun phrases. However, the results showed that there was not a remarkably high use of abbreviations in the studies.

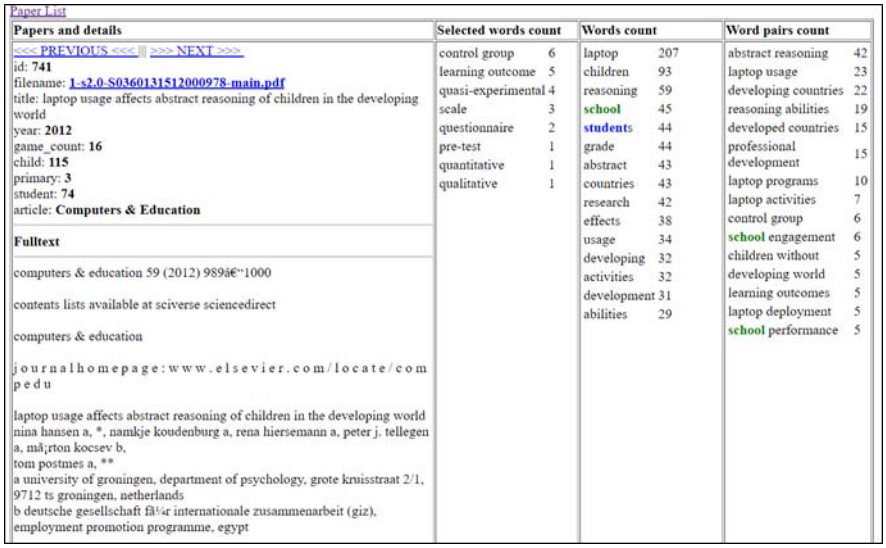
Table 6 – The most frequently used abbreviations in the studies

Abbr.	Word	Count	Abbr.	Word	count
(ict)	information and communication technology	16	(awma)	automated working memory assessment	4
(pd)	participatory design	14	(ddr)	dance dance revolution	4
(ar)	augmented reality	10	(er)	emotional regulation	4
(ple)	playful learning environment	10	(hsct)	hematopoietic stem cell transplantation	4
(cpl)	creative and playful learning	8	(it)	information technology	4
(dans)	data archiving and networked services	8	(iq)	intelligence quotient	4
(ece)	early childhood education	8	(its)	intelligent tutoring system	4
(cai)	computer assisted intervention	7	(ig)	inventing games	4
(elis)	everyday life information seeking	6	(dma)	degree of musical activity	4
(hme)	home musical environment	6	(zpd)	zone of proximal development	4
(ite)	initial teacher education	6	(pta)	proxy technology assessment	4
(par)	participatory action research	6	(nui)	natural user interfaces	4
(qa)	quest atlantis	6	(spp)	schome park programme	4
(cci)	child computer interaction	5	(sdk)	software development kit	4
(pnab)	phonetic alphabet	4	(tgfu)	teaching games for understanding	4
(tdm)	technology and digital media	4	(ts)	transactional support	4
(au)	anxiety and uncertainty	4	(uiui)	unsafe internet usage index	4

(av)	augmented virtuality	4	(vle)	virtual learning environment	4

Findings regarding the analysis method

This study aimed to obtain useful findings by applying a word analysis approach in investigating studies. The most frequently used words, word pairs, and abbreviations found within the studies examined were counted within the scope of this study. In addition, the presence and frequency of certain predetermined words or word pairs in the studies were investigated. To serve as an example, the details and analysis data of a publication by Hansen et al. (2012) are presented in Figure 4:



Paper List

Papers and details	Selected words count		Words count		Word pairs count	
<<< PREVIOUS <<< || >>> NEXT >>> id: **741** filename: 1-s2.0-S0360131512000978-main.pdf title: laptop usage affects abstract reasoning of children in the developing world year: **2012** game_count: **16** child: **115** primary: **3** student: **74** article: **Computers & Education** **Fulltext** computers & education 59 (2012) 989â€“1000 contents lists available at sciverse sciencedirect computers & education journalhomepage:www.elsevier.com/locate/compedu laptop usage affects abstract reasoning of children in the developing world nina hansen a, *, namkje koudenburg a, rena hiersemann a, peter j. tellegen a, mã¡rton kocsev b, tom postmes a, ** a university of groningen, department of psychology, grote kruisstraat 2/1, 9712 ts groningen, netherlands b deutsche gesellschaft fã¼r internationale zusammenarbeit (giz), employment promotion programme, egypt	control group	6	laptop	207	abstract reasoning	42
	learning outcome	5	children	93	laptop usage	23
	quasi-experimental	4	reasoning	59	developing countries	22
	scale	3	school	45	reasoning abilities	19
	questionnaire	2	students	44	developed countries	15
	pre-test	1	grade	44	professional development	15
	quantitative	1	abstract	43	laptop programs	10
	qualitative	1	countries	43	laptop activities	7
			research	42	control group	6
			effects	38	school engagement	6
			usage	34	children without	5
			developing	32	developing world	5
			activities	32	learning outcomes	5
			development	31	laptop deployment	5
			abilities	29	school performance	5

Figure 4 –Screenshot of publication details and analysis data

Papers and details: Figure 4 is a screenshot of the webpage designed by the researcher. In the furthest left column, the data related to title, year, game_count, child (word count), primary (word count), student (word count), article and full-text are presented.

Selected words count: Under this column, the word count, in the article, of the words predefined by the researcher is presented. For the model applied in the study conducted by Hansen et al., the words/word pairs *control group* (n=6), *learning outcome* (n=5), *quasi-experimental* (n=4), *scale* (n=3), *questionnaire* (n=2), *pre-test* (n=1), *quantitative* (n=1), and *qualitative* (n=1) were used. Considering the frequency of these uses, it can be inferred that among the studies investigated, some used a control group, some reported results or information derived from learning outcomes, some were designed as a quasi-experimental study, and some used a scale and/or questionnaire.

Words count: The top 5 most frequently used words in the sample study were: laptop (n=129), children (n=93), laptops (n=78), reasoning (n=59), school (n=45), and students (n=44). These words provide clues about the content. In this study conducted by Hensen et al. (2012), the sample model was structured around the laptop concept, as indicated by its title, which highlighted laptop use.

Word pairs count: The top 5 most frequently used word pairs in the sample study were: abstract reasoning (n=42), laptop usage (n=23), developing countries (n=22), reasoning abilities (n=19), developed countries (n=15), and professional development (n=15). Results similar to those shown in the previous paragraph were obtained in this part as well, as indicated by the most frequently used word pairs *abstract reasoning* (n=42) and *laptop usage* (n=23). Another concept that was often mentioned was *developing countries* (n=22).

CONCLUSIONS

Considering the trend analysis of the publications according to years, there was a decrease in the number of the publications towards 2009. A similar tendency was also determined towards 2016 and 2017. Although the studies on EDGC did not appear to diminish in popularity in the short term, there was an emergent decrease underway in the studies. However, it should be noted that the year 2017 has not yet been completed at the time the literature review for this study was carried out. Therefore, it will become evident in the coming years whether the trend will increase or decrease. In examining the journals in which the studies were published, the British Journal of Educational Technology and Computers & Education were found to be the most prominent,

followed by the Journal of Child-Computer Interaction and Computers in Human Behavior.
There was a diversity of words or word pairs mentioned together with the game concept. The same meaning is attached to some of the concepts (teaching game, educational game, edutainment game etc.). Although today, smartphones and tablets have taken the place of computers, the concept of video games and computer games remain popular. These definitions/classifications are made according to the platform in which they operate. One of the concepts frequently used under this heading is iPhone games. The concepts of educational games or edutainment games indicate games related to learning. It is recommended that future studies on this topic focus on developing a common concept or unity of terminology, or seek to determine whether these terms are used accurately.

In Table 4, which presents the most frequently used word pairs, the concepts of serious games, simulation games, and reality games are shown to be prominent concepts.
The most frequently used words and word pairs offer an important clue about the content of the studies. Considering the publication-based reviews, the titles of the publications clearly coincide with the frequencies. From this, it can be inferred that such studies were accurately titled, as the titles of studies are an important indicator of their content. However, with that said, it may not always be possible to include all relevant concepts in the title.

A new method was applied in the current study. The literature from the last decade on learning through EDGC was reviewed and analyses were conducted based on big data analysis. Advanced technology has led to there being an excessive amount of data in the hands of humankind. Studies have been conducted to make inferences from this large amount of data. This situation also holds true in the field of education. This study was conducted to serve as an example of the use of big data analysis in education.

The studies that have been conducted in this field have tended to apply meta-analysis, document analysis, trend analysis, and bibliometric analysis. While the method used in this study does have similarities to these said methods, there are nonetheless major differences. To date, analyses have been based on the interpretation of quantitative data. In such studies, analyses of the change in the trend have been performed according to year, the number of authors in publications, citations, and common citations. Although the search of the databases listed a superabundance of studies, useful clues about the content of the publications can be obtained by examining the frequently used words and word pairs. Approximately 1,500 publications were downloaded within the scope of the study. After the elimination process, the number was initially decreased to 403 before being further reduced to 103 at the final stage. This number could even be further decreased if this dataset on EDGC were to be subjected to a more specific filtration. The increase in the number of publications and thus the increase in the dataset makes it more difficult for researchers to handle the data. It is here that more detailed and intelligent search systems are needed to support researchers. Methods capable of providing better support to researchers can be discovered through the development of higher-order software. For example, inferences about samples, method, and technology can be analyzed through software by using word analysis/data analysis, and the results can be shared with researchers.

Abbreviations are extensively used in studies. However, the analysis regarding abbreviation use did not yield meaningful findings. Abbreviation use can make it possible for readers to become informed about the concept related to the abbreviated term(s) and to get familiar with the abbreviation itself. It was found, in this study's analysis, that after using abbreviations, the long version continued to be used in some studies.

Considering the word pairs that included the word *parental* in the dataset, the word pairs of parental supervision, parental control, parental support, parental education, parental involvement, parental rating, and parental scaffolding were listed. This result served to indicate that when purposefully selected special words are searched in the dataset, the related word pairs are listed. These searches revealed records that yield meaningful results. According to these findings, the word-based analysis can provide useful results. It is not yet evident what kind of findings can be obtained by performing investigations through data analysis. Different findings can be reached as data become more enlarged or new data analyses are attempted. More studies need to be conducted on this topic or similar such topics.

The analyses revealed that some words and word pairs are important parameters despite not being frequently used in the studies. For example, the fact that a study used qualitative data analysis was an important indicator for this study. An analysis may reveal that the word *qualitative* is not frequently used. However, this does not mean that using qualitative data analysis is not an important parameter in data analysis results. A greater amount of theoretical and practical knowledge is needed in order to better understand how to perform data analysis techniques in this field.

REFERENCES

Ai-Lim Lee, E., Wong, K. W., & Fung, C. C. (2010). How does desktop virtual reality enhance learning outcomes? A structural equation modeling approach. *Computers & Education*, *55*(4), 1424–1442. https://doi.org/10.1016/j.compedu.2010.06.006

Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In *Learning analytics* (pp. 61-75). Springer New York.

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly*, *36*(4).

Daniel, B. (2015). Big Data and analytics in higher education: Opportunities and challenges. *British Journal of Educational Technology*, *46*(5), 904–920. https://doi.org/10.1111/bjet.12230

Ebner, M., & Holzinger, A. (2007). Successful implementation of user-centered game based learning in higher education: An example from civil engineering. *Computers & education*, *49*(3), 873–890.

Egenfeldt-Nielsen, S. (2011). *Beyond edutainment: Exploring the educational potential of computer games*. Lulu. com.

Feldman, R., & Sanger, J. (2006). Information extraction. *The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data*, 94-130.

Furió, D., González-Gancedo, S., Juan, M.-C., Seguí, I., & Costa, M. (2013). The effects of the size and weight of a mobile device on an educational game. *Computers & Education*, *64* (Supplement C), 24–41. https://doi.org/10.1016/j.compedu.2012.12.015

Garaigordobil, M. (2005). Importancia del juego infantil en el desarrollo humano. *Aula de infantil*, 25, 37–43.

Hansen, N., Koudenburg, N., Hiersemann, R., Tellegen, P. J., Kocsev, M., & Postmes, T. (2012). Laptop usage affects abstract reasoning of children in the developing world. *Computers & Education*, *59*(3), 989–1000. https://doi.org/10.1016/j.compedu.2012.04.013

Hoda, R., Henderson, A., Lee, S., Beh, B., & Greenwood, J. (2014). Aligning technological and pedagogical considerations: Harnessing touch-technology to enhance opportunities for collaborative gameplay and reciprocal teaching in NZ early education. *International Journal of Child-Computer Interaction*, *2*(1), 48–59. https://doi.org/10.1016/j.ijcci.2014.06.001

Horn, J. D. V. (2016). Opinion: Big data biomedicine offers big higher education opportunities. *Proceedings of the National Academy of Sciences*, *113*(23), 6322–6324. https://doi.org/10.1073/pnas.1607582113

Hung, J. (2012). Trends of e-learning research from 2000 to 2008: Use of text mining and bibliometrics. *British Journal of Educational Technology*, *43*(1), 5–16. https://doi.org/10.1111/j.1467-8535.2010.01144.x

Johnson, S. (2006). *Everything bad is good for you: How today's popular culture is actually making us smarter*. Penguin.

Kirriemuir, J., & McFarlane, A. (2004). Literature review in games and learning.

Klösgen, W., & Zytkow, J. M. (2002). Knowledge discovery in databases: the purpose, necessity, and challenges. Içinde *Handbook of data mining and knowledge discovery* (ss. 1–9). Oxford University Press, Inc.

Leeuwen, T. Van. (2004). Descriptive Versus Evaluative Bibliometrics. Içinde *Handbook of Quantitative Science and Technology Research* (ss. 373–388). Springer, Dordrecht. https://doi.org/10.1007/1-4020-2755-9_17

Lisi, R. D., & Wolford, J. L. (2002). Improving Children's Mental Rotation Accuracy With Computer Game Playing. *The Journal of Genetic Psychology*, *163*(3), 272–282. https://doi.org/10.1080/00221320209598683

Martín-SanJosé, J.-F., Juan, M.-C., Gil-Gómez, J.-A., & Rando, N. (2014). Flexible learning itinerary vs. linear learning itinerary. *Science of Computer Programming*, *88*(Supplement C), 3–21. https://doi.org/10.1016/j.scico.2013.12.009

McFarlane, A., Sparrowhawk, A., & Heald, Y. (2002). *Report on the educational use of games*. TEEM (Teachers evaluating educational multimedia), Cambridge.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. Penguin.

Mitchell, I., Keast, S., Panizzon, D., & Mitchell, J. (2017). Using "big ideas" to enhance teaching and student learning. *Teachers and Teaching*, *23*(5), 596–610. https://doi.org/10.1080/13540602.2016.1218328

Mumtaz, S. (2001). Children's enjoyment and perception of computer use in the home and the school. *Computers & Education*, *36*(4), 347–362. https://doi.org/10.1016/S0360-1315(01)00023-9

O'Neil, H. F., Wainess, R., & Baker, E. L. (2005). Classification of learning outcomes: evidence from the computer games literature. *The Curriculum Journal*, *16*(4), 455–474. https://doi.org/10.1080/09585170500384529

Prinsloo, P., Archer, E., Barnes, G., Chetty, Y., & van Zyl, D. (2015). Big(ger) Data as Better Data in Open Distance Learning. *International Review of Research in Open and Distributed Learning*, *16*(1), 284–306.

Robertson, J., & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers*

& Education, *50*(2), 559–578.
Romero, C., Ventura, S., & García, E. (2008). Data mining in course management systems: Moodle case study and tutorial. *Computers & Education*, *51*(1), 368–384. https://doi.org/10.1016/j.compedu.2007.05.016
Selwyn, N. (2015). Data entry: towards the critical study of digital data and education. *Learning Media and Technology*, *40*(1), 64–82. https://doi.org/10.1080/17439884.2014.921628
Thompson, G. (2017). Computer adaptive testing, big data and algorithmic approaches to education. *British Journal of Sociology of Education*, *38*(6), 827–840. https://doi.org/10.1080/01425692.2016.1158640
Virvou, M., Katsionis, G., & Manos, K. (2005). Combining Software Games with Education: Evaluation of its Educational Effectiveness. *Educational Technology & Society*, *8*(2), 54–65.

The Teachers' Existing Ideas of Enhancing Students' Inventive Thinking Skills

Nophakun Ngaewkoodrua
Faculty of Education, Khon Kaen University, Khon Kaen, Thailand
ngnophakun@yahoo.com

Chokchai Yuenyong
Faculty of Education, Khon Kaen University, Khon Kaen, Thailand
ychok@kku.ac.th

ABSTRACT
This study aimed to explore the science teachers' existing ideas about Inquiry based learning as a way of enhancing students' inventive thinking skills. Methodology regarded interpretive paradigm. The first author participated in the STEM in-service teacher professional development project called the Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science. The first author as participant observer, therefore, would interpret teachers' existing ideas of ways of enhancing students' inventive thinking skills during their participation in the workshop. Key informants 15 females and 5 males who participated in the Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science at Khon Kaen, Thailand. Teachers' existing ideas of ways of enhancing students' inventive thinking skills will be examined through their responding on the checklist about the five essential features of the Inquiry based learning NRC (2000) and their sharing ideas on the open-ended questions about inquiry based learning and enhancing inventive thinking. The results of this study to be the evidence support the researchers' belief that the number of Thai teachers hold some understanding of the inquiry based learning which could be developed some more ideas of organizing learning activities for enhancing the students' inventive thinking skills.

Keywords: Inventive thinking skill; Inquiry based learning

INTRODUCTION
Science and Technology are critical to the daily lives of humans and to be the role in the creation of many things for convenience and to meet the basic necessities of life (Abdullaha and Osman, 2010). Science and technology can foster creativity on various aspects of the creative itself (Sokol, Oget, Sonntag and Khomenko, 2008). Including, the Inventive thinking is considered to have a relationship and a very important mechanism in the development of scientific knowledge and technology in this century (NCREL and Metiri, 2003). The invention and creative innovation benefit to science and technology as well (Williams and Yang, 1999).

In this 21st century, young generation of students require special multiple skills (Abdullaha and Osman, 2010) in order to succeed in their workplace because of the growth of the world is going incredibly fast. So that young students who will be the smart generation must to be the many sets of special skills were prepared and practiced for work and life in the future (Abdullah and Osman, 2010). People who are markers in the new Economy are rewarding those who have high educational achievement and multiple skills. The key word of this is the multiple skills as the Inventive thinking skills.

NCREL and Metiri (2003) stated that the Inventive thinking is one of the important skills for citizens in the 21st century and includes six elements are followed: the first element is the ability to *Adapt and manage complexity*. Secondly is *Self direction* refer to the ability to set goals related to learning, plan for the achievement of those goals and independently assess the quality of learning and any products that results from the learning experience. The third is *Curiosity*. The fourth is *Creativity* is consists of four items as Fluency, Flexibility, Originality and Elaboration. The Fifth is *Risk taking.* And lastly, *is the higher-order thinking*. Consequently, 21st century education should equip students with this skill by moving from primarily measuring discrete knowledge to measuring students' ability to think critically, examine problems, and gather information, collaboration communication, creativity and innovation required for success in their future. Therefore, educational systems must transform their objectives, curriculum, pedagogies, and assessments to help all students achieve the outcomes required for a prosperous, attractive lifestyle based on effective contributions in work and citizenship.

To support students the multiple skills as the inventive thinking skills, teachers may provide variety of teaching styles for inquiry learning. The levels of inquiry based learning are the students' center learning that is the best way to bring the students in line of promotes the students' inventive thinking. It can encourage students to develop advanced skills including inventive thinking skills. The students could describe their own thinking (Loh et al., 2001). It may take several techniques or strategy in order to enable students to learn the essential features of inquiry (NRC, 2000). In order to the open inquiry is to enable students to learn in this process. Students must to have basic skills gained from the training routine before. And they require multiple skills of mental or cognitive skills required (Ural, 2016).

As the part of a professional development called the Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science, the first author participated in the workshop as a trainer who organized the workshop across the nation. This project suggested us the plausibility of enhancing teachers who participated in the project to develop their knowledge and skills to support students' inventive thinking skills. Therefore, we need to develop the framework of strategies imply ways to facilitate teachers' knowledge of how to teach science and enhancing students' inventive thinking. To develop guideline to monitor the understanding of teachers' knowledge, beliefs, and actions, their existing ideas about enhancing students' inventive thinking skills need to be examined.

METHODOLOGY

Methodology regarded interpretive paradigm. The first author participated in the STEM in-service teacher professional development project called the Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science. The first author participated in the workshop as a trainer who organized the workshop across the nation in order to enhance teachers to understand the concept of STEM education. The science teachers who participated in this project may hold some exiting ideas about ways of enhancing students' inventive thinking skills. The first author as participant observer, therefore, would interpret teachers' existing ideas of ways of enhancing students' inventive thinking skills during their participation in the workshop.

Key informants

The 20 volunteer key informants who attended the Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science. The 20 key informants, including 15 females and 5 males who have highest score based on the criteria that are the behavior, curiosity, action and interaction as active learner for attending in the workshop, participated in the workshop at Khon Kaen, Thailand.

The Inquiry based learning workshops

The Inquiry based learning workshops of the Thailand STEM Education Project of Chevron Enjoy Science provided some of essential features of inquiry based learning checking by the criteria that focused on the behavior, curiosity, action and interaction as active learner. The activities provided some views which represent the structure of Inquiry based learning. The activities emphasize that how to choose the appropriate methods in order to enhance inquiry process. Group of four has been used to divide students into a small group and clearly see their duty and responsibility in their own group. Think-pair share has been used to encourage students' writing effectively such as express key ideas, taking a note, using a sign. It can also help both students and teachers to recheck students' prior knowledge, to represent the deep understanding of the data using graph or graphic or diagram. Gallery walks has been used to help students communicate their understanding with other. Formative assessment has also been used as the tool in evaluating students' knowledge. These workshops have been running for a year on April and October 2015. Regarding on teachers' participation on the inquiry based learning workshop, they may hold knowledge and belief related to enhance students' inventive thinking. Taylor and Fratto (2012) argued that students who hold inventive thinking could be able to person who have inventive thinking can solve the problems in a real situation compliance with for learning skills in the 21st Century. The inquiry skills will request the inventive thinking skills. Teachers who perceived some teaching strategies for inquiry based learning may hold some existing ideas about enhancing students' inventive thinking.

Method of inquiry

Teachers' existing ideas of ways of enhancing students' inventive thinking skills were examined through their responding on the checklist about the five essential features of the Inquiry based learning NRC (2000). And, teachers' sharing ideas on the open-ended questions about inquiry based learning and enhancing inventive thinking will be interpreted as their existing ideas about enhancing students' inventive thinking skills.

The checklist questionnaire was developed based on the analysis of the five essential features of the Inquiry based learning NRC (2000). There are 12 items as shown in the Table 1. Key informants have to checklist (correct, incorrect, and no ideas) on the 12 items of inquiry based learning inquiry. Their responding on the

checklist may represent how they understand the essential features of inquiry based learning. Then, participants were further probed in order to give reasons on their checklist. Their reasoning will be categorized to represent their understanding about inquiry based learning.

Teachers' existing ideas about enhancing students' inventive thinking were also interpreted when they participated in the workshop. They shared some ideas on the open – ended questions about teaching strategies during the workshop. They have to share their some ideas of providing learning activities for inventive thinking. There are two items of questions that teachers need to answer; 1) What are teaching methods that can be as Inquiry based learning?; 2) How to develop and enhance the students' Inventive thinking?These could represent what they had existing ideas about enhancing students' inventive thinking as showed in the Table 2 and 3.

FINDINGS

The teachers' existing ideas were examined in three aspects. These included (1) understanding on inquiry based learning, (2) teaching methods regarding on the inquiry based learning, and (3) enhancing students' inventive thinking. Each aspect will be discussed as following.

Teachers' understanding on inquiry based learning

This section aims to find some teachers who hold some of essential features of inquiry based learning. The result showed that all participants have gained deep understanding of inquiry based learning as shown in Table 1.

All participants have experienced in participating in the inquiry based learning workshop. After finish workshop, participants completed the questionnaire about inquiry based learning. Their responding revealed that they perceived the 5Es as inquiry based learning. However, it seems that they hold objectivist perceived about inquiry based learning when they tried to remember the stages of 5Es rather than seeing it as an approach. Below are some of their ideas about.

> *Firstly, item 2 as "5Es learning process (5 steps of inquiry based learning including: engagement, exploration, explaination, Elaboration and Evaluation) is the best Scientific Inquiry." 5Es model is the best strategy of inquiry based learning that is the answering from their idea. They are certain that 5Es is Inquiry based learning. But I still not judge their understanding. There are more evidences below to concern about this data.*
>
> *Teaching by using 5Es, there are five stages and it always beginning by science problems. The way to seek the answering that look like inquiry based learning…" (Nida, interview 2015)*

These 20 participants' answers led we concern that the participants be able to consider the key components of inquiry process which one is important. Based on the reason they gave as "The learning activity begin from the science problems…" that is the one of essential feature of Inquiry based learning. Thus, we do not judge that they are misunderstanding about inquiry because they can classify the essential features of Inquiry based learning. These participants needed to be considered that how they understand the relationship between the 5Es and Inquiry based learning.

Table 1: The percentage of teachers' understanding of Inquiry based learning from interviewing of 20 participants.

	Items	Correct (%)	Incorrect (%)	No idea (%)
1.	Scientific Inquiry is a learning process to develop science process skills while practicing as a scientific activity, which means that scientists use.	90.24	4.88	4.88
2.	5Es Learning process is the best Scientific Inquiry.	26.83	65.85	7.32
3.	Scientific Inquiry focuses on the ability to use scientific skills and scientific concepts.	82.95	12.20	4.88
4.	The Inquiry was held to just try to get results based on theory only.	11.22	82.95	2.44
5.	Scientific Inquiry explained the methods of teaching science group to train students to find answers and develop a scientific understanding of science concepts.	90.24	4.88	4.88
6.	Teacher using the questions to students be considered in the top of level of Inquiry.	48.78	48.78	2.44
7.	Teachers just spend time talking and lecturing more show that these are the open inquiry learning level.	9.76	78.05	12.20
8.	Experimental design in classroom by using the same both of method	24.39	68.29	7.32

	and the conclusion of result as the open inquiry learning level.			
9.	Teaching only one unit the Science Conception should be used to teach the same to the entire unit, because it is the best way to teach it.	2.44	87.80	12.20
10.	The project-based learning as similar as open inquiry learning.	90.24	0	9.76
11.	As a matter of fact, the students' learning in the classroom with the Scientific Inquiry in a variety of ways, such as teaching methods by POE (predict - Observe and Explain) and analogy.	95.12	2.44	2.44
12.	The Students' prior knowledge, behavior, cognition and also learning Media are not influence to the management of Scientific Inquiry learning.	36.59	56.10	7.32

Secondly, item 6 as "The way that teacher asked the student is considered in the top of Scientific Inquiry", asking students a question is highly inquiry. Shown that using the questions to students in classroom lead them to the top of inquiry level. Half of them believe that, while half of participants disagree with. There is teachers' perspective that supported these data.

> "*Using the challenging questions can enhance students' Inquiry, especially, opened-end question.*" (*Sompong, interview 2015*)
> "*Using the questions cannot help students reach the inquiry, it depend on other factor and needs more supporting.*" (*Sunee, interview 2015*)

However, all participants have learned that it needed to seek more factors influent inquiry. Which question lead students into the inquiry that considering. Thirdly, item 8 as "Experimental design in classroom by using the same both of method and the conclusion of result as the open inquiry learning level", same experiment setting in laboratory providing students but end up with the different conclusion that can be an open inquiry. There are 24 percents of participants that agree with.

> *"Inquiry has a fix pattern and need to follow the same stages. The activities have already set up as recipe" (Nongluk, interview 2015)*
> *"…There is no different of each level of inquiry." (Precha, interview 2015)*
> *"The answer is already fixed, it cannot be other answers" (Weena, interview 2015)*

Based on the reason given above, it seemed that some teachers misunderstand some points about inquiry. Lastly, item 12 as "The Students' prior knowledge, behavior, cognition and also learning Media are not influence to the management of Scientific Inquiry learning." , these factors including students' prior knowledge, behavior, material and students' intelligent do not influence to inquiry based learning. There are 37 percents of participants that agreed with.

> *"All students can learn and gain knowledge at the same level..." (Aree, interview 2015)*
> *"If the inquiry activities have been organized well, there is no factors influence..." (Jinda, interview 2015)*

Obviously, this evidence confirmed that some teachers misunderstood about inquiry based learning. It is because these factors including students' prior knowledge, behavior, material and students' intelligent have direct and indirect effected in order to design and create the activities suit with students. In generating and bringing the inquiry activities into the classroom, these factors are key components concerned for teachers. Conclusion, all science participants who hold some of essential features of inquiry based learning (NRC, 2000) from the checklist questionnaire with short answers as a tool. Some of misunderstandings that I mentioned need to explain and fulfill their idea.

Teachers' existing ideas on teaching methods regarding on the inquiry based learning

During the workshop, teachers have shared their perception of teaching methods regarding on the inquiry based learning. It found that their ideas could be categorized into 7 different ideas. These included 1) Starting by Science Problems, 2) Creating the product, 3) Group or team leaning, 4) Focused on Scientific Experiment, 5) Using the mind mapping, 6) Using the science show activities, and 7) Using the multiple methods.

Table 2: The patterns of teaching methods for Inquiry based learning.

Types of teaching methods	frequency (N)	Percentage
1. Starting by science problems	7	25.96
2. Creating the product.	6	22.21
3. Group or team leaning	6	22.21
4. Focused on scientific experiment	5	18.52
5. Using the mind mapping	1	3.70
6. Using the science show activity	1	3.70
7. Using the multiple methods	1	3.70
Over all	**27**	**100**

Twenty six percent of participants asserted that starting by science problems seemed to be Inquiry based learning. Both of focusing to create product and groups or team learning was selected by twenty two percent of participants. There are some dialogs based on the interview supported these data:

> *"Beginning by using the real problems (Scientific problems)" (Weena, interview 2015)*
> *"Dividing students into a small group and working together" (Nida, interview 2015)*
> *"Beginning by using the problem, students need to take their responsibility in their duty as member (Nongluk, interview 2015)*
> *"Students have learned by doing based on the evidence supported*
> *"Students learned by hand on activity" (Jinda, interview 2015)*

Some participants supported that in different ways.

> *"Teaching by using mind mapping makes my students gaining deep understanding" (Juntra, interview 2015)*

Based on these reasons, we do not see involving between teachings by mind mapping and inquiry based learning, so it needed to seek more evidence.

> *"Science show can encourage students' interest" (Suri, interview 2015)*
> *"Using various teaching strategies can enhance inquiry based learning" (Nalinee, interview 2015)*

These reasons are rather weak to support the inquiry based learning. Teachers, who have experience for teaching science less than 5 years and they did not graduations in science major, explained teaching strategies as mind mapping and multiple methods without linking to science content and skills. The science teacher who answered as using science show activity is not clear what exactly the main aim of this teaching style. It indicated that they could not recognize to scientific inquiry as way of knowing science. The science show activity just is the activity beginning to encourage students wonder or might be curious students in science concepts. And also, in the creating the science question, the science show may help students to do this but science teacher must to aware inquiry based learning is consisted of 5 essential features for students learn through all of items (NRC, 2000). The last science teacher just gave the answer as "Using various teaching strategies can enhance inquiry based learning" but she cannot explain more details how to use the various strategies to teach science and enhance inquiry based learning. Then, when talking to the essential feature of the inquiry based leaning, they still be confused and could not explain the detail of essential feature of the inquiry based leaning too.

Teachers' existing ideas on enhancing students' inventive thinking

The 20 key informants were interviewed what their ideas about teaching strategies for enhance students' inventive thinking. It found that they raised 8 teaching strategies as in Table 3. According to the Table 3, teachers provided eight groups of enhancing students' inventive thinking. These included teaching based on science technology and society (STS) approach, problem based learning, project based learning, open – ended question, co – operative learning, focus on ICT tools, scientific method and learning by doing. Interestingly, the STS approach, problem based learning and project based learning were high recognized among them.

Table 3: The teachers' ideas of teaching strategies for enhancing the students' inventive thinking skills.

Types of teaching strategies	frequency (N)	Percentage
1. STS approach	5	23.81
2. Problem based Learning	5	23.81
3. Project based Learning	4	19.06
4. Open – Ended Question	1	4.76
5. Co – operative Learning	1	4.76
6. Focus on ICT tools	2	9.52
7. Scientific method	1	4.76
8. Learning by doing	2	9.52
Over all	**21**	**100**

Both of STS approach and problem based learning have been answered as the same percents were twenty four, whereas nineteen percents of participants answered focus to the project based learning. These are some of ideas that they represented as:

> *"I think, STS approach is interesting because it may begin the local problem based on the context and closely to us or our environment problem around us. It means to us a lot if we can solve our problem by ourselves. It might to promote the science students' higher skills" (Suda, interview 2015)*
> *"Social problem based on STS approach can be used to be as real opened-ended question which lead to the open inquiry" (Malee, interview 2015)*

From the Suda and Malee's idea said, they focused to the Context based is the one of features of the STS approach might enhance the Inventive thinking skills. Another dialogue which some teachers represented about the problem as below:

> *"The process of solving the problem need various skills in order to discuss and synthesis the best way. It needs to promote the higher order thinking and also the Inventive' thinking skills too." (Suri, interview 2015)*

To sum up based on the reason given by participants, most of them focused on the local problems around students. Context based was talking in the leaning. Students may learn through their problems that make a meaningful in their life and social. Students may relate scientific knowledge into daily life that can go together and may enhance the Inventive thinking skills of students also.

DISCUSSION AND CONCLUSION

The most of participants gain deep understanding in the meaning of inquiry and also be able to synthesis the essential features of inquiry based learning which themselves. They perceived some of essential features of inquiry based learning checking by the criteria that focused on the behavior, curiosity, action and interaction as active learner. They can design and choose the appropriate methods into the classroom in order to enhance students' inventive thinking skills. Approximately, 26 percentages of participants selected the Starting by Science Problems as the ideas of enhancing students' inventive thinking. And, 26 percentages of participants selected the STS approach and Problem based learning. This is good sign of teachers' existing ideas because literatures Miri, David, and Uri, 2007; Madhuri, Kantamreddi, and Goteti, 2012) stated that fostering inquiry based learning was a good chance for higher skills also the dealing in class with context based.

It could be mentioned that teachers perceived the context based inquiry such as Science, Technology and Society (STS) to provide students' inventive thinking. Science, Technology and Society (STS) is an approach for Inquiry based leaning style which might be the best way to promote the students' Inventive thinking skills. Moreover, it found that knowledgeable teachers and skillful teachers in inquiry based learning, be able to design various activities and be able to apply it into the classroom. Teachers who had experience in participating in the inquiry based learning workshops able to design a various activities and be able to apply it into the classroom. It might be the merging inquiry based learning and STS approach in order to enhance students' inventive thinking (Barrow, 2010). This suggests that the guideline to monitor the understanding of teachers' knowledge, beliefs, and actions of enhancing students' inventive thinking skills need to be developed regarding on those of their mentioned about inquiry based learning approach and STS approach.

ACKNOWLEDGEMENTS

This research was financially supported by The Institute for Promotion Teaching Science and Technology (IPST) Thailand and the Graduate School, Khon Kaen University, Thailand.

REFERENCES

Abdullah, M., & Osman, K. (2010). 21st century inventive thinking skills among primary students in Malaysia and Brunei. *Procedia Social and Behavioral Science9,* 1646 – 1651.

Barrow, L. (2010). Encouraging creativity with scientific inquiry. *Creative Education, 1,* 1 – 16.

Canedo, M. (1988). *The Inventive Thinking Curriculum Project***.** The United States Patent and Trademark Office.

Chattabud, J., Suwannoi, S., Sranamkam,T., & Yuenyong, C. (2015). Thai Students' Decision Making in Societal Issue of Surface Area and Concentrated Solutions as a Factor in the Rate of Chemical Reactions. *Mediterranean Journal of Social Sciences*, 6 (6), 56 – 61.

DeHaan, R.L. (2009). Teaching Creativity and Inventive Problem Solving in Science. *CBE - Life Science Education*, 8, 172 – 181.

Loh, B., Reiser, B.J., Radinsky, J., Edelson, D.C., Gomez, L.M., & Marshall, S. (2001). *Developing reflective inquiry practices: A case study of software, the teacher, and students*. In K. Crowley, C. Schunn & T. Okada (Eds.), Designing for science: Implications from every day, classroom, and professional settings, Mahwah, NJ: Erlbaum, 279 – 323.

Madhuri, G. V., Kantamreddi, V. S. S. N., & Prakash Goteti, L. N. S. (2012). Promoting higher order thinking skills using inquiry – based learning. *European Journal of Engineering Education*, 37(2), 117 – 123.

Miri, B., David, BC., & Uri, Z. (2007). Purposely Teaching for the Promotion of Higher-order Thinking Skills: A Case of Critical Thinking**.** *Research in Science Education*, 37(4), 353 – 369.

NCREL & Metiri (2003). EnGauge 21st century skills for 21stcentury learners. EnGauge. Available online at: http://www.metiri.com/21/Metiri-NCREL21stSkills.pdf.

National Research Council (NRC) (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. Washington, DC: National Academy Press.

Sokol, A., Oget, D., Sonntag, M., & Khomenko, N. (2008). The Development of Inventive Thinking: Skills in the Upper Secondary Language Classroom. *Thinking Skills & Creativity*, 3(1), 34 – 46.

Taylor, L. M., & Fratto, J. M. (2012). *Transforming learning through 21st century skills: the who took my chalk? model for engaging you and your students*. Boston: Pearson.

Taylor, P.C.S. (1993). Collaborating to reconstruct teaching: The influence of Teaching, San Diego, CA.

Ural, E. (2016). The Effect of Guided-Inquiry Laboratory Experiments on Science Education Students' Chemistry Laboratory Attitudes, Anxiety and Achievement. *Journal of Education and Training Studies*, 4(4).

Williams, M., & Yang, L. T. (1999). Organizational creativity. In R. Sternberg (Ed.), *Handbook of creativity*. Cambridge, MA: Cambridge University Press. 373 – 391.

The Usage of Short Story via Phone Application: Enhancement and Motivation among Second Language Learners

NORMALIZA ABD RAHIM
NOR AZURA ADZHARUDDIN
Faculty of Modern Languages and Communication, Universiti Putra Malaysia, Serdang, 43400 Selangor
drnormaliza@gmail.com

ABSTRACT
The study focuses on the use of short story via phone application among second language learners. The samples of the study consist of 21 subjects from two classes of Malay language. The subjects were given a story entitled "The Fox" from the phone application. The subjects were to watch the story for three weeks. Then, the subjects rewrite the story and the essays were marked accordingly. The results of the story revealed that majority of the subjects managed to write the character, characteristic and storyline of the story. The study also revealed that the subjects managed to write the correct vocabulary, sentence structure and spelling in their writings. In addition to that, short story via phone application enhances the subjects learning in the second language and motivates subjects learning in the classroom. It is suggested that future studies will focus on other short stories using the phone application.

Keywords: short story, phone application, second language learners

INTRODUCTION

Short stories can be found not only in books but also in the new digital media. The new digital media includes the usage of internet in computer and mobile phones. Learners will find reading the short stories using the mobile phones as a motivation in learning where they can read the stories at anywhere and anytime of the day. Nowadays, researchers have studies on the usage of technology among users of language learners. Learners seem to be interested to learn something new with the technology and this will help in the process of learning a second language. The mobile phone technology has also managed to boost students motivation in learning and therefore, various suggestion were made in order to have a new learning experience among learners of all ages. Mobile phones as in phone application is a software application designed to run on mobile devices such as smartphones and tablet computers. As such, most devices are sold with several apps compiled as pre-installed software, such as a web browser, email client, calendar, mapping program, and an app for buying music or other media or more apps (Cutlack, 2013).

A study by Cavus & Ibrahim (2016) showed the development of an interactive application that can be used in teaching English as a second language using children's stories in mobile devices. The experimental study was to find out the potential of using the developed interactive mobile application in improving the learning skills such as vocabulary, pronunciation, listening and comprehension of the learners of the English language. Cavus & Ibrahim (2016) claimed that the study is applying the autonomy among learners where the students learn without the help of a teacher. 37 volunteered subjects participated in the study. A Pre-Test and a Post-Test have been performed to find out the learning abilities of students. The results of the experimental study clearly showed that English learning skills of young students had higher statistically significant improvements as a result of using the developed application in the experimental group. It can be concluded that the developed mobile application can be used as an educational tool in teaching English as a second language. Learners of second language who may be interested in improving their listening, vocabulary, comprehension and pronunciation skills (Normaliza Abd Rahim, 2014) while learning a second language should find this mobile application enjoyable and useful. The study by Cavus & Ibrahim (2016) is parallel to the study by Stewart & Gachago (2016), Normaliza Abd Rahim (2014), McWilliam (2010) and Lambert (2010) where the study focused on storytelling to enhance learning.

On the other hand, Stewart & Gachago (2016**)** focused on collaborative digital storytelling project. The study implemented simultaneously in both a South African and an American university classroom in 2015. This study facilitated dialogue and the sharing of digital stories by means of a closed Facebook group where instructors were able to investigate students' critical awareness and social consciousness across continents. The result of the study showed that personal stories were viral in the space for critique and a raised awareness of how students are

impacted by global hegemonic discourses. The implications of practice for this study include breaking down the barriers for both real and imagined since they relate to how educators conceive the use of technology in classroom spaces and student engagement across continents. However, Stewart & Gachago's study (2016) is also similar to the study by Burgess (2006) and Carabas & Harter (2005) where digital storytelling among learners created interesting experience and learning environment. Also, Normaliza Abd Rahim, Hazlina Abdul Halim & Noor Shahila Mansor (2017) and Harter, Japp & Beck (2005) stated that learning through stories will help the narratives, health and healing process of a learner.

Subsequently, Glover, Hepplestone, Parking, Rodger & Irwin (2016) claimed that pedagogy approach to technology has played a major role to enhance learning. The approach to technology enhanced learning was developed by Sheffield Hallam University (SHU). It is a method to encourage the use of, and experimentation with the technology within teaching practice and also to promote the mainstreaming of innovative practice. Through a consultative approach, all staff members were invited to contribute, SHU has created a Teaching Approaches Menu that reflects the practice at the institution. The Menu can be used to explore teaching practice and appropriate supporting technology either by individuals or as part of a facilitated discussion. The background to the project is provided, along with the design philosophy and approach, including a brief review of other frameworks. The Teaching Approaches Menu is introduced, its development outlined, and some initial feedback is presented. The study by Glover, Hepplestone, Parking, Rodger & Irwin (2016) is parallel to the study by Cavus & Ibrahim (2016), Stewart & Gachago (2016), Zhang & Koda (2016), Borich (2012), Hartley (2009), Lundby (2008) and Meadows (2003) where, the materials chosen for learning will affect the students' motivation in learning.

On the other hand, Hoang & Boers (2016) suggested that adult second language learners have often been found to produce discourse that manifests limited and non-native use of multiword expressions. It can be said that adult second language learners are relatively unsuccessful without the pedagogic intervention at transferring multiword expressions from input texts to their own output resources. Hoang & Boers (2016) found that the learners were asked to re-tell a short story which they had read and listened to, twice. The learners' re-tells were subsequently examined for the extent to which they recycled multiword expressions from the original story. In the study, in order to gauge the influence of the input text on these learners' renderings of the story, a control group was asked to tell the story based exclusively on a series of pictures. The results of the study suggest that multiword expressions were recycled from the input text to some extent in comparison with the recycling of single words. It can be seen that this study managed to enhance students learning the second language. However, the activities chosen have made the students increased in motivation when learning the second language by using the short story. Hoang & Boers (2016) study is parallel to the study by Zhang & Koda (2016) and Webb & Chang (2012) where second language vocabulary can also be learnt successfully using the assisted repeated reading. The study by Webb & Chang (2012) showed that repeated reading ensured the students' knowledge of the vocabulary. Schmitt (2010) claimed that vocabulary can be learnt in various ways and educators will find ways to enhance students learning. Schmitt (2010) agrees with Nation (2001) and claims that learning vocabulary in another language can be interesting if educators prepare with various materials. Here, Ellis (2003), Normaliza Abd Rahim (2013), Normaliza Abd Rahim, Hazlina Abdul Halim, Roslina Mamat & Nor Shahila Mansor (2016), Siti Noor Riha Sulong & Normaliza Abd Rahim (2017) and Normaliza Abd Rahim, Nik Rafidah Nik Muhammad Affendi & Awang Azman Awang Pawi (2017) suggested the task-based language learning and teaching in order to have interesting lessons in the classroom.

The objectives of the study were to identify and discuss the students' writing in the second language by using short story via phone application.

METHODOLOGY

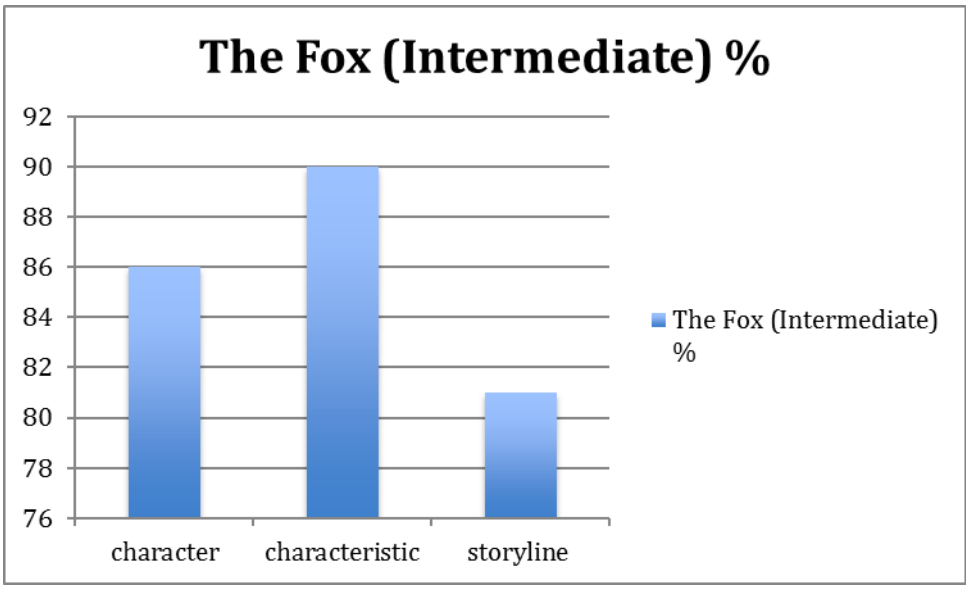
The samples of the study consist of 21 subjects from two classes of Malay language at Hankuk University of Foreign Studies, South Korea. The subjects were given a short story entitled "The Fox" from a phone application. The short story is in the Malay language. The subjects were given three weeks to watch the story via online and they have to ensure that they understood the story. Then, the subjects were to write an essay on the story that they have watched. The written essays were marked according to the character, characteristic and storyline. The essays were marked according to the vocabulary, sentence structure and spelling. Two graphs were prepared for the discussion of the study. The Fox is taken from the compilation of *Pekaka Bercerita Siri 1*, copyrighted by Dewan Bahasa dan Pustaka (Normaliza Abd Rahim, 2016). This data of the study were analysed by using Brown & Yule's (1983) discourse analysis theory. According to Brown & Yule (1983), there are four approaches in spoken and written discourse; reference, presupposition, implicature and inference. This study focuses on presupposition of the discourse analysis theory. Presupposition a thing tacitly assumed beforehand at the beginning of a line of argument or course of action.

Summary of The Fox

Pada zaman dahulu, terdapat sekumpulan musang yang tinggal di dalam sebuah gua yang besar di dalam sebuah hutan. Pada waktu siang, musang akan tidur bersama keluarga. Setiap malam pula, musang-musang akan keluar ke hutan dan kampung untuk mencari makanan. Musang akan mencari ayam hutan dan ayam kampung. Musang akan membawa makanan tersebut untuk keluarga di dalam gua. Orang kampung berasa terkejut apabila melihat ayam peliharaan kesemuanya hilang. Mereka berasa marah. Pada suatu hari, seorang pemburu masuk ke dalam hutan. Dia terlihat sebuah gua. Lalu, dia cuba masuk ke dalam gua tersebut. Alangkah terkejutnya dia melihat banyak musang di dalam gua itu. Apabila melihat pemburu, kesemua musang terkejut. Mereka berlari keluar dari gua dan masuk ke dalam hutan. Pemburu pun menamakan gua itu gua musang.

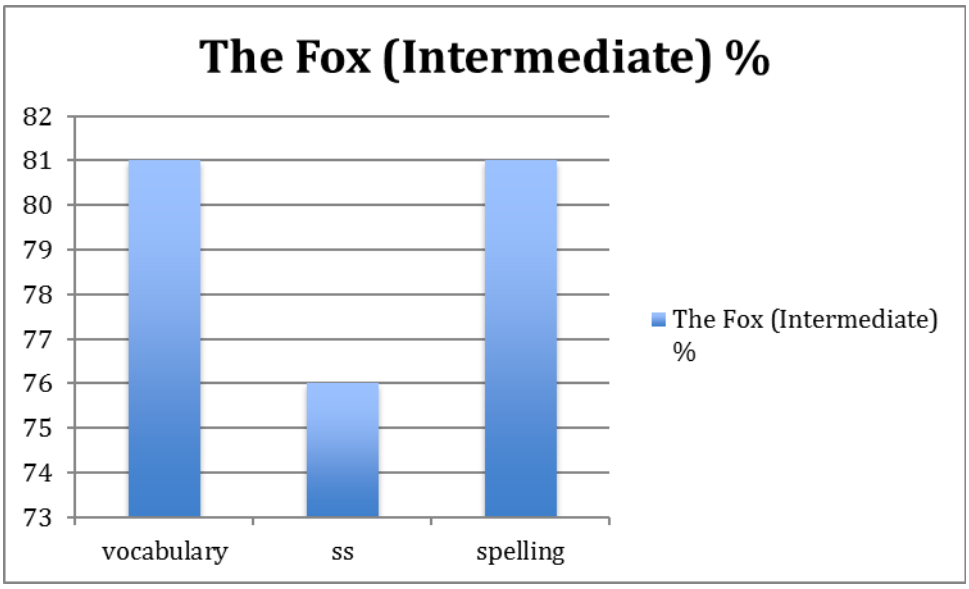
Long time ago, there lived a group of foxes in a big cave in the forest. During the day, the foxes sleep with the family. Every night, the foxes will go out to the forest and village to find food. The foxes will find the chicken from the forest and village. The foxes find the food for the family. The villagers were shocked when they found out that their domestic animals gone missing. They were angry. One day, a hunter went into the forest. He saw a cave. Then, he went inside to check. He was shocked to see a group of foxes in the cave. The foxes were also shocked to see the hunter. They ran out to the forest. The hunter named the cave “Fox Cave”.

RESULTS AND DISCUSSION



Graph 1: Character, characteristic and storyline in The Fox

Graph 1 above shows the character, characteristic and storyline in the story The Fox among intermediate subjects at Hankuk University of Foreign Studies, South Korea. As for character, it can be seen that 86% of the subjects (18 subjects) managed to identify the characters in the story. The subjects also managed to identify between the main and other characters. The subjects mentioned that besides the fox, there were also other characters such as the village people and hunter. On the other hand, it can be seen that 90% of the subjects (19 subjects) managed to explain about the characteristics of the characters in. The subjects also stated that the foxes have similar and differences in characters. The subjects claimed that “Some foxes were happy (Ada musang yang gembira)”, “Some were serious (Ada musang yang serius)” and “Others were focused on finding food for their children (Musang yang lain memberi fokus terhadap mencari makanan untuk keluarga).” Also, the subjects claimed that, “The villagers were worried about their domestic animals which were taken by the foxes (Orang kampung berasa risau tentang binatang peliharaan yang dicuri oleh musang”. On the other hand, the subjects also stated that “The hunter tried to help the villagers (Pemburu cuba membantu orang kampung”. Subsequently, 81% of the subjects (17 subjects) showed that they managed to write the correct storyline of the story. The subjects seemed to understand from the beginning of the story until the ending of the story without missing the plot of the story. It can be seen that the subjects claimed in their writing that “The storyline seemed to be interesting (Jalan cerita ini sangat menarik)”, “The foxes ran away (Semua musang melarikan diri)”, “The foxes tried to find food for the family (Musang cuba mencari makanan untuk keluarga)”, “The villagers were worried (Orang kampung berasa sangat risau)” and others. The evidences showed that the subjects understood the story.



Graph 2: Vocabulary, sentence structure and spelling in The Fox

Graph 2 above showed the vocabulary, sentence structure and spelling in the story The Fox. It can be seen that majority of the subjects seemed to have written the correct vocabulary, sentence structure and spelling. 81% of the subjects (17 subjects) managed to use most of the vocabulary from the story. The subjects wrote words like, "catch (tangkap), cari (find), coop (reban), village (kampung), hunter (pemburu), shock (terkejut), lari (ran), family (keluarga) and others. The subjects also managed to put the vocabulary in the right sentence. However, 76% of the subjects (16 subjects) managed to write the correct sentence structure in the story. The sentences written such as, "The foxes live in the big cave in the forest (Musang tinggal di dalam gua yang besar di dalam hutan)", "There are sleeping in the cave (Mereka tidur di dalam gua)", "They will go to the village at night (Mereka akan pergi ke kampung pada waktu malam), "They have to find food for their family (Mereka mencari makanan untuk keluarga)" and others. It can be seen that the sentences used were correct and it can be seen that the subjects managed to understand the original story in the Malay language. On the other hand, 81% of the subjects (17 subjects) claimed that they memorized most of the words from the story. The subjects have written the correct spelling for most of the words. The words were similar to the vocabulary as stated above, "catch (tangkap), cari (find), coop (reban), village (kampung), hunter (pemburu), shock (terkejut), lari (ran), family (keluarga) and others. Here, it can be seen that the subjects managed to spell the words the English language correctly.

Among all the subjects, it seemed that four to five subjects did the same mistakes in writing. The subjects stated that they did not have the application in their phones and were not bothered to find the solution. So therefore, the subjects did not write the essay correctly. They admitted that they heard the story from their friends and guessed the storyline in the essay. Also, the subjects claimed that the process of learning by using the phone application that they did not have has made learning a difficult task.

CONCLUSION

The results of the study showed that majority of the subjects managed to rewrite the story by looking at the character, characteristics and storyline. The study too revealed that majority of the subjects managed to write the correct vocabulary, sentence structure and spellling. Here, it can be seen that the short story using the phone application has helped the subjects in understanding the story. Thus, the short story using phone application has also managed to enhance subjects in learning the second language. The subjects seemed to have motivation in learning the second language since it has different approach as compared to other activities carried out in the classroom. The result of the study is similar to the study of Cavus & Ibrahim (2016) where learning using the phone technology will help in the process of learning the second language. Also, this study is parallel to the study of Noraien Mansor & Normaliza Abd Rahim (2017a; 2017b; 2017c; 2017d), Cavus & Ibrahim (2016), Stewart & Gachago (2016), Hoang & Boers (2016) and Normaliza Abd Rahim (2014) in second language learning will motivate students in learning in a different environment than the normal classroom.

This study helps educators in preparing materials in the second language classroom. Educators will consider in using the short story by using the phone application since most students nowadays have a mobile phone. Therefore, with the availability of the mobile phones, the students will use it for learning purposes. This study

also helps second language learners in considering short stories by using the phone application. Second language learners will find it interesting since the word choice and sentence structure from the stories are suitable for them to learn. It is suggested that further studies should focus on other short stories using the phone application.

REFERENCES

Borich, J. (2012) Teaching Foreign Language Through Storytelling. TLN Teachers Leaders Network. http://www.edweek.org/tm/articles/2012/04/02/tln_borich.html. Retrieved 18 dec 2016

Brown, G., & Yule, G (1983). *Discourse Analysis*. Cambridge: Cambridge University Press.

Burgess, J. (2006). Hearing Ordinary Voices: Cultural Studies, Vernacular Creativity and Digital Storytelling. *Continuum* 20 (2), 201-14.

Carabas, T. & Harter, L. (2005). State-Induced Illness and Forbidden Stories: The Role of Storytelling in Healing, Individual and Social Traumas in Romania. *Narratives, Health and Healing.* Eds. Lynn Harter, Linda Japp, and Christina Beck. New York: Taylor and Francis, 149-69.

Cavus, N. & Ibrahim, D. (2016) Learning English using children's stories in mobile devices. *British journal of education technology.* 47 (2), 227-237

Cutlack, G. (2013). What are apps and how do they work with your smartphone? Retrieved 25 december 2016. http://www.techradar.com/news/phone-and-communications/mobile-phones/what-are-apps-and-how-do-they-work-with-your-smartphone-1141429

Ellis, R. (2003). *Task-based Language Learning and Teaching*. London: Oxford University Press.

Glover, I., Hepplestone, S., Parking, H. J., Rodger, H., & Irwin, F. (2016) Pedagogy first: Realising technology enhanced learning by focusing on teaching practice. *British journal of education technology.* 47 (5), 993-1002

Harter, L., Japp, L. & Christina Beck, C. eds. (2005) *Narratives, Health & Healing.* New York: Taylor & Francis.

Hartley, J. (2009). TV Stories: From Representation to Productivity. *Story Circle: Digital Storytelling around the World.* Eds. John Hartley and Kelly McWilliam. Oxford: Blackwell, 16-37.

Hoang, H. & Boers, F. (2016) Re-telling a story in a second language: How well do adult learners mine an input text for multiword expressions?. *Studies in Second Language Learning and Teaching*, 3/VI, 513-535

Lambert, J. (2010). Where It All Started: The Centre of Digital Storytelling in California. *Story Circle: Digital Storytelling around the World.* Eds. John Hartley and Kelly McWilliam. Oxford: Blackwell, 79-90.

Lundby, K. (2008). *Digital Storytelling, Mediatized Stories: Self-Representations in New Media.* New York: Peter Lang.

Meadows, D. (2003). Digital Storytelling - Research Based Practice in New Media. *Visual Communication* 2 (2), 189-93.

McWilliam, K. (2010). The Global Diffusion of a Community Media Practice: Digital Storytelling Online. Eds. John Hartley and Kelly McWilliam. Oxford: Blackwell, 37-77.

Nation, I. S. P. (2001). *Learning Vocabulary in Another Language*. Cambridge: Cambridge University Press.

Normaliza Abd Rahim, Hazlina Abdul Halim, Roslina Mamat & Nor Shahila Mansor (2016). Malay Folklore Discourse among Korean Students. Jurnal Kemanusian. 25 (1), 12-21

Normaliza Abd Rahim, Nik Rafidah Nik Muhammad Affendi & Awang Azman Awang Pawi (2017). Dissemination of Values and Culture through the E-Folklore. *The Turkish Online Journal of Educational Technology*. 16 (1), 32-36

Noraien Mansor & Normaliza Abd Rahim (2017a) Written Discourse in Digital Audio Folklore. *Man in India*. 97 (2), 491-499.

Noraien Mansor & Normaliza Abd Rahim (2017b) Implicature in Students' Perception towards Language Learning. *Man In India*. 97 (2), 329-336

Noraien Mansor & Normaliza Abd Rahim (2017c) Digital Written Discourse. *Man in India*. 97 (20), 115-124

Noraien Mansor & Normaliza Abd Rahim (2017d). *Boom! With Social Media*. Terengganu: Penerbit Universiti Malaysia Terengganu

Normaliza Abd Rahim, Hazlina Abdul Halim & Noor Shahila Mansor (2017). E-story and Writing Skill among Second Language Learners. *The Turkish Online Journal of Educational Technology.* 16 (4), 27-32

Normaliza Abd Rahim (2016) *Pekaka Bercerita Siri 1*. Kuala Lumpur: Dewan Bahasa dan Pustaka.

Normaliza Abd Rahim (2013) Literature Computer Program among Primary School Learners. *TOJET: The Turkish Online Journal of Educational Technology*, April 2013, 12 (2), 193-199

Normaliza Abd Rahim (2014) The Nearly Forgotten Malay Folklore: Shall We Start With The Software? *TOJET: The Turkish Online Journal of Educational Technology*. July, 13 (3), 216-221.

Siti Noor Riha Sulong & Normaliza Abd Rahim (2017). Tahap Keberkesanan Lagu "Si Pintar" Dan "Si Manis Dan Kura-Kura" Terhadap Kanak-Kanak. *Journal of Business and Social Development*, 5 (2), 102-110

Schmitt, N. (2010). *Researching vocabulary: A vocabulary research manual*. New York, NY: Palgrave Macmillan.

Stewart, K. & Gachago, D. (2016) Being human today: A digital storytelling pedagogy for transcontinental border crossing. *British journal of education technology*. 47 (3), 528-542

Webb, S. A., & Chang, A. (2012). Vocabulary learning through assisted and unassisted repeated reading. *Canadian Modern Language Review*, 68, 267-290. doi: 10.1353/cml.2012.0020

Zhang, H. & Koda, K. (2016). Word-Knowledge Development In Chinese As A Heritage Language Learners: A Comparative Study. Studies in Second Language Acquisition. Retrieved 25 december 2016. https://www.cambridge.org/core/journals/studies-in-second-language-acquisition/article/div-classtitleword-knowledge-development-in-chinese-as-a-heritage-language-learnersdiv/B51ED6E97A5B542CF3314032C72F6599

Using Technology for Formative Assessment to Improve Students' Learning

Dr. Ismail Elmahdi
Bahrain Teachers College, University of Bahrain, Bahrain
ielmahdi@uob.edu.bh

Dr. Abdulghani Al-Hattami
Bahrain Teachers College, University of Bahrain, Bahrain
aalhattami@uob.edu.bh

Dr. Hala Fawzi
Bahrain Teachers College, University of Bahrain, Bahrain
hfawzi@uob.edu.bh

ABSTRACT
One way that technology can be a considerable support in teaching and learning is by improving the ability to offer formative assessment of the learners' skills and knowledge during the teaching and instructional process. Providing immediate feedback during the formative assessment process, with the aim of improving students' performance, is very crucial in learning and teaching. This study investigates the effectiveness of using the classroom response system *Plickers*, which is a technology based formative assessment tool, in improving students' learning. A descriptive mixed method design was implemented in this study. A questionnaire was used to collect data from 166 students in Bahrain Teachers College, University of Bahrain. The findings revealed that students believe in the importance of formative assessment and receiving immediate feedback which is supported by the use of *Plickers*. Moreover, the findings showed that using *Plickers* for formative assessment aid the learning process as it improves students' participation; saves the learning time, guarantees equal participation opportunities, and creates fun and exciting learning environment. The findings also encourage instructors to integrate technology tools such as *Plickers* in their classrooms to help them assess the effectiveness of their teaching and their students' learning.

Keywords*:* Formative assessment, teacher education, improves teaching, improve learning, educational technology, Plickers, online tools.

INTRODUCTION
The integration of technology in classrooms becomes a necessity for effective teaching that improves learning, specially in the 21st century; where the road to motivate and encourage students to learn is paved with their passion to technology and digital tools. With the advent of technology and its role in education, a wide body of research has developed in investigating the role of technological instructions in the educational process and their effect in improving the interactive education environment (Danielson, 2011; Ali and Elmahdi, 2001; Fawzi, 2010; Irving, 2015; Damick, 2015; Caldwell, (2007; Baylor, and Ritchie, 2002) A number of these studies have provided evidence of the significant contribution which technology makes to improve the methods of teaching, learning and assessment which positively impact the students' knowledge and skills.

One of the important and interesting uses of modern online classroom response systems to enhance students' learning is using them for formative assessment. Irving (2015) asserted that these tools "assist in the formative assessment process by supporting classroom environments that allow students and teachers to assess learning and providing mechanisms to present information about student learning during instructional sequences" (p. 380).

Popham (2011, p. 270) defined formative assessment as "a planned process in which assessment-elicited evidence of student's' status is used by teacher to adjust their ongoing instructional procedure or by students to adjust their current learning tactics". Formative assessment provides students with just in time specific and non-evaluative feedback that improve their performance. Effective teachers in every corner of the world strive to engage their students in formative assessment process to gauge understanding and correct misconceptions by utilizing multiple techniques such as diagnostic tests, startup activities, exit cards, pop quizzes, group discussion, think-pair-share, etc. Teachers also equally benefit from applying formative assessment techniques as they

provide them with the opportunity to assess their teaching effectiveness and, accordingly, adjust and modify their teaching activities. In other words, formative assessment informs instruction.

There are a number of affordable newly introduced technologies and software that aid teachers to use formative assessment during the instructional process which enhance learning and assessment. One of these technologies are classroom response systems; mainly referred to as CRSs. These technologies include, but not limited to, Clickers, *Socrative, Kahoot, Plickers and RecaP*. The common denominator among these technologies is their ability to collect real-time formative assessment data that helps teacher to provide just-in-time feedback. Beatty and Gerace (2009) reported that "Teachers have limited time to assess students' performances and provide feedback, but new advances in technology can help solve this problem" (p. 142).

The technology based formative assessment tool *Plickers*, which many called "*Clickers without clicking"*, is an online classroom student response system that uses paper coded cards. Most importantly, the students do not need any electronic devices to participate in the assessment process. The teacher only needs to create an account on Plickers.com. To create an account on Plickers, a teacher will be asked to provide his/her first and last name, a valid email address and create a password. Later, with the available online guidelines or a limited training, he/she can easily build questions bank and start to use it for nearly zero cost.

This research investigated the effectiveness of using *Plickers* for formative assessment to enhance students' learning. The authors of this study are full time professors at Bahrain Teachers College (BTC). They are utilizing and using *Plickers* in their regular classroom activities for more than three years. For the purpose of this study, and in order to achieve more precise results, each researcher used *Plickers* three times during the first semester of the academic year 2016/2017 to give students immediate feedback for activities he/she has done. The courses in which *Plickers* was used are under the English Language Education and Science and Education Studies departments in BTC. The study was conducted for a period of 12 weeks; in an attempt to use the tool in assessing the students when they were learning different concepts. At the end of the semester, the questionnaire was distributed to the students with the objectives of investigating their opinions about the effectiveness of using *Plickers* as a formative assessment tool to enhance their learning.

LITERATURE REVIEW

Formative assessment is the major area of interest within classrooms that "provides teachers and students with continuous, real time information that informs and supports instruction" (Ramsey & Duffy, 2016). The crucial need to adjust teaching and learning to gather evidence for the purpose of improving student learning demanded for formative assessment to be considered as a central part of classroom learning. This is due to the help formative assessment extends in leading students during the class time in understanding skills and concepts; in addition to making decisions about moving forward to achieve the course learning objectives.

On the other hand, formative assessment yielded substantial learning gains with the affordable wireless 21st century technology that are designed to enhance students' learning. While Preszler et al (2007) highlighted collecting quick and immediate data about students' understanding as one of the advantages of using technology in formative assessment. Ramsey and Duffy (2016) identified two major advantages: a) supporting individualized learning, and b) opening up time in lecture courses for interactive sessions.

Moreover, interest emerged in the integration of online classroom response systems (CRSs) which are considered "promising" (Beatty and Gerace, 2009) and affordable tech-tools used by teachers when they use formative assessment in the classroom, e.g., Clickers, Plickers, Kahoot digital quizzes, Socrative and RecaP. Research findings reported that CRSs enhanced questioning and feedback when technology is integrated with pedagogy (Roschelle, Penuel & Abrahamson, 2004); and maximized learner engagement (Schell, Lukoff, & Mazur, 2013) and had a positive effect on students' attitudes and academic performance (Preszler et al, 2007).

The 'tech-help' extended by these systems is seen in activating students' thinking, enhancing immediate feedback, motivating participation, and fostering knowledge-centered discussion. Likewise, the essential features of the CRSs help teachers in effectively transforming the classroom from teacher-centered to students-centered. This takes place because CRSs help in assessing students' learning by polling subject related questions, collecting students' responses instantly and quickly, and finally, projecting the responses to the whole class. Accordingly, CRSs help teachers in effectively and efficiently assess students' knowledge, concepts and skills.
What added to teachers' preference in accepting to use CRSs as part of technology-based formative assessment is the user-friendly features they hold. All that are needed to bring CRSs into action is using two input devices- the teacher's classroom computer and his/her cell phone/tablet. The teacher starts by posing a question, students raise the answers on their cards and the CRSs "software collects the responses, aggregates them, and displays to

the class in a bar chart showing the number of students selecting each response" (Roschelle, Penuel and Abrahamson, 2004; Beatty, 2004; Fies and Marshall 2006. In: Beatty and Gerace, 2009).

This study examines the use of *Plickers*, also known as paper clickers, as one of the CRSs used for classroom formative assessment. Teachers use *Plickers* in different specialization around the world; for example, in courses like algebra (Damick, 2015); science (Beatty and Gerace, 2009), biology (Preszler et al, 2007). According to Damick (2015), *Plickers* could be used for many different purposes to formally assess students; such as for warm up or exit tickets. Each student has no other option but to participate in selecting an answer. After seeing the percentage of the class and how each individual student performed on the question, the teacher, uses the live view tab that projects the answers from the teacher's digital device to the screen board (Damick, 2015).

There is a large volume of published studies describing the effect of technology based formative assessment on the teaching and learning process (Sheill, Lukoff, & Mazur, 2013; Beatty & Gerace, 2009; Damick, 2015; Preszler et al, 2007; Caldwell, 2007; Roschelle, Penuel, & Abrahamson, 2004). However, none of the available studies covered the use of using technology for formative assessment to improve students' learning at the university classrooms in Bahrain. The study will try to answer the following three questions from the students' perception:

1) What is the effectiveness of using formative assessment to improve learning?
2) What is the impact of using *Plickers* as classroom response system technology in providing immediate feedback to enhance students' learning?
3) What is the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom?

METHODOLGOY

The study employed mixed research methods: quantitative by using the means and standard deviations and qualitative by analyzing students' responses to three open-ended questions. Three open-ended questions were used to boost the authenticity of the results. No pre-determined answers were required and the participants were free to express their opinions. On the same lines, Woike (2007) describes open-ended responses as "A unique and perhaps most important aspect is that they offer individuals freedom of expression" (p. 293). Participants were asked to respond to a questionnaire that was validated by two experts in the use of technology and education. Both of them are assistant professors who have been teaching for more than 15 years. One is specialized in technology and the other in education.

Sample

The study sample consisted of 166 BTC students representing various academic levels (year one to year four) and divisions (Cycle one, Islamic and Arabic, Math and Science, and English). A cluster sampling technique was used because the authors wanted students from each academic years and different divisions. Therefore, the sections were selected randomly and then all the students in those selected sections participated in the study. The questionnaire was presented to them in their classroom and data was collected by using *Plickers.*

Instruments

The questionnaire used in this study consisted of 17 items that are related to the importance and effectiveness of using formative assessment (5 items), technology (1 item), *Plickers* (7 items) and whether or not they would plan to use it in their future classrooms (4 items) in the classroom. Statements are rated on a five-point Likert scale ranging from one (Strongly Disagree) to five (Strongly Agree). For open-ended questions, only three questions were used to ask students about their perception on how effective is using *Plickers* in the classroom in teaching and/or learning; if they plan to use it in their classrooms when they become teachers and why; and if there are any problems that may occur when using it in the classroom. The open-ended questions gave the participants the opportunity to elaborate and explain in-depth their perception regarding the use of *Plickers* as a tool for formative assessment to improve learning. The use of the mixed methods is to triangulate the data collection so deeper understanding can be attained.

RESULTS AND DISCUSSION

This section presents the results and discussion of the students' responses using the mean and standard deviation statistics and their responses to the open-ended questions. When answering the open-ended questions, interestingly, not only their responses supported the answers they offered in the questionnaire, but they also highlighted other important aspects related to this study, "So the qualitative material generated from open-ended questions may reveal innermost thoughts, frames of reference, emotional reactions and cultural assumptions that may or may not be accessible by other methods" (Woike, 2007, p. 293). Although, the participants' qualitative responses covered a wide range of aspects, the researchers highlight the most important themes emerged from

these responses. These themes are: engagement, checking for understanding, equal opportunity to participate, excitement and fun, saving the learning time, breaking the routine, ease of use, network problem and lack of infrastructure in schools.

Table 1: *Descriptive Statistics for the Formative Assessment Statements*

Items	**Mean**	**SD**
Formative assessment should be an integral part of classroom learning.	4.57	0.77
Formative assessment helps teachers identify difficult concepts that students are struggling to understand.	4.46	0.89
Formative assessment helps teachers identify skills students are having difficulty acquiring.	4.29	0.96
Formative assessment provides information needed to adjust teaching and learning while it is happening.	4.38	0.80
Formative assessment is guiding teachers and students in making decisions about how to move forward to reach their goals.	4.28	1.00
Overall	4.40	0.54

It is apparent from this table that in investigating students perception about the importance of implementing formative assessment in their classroom, their responses showed how highly they view the importance of formative assessment (Mean = 4.40, SD = 0.54) in identifying different concepts that students are struggling to understand (Mean = 4.46, SD = 0.89), in identifying skills students are having difficulty acquiring (Mean = 4.29, SD = 0.96), in providing information needed to adjust teaching and learning while it is happening (Mean = 4.38, SD = 0.80), and in guiding teachers and students in making decisions about how to move forward to reach their goals (Mean = 4.28, SD = 1.00). The results also showed that participants agree that formative assessment should be an integral part of classroom learning (Mean = 4.57, SD = 0.77).

In response to the first open-ended question "As a student, how effective is using *Plickers* in the classroom for the teaching and learning process?" participants overwhelmingly agree that *Plickers* is an effective tool in aiding the learning process. As students, they argue that Plickers help them to be engaged in the lesson. One student wrote, "I think that it's very useful method to engage all students to participate even they are shy or quiet." On the same line, another respondent stated, "I think this method attract the students and makes them interest[ed]." A third participants wrote "the students will be engaged and enjoy their learning." One participant argued, "It motivates all learners and engages them." Another aspect that the participants offered in response to the above question is about checking understanding, which can be quickly and easily obtained by using Plickers. For example, one respondent stated, "It measures the students understanding in a fun and different way". Another respondent wrote, "I will use it to assess the students' understanding". A third student wrote, "Yes, because it's a very interesting way to assess the students and check their understanding."

Table 2: *Descriptive Statistics for Using Technology*

Items	Mean	SD
Using technology-based formative assessment in the classroom impacts students learning outcome	4.19	0.98

It is obvious that new generation (millennials) do like to use technology in their daily life and using it in the classroom has positive effect on students learning as stated by many researchers (Sheill, Lukoff, & Mazur, 2013; Preszler et al, 2007). Therefore, we asked the students if using technology-based formative assessment in the classroom impacts their learning outcomes, the results showed that they do agree (Mean = 4.19, SD = 0.98). For the open-ended question "Do you plan to use Plickers in your classrooms when you become a teacher? If the answer is yes, would you please explain the reasons?" indicated that they will use Plickers in the future when they become teachers. They offered a number of reasons; one of which is the excitement and fun that technology brings to the classroom; as one participant put it this way "it is fun of all ages for primary school or college students will have fun." Another participant wrote "it makes the lesson very easier and in a fun way". A second aspect that the researchers identified in the participants' responses to the above question is saving the learning

time. “Yes, I plan to use Plickers [because] it saves the learning time,” mentioned one respondent. Another respondent stated, “Another thing, it saves time because it can be done in a very quick [way].” Many of the respondents maintain that Plickers is good to break the traditional classrooms’ routines, as mentioned by one of the respondents in writing “Plickers is a great way to change the routine and change the ordinary atmosphere of the class”. Moreover, the participants indicated that using Plickers gives equal opportunities to all students to participate. “Students will have an equal chance to participate in the class,” stated one respondent. Another participant wrote, “Yes [I will use it] because by it all the students will be participating.” A third respondent stated, “It gives all students the chance to respond”.

Table 3: *Descriptive Statistics for the Plickers*

Items	Mean	SD
Plickers helps students get immediate feedback.	4.17	1.11
Plickers is simple for teachers to use in the class.	4.22	1.02
Plickers allows teachers to collect real-time formative assessment data without the need to use students’ devices.	4.22	1.07
Plickers helps in saving students’ responses for later use.	4.04	1.14
Plickers helps in showing students responses graphically.	4.27	1.02
I like it when teachers use Plickers in the classroom.	4.54	0.86
I feel comfortable in giving honest responses when teachers use Plickers.	4.12	1.27
Plickers allows students to deduce what incorrect answers are and why they are incorrect.	3.98	1.31
Students feel excited when Plickers is used for the first time.	4.49	1.01
Plickers helps in checking students’ progress and understanding of the content.	4.19	1.09
I plan to use Plickers with my students when I become a teacher.	4.26	1.04
Overall	4.23	0.56

The authors of this study have been using *Plickers* in their classroom and were interested in finding out its effectiveness for formative assessment to enhance students’ learning. Therefore, to further explore the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom, overall, students indicated that they agree on the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom (Mean = 4.23, SD = 0.56). As students, participants showed that they like and feel excited when instructors use Plickers in the classroom (Mean = 4.54, SD = 0.86), (Mean = 4.49, SD = 1.01), respectively. Furthermore, they stated that they plan to use Plickers with their students when they become teachers (Mean = 4.26, SD = 1.04). The students participated in this study know the features that *Plickers* provides its users, e.g. it helps students get immediate feedback about their responses; simple to use in the classroom, allows teachers to collect real-time formative assessment data without the need to use students’ devices, helps in saving students responses for later use, effective in showing students responses graphically with a mean range of 4.04 – 4.27 and standard deviation 1.02 – 1.14.

In analyzing and discussing the open-ended responses, the researchers centered their attention on the relevance of the responses to the research’s main questions. In other words, to what extent the participants’ open-ended responses contribute to the research questionnaire. Evidently, these responses supported the participants’ statements in the questionnaire, which strongly supported the researchers’ hypothesis that Plickers positively enhances formative assessment and consequently improves students’ learning. For example, improving students’ engagement by using Plickers as a tool for formative assessment is a huge factor in creating an effective learning environment that promotes learning.

In the open-ended questions, the participants' responses to the above statements are, overwhelmingly, about the difficulties and problems related to technical aspects. For example, one participant wrote, "the network might not work or it might be slow". Another respondent stated, "Sometimes there is no internet service in the classroom so it will be hard to for the teacher to move from one question to another," a third participant wrote, "The teacher may face technological problems. For example, access to the Internet." An additional aspect that emerged from the respondents' answers to the above question is that *Plickers* is only limited to objective questions. For example, one of the respondents wrote, "The teacher is limited to use the multiple-choice questions." On the other hand, some respondents questioned the security of the information, "You don't guarantee that there won't be no bugs in the application that may delete all the histories and answers you saved in the application."

The positive impact of using technology to improve learning as presented in the results of this study is in line with what a number of researchers have argued (Irving 2015, Ramsey & Duffy, 2016, Baylor and Ritchie, 2002). The participants also pointed out that the use of *Plickers* in the classroom creates fun and excitement which, eventually, aid the learning process. Another important factor identified by the respondents which expected to improve students' learning is that using *Plickers* saves the learning time. Giving all students in classroom equal opportunity to participate in one class session is a farfetched goal for many teachers. However, the respondents argued that *Plickers* eliminates this obstacle and gives all students, even the shy ones, equal opportunities to participate.

In regard to the problems, challenges and difficulties that teachers may face in using *Plickers* in classrooms, most of the participants pointed out that technology resources and support are the main issues. Some studies (Ali and Elmahdi, 2001; Fawzi, 2010) indicate that teachers' reluctance in adopting technology in their teaching activities is a global phenomenon. At the top of the factors that influence teachers to use technology is the technical support offered. Teachers do not integrate technology in their teaching activities unless they have been provided with just-in-time technical support. Ali and Elmahdi (2001) highlighted the proper integration of technology into instructional activities; stating that when technology tools "are not incorporated for the intended use, because of the inability to use, it defeats the very purpose for which they have been made available (p. 72).

CONCLUSION

An enormous amount of literature stressed the effectiveness of using formative assessment in the teaching and learning process. The main goal of the current study was to determine the effectiveness of using the technology based formative assessment tool classroom *Plickers*, in improving students' learning. The most obvious finding to emerge from this study is that using technology based tools, such as *Plickers*, enhances formative assessment and, consequently, improves students' learning. In addition, it is found that students' engagement is improved, when the teacher uses *Plickers* for formative assessment which leads to creating an effective learning environment that promotes learning. Furthermore, these tools help in providing individualized learning and engaging students with the feedback which, in turn, leads to creating effective teaching and learning environment. The participants in this study indicated the importance of using technology based formative assessment. Moreover, using technology based tools such as *Plickers* helps in providing feedback and makes the class interesting, fun and informative. Nevertheless, the Ministry of Education in Bahrain encourages the use of technology in all education institutions. Further empirical research is needed to investigate the effectiveness of using technology based tools for formative assessment and feedback on students' achievements and performance.

LIMITATIONS

Due to practical constraints, this paper cannot provide a comprehensive review of the perceptions of all the students in the University of Bahrain as the data was collected from one educational college. Collecting data from other colleges at the University of Bahrain, or other universities in the Kingdom of Bahrain, would make the results generalizable in a larger context.

RECOMMENDATIONS

On the basis of the results and findings this study recommends instructors to:

- Engage their students in formative assessment process to gauge understanding and correct misconceptions. Teachers can also check their teaching effectiveness and, accordingly, adjust and modify their teaching activities and strategies.
- Integrate technology in the classrooms because it enhances students' learning when it is used for formative assessment.
- Utilize new digital apps and software (like *Clickers, Socrative, Kahoot, Plickers* and *RecaP*) that aid them to apply formative assessment in their classrooms. These technologies collect real-time formative assessment data that help teachers provide instant feedback.

- Realize that formative assessment is a major teaching strategy within classrooms that provides both teachers and students with continuous, real time information that informs and supports teaching and learning.

REFERENCES

Ali, A. & Elmahdi, I. (2001). The wired Professor: A collaborative learning experience in one-on-one mentoring. *Journal of Computing in Teacher Education, 18*(2), 68 – 73. http://doi.org/10.1080/10402454.2001.10784436

Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers and Education*, *39*(4), 395-414.

Beatty, I. & Gerace, W. (2009). Technology-enhanced formative assessment: A research-based pedagogy for teaching science with classroom response technology. *Journal of Science Education and Technology*, *18*(2), 146–162. http://doi.org/10.1007/s10956-008-9140-4

Caldwell, J. (2007). Clickers in the large classroom: Current research and best-practice tips. *CBE Life Sci Education*. *6*(1), 9-20. http://doi.org/10.1187/cbe.06-12-0205

Damick, J. (2015). Implementing technology in an algebra classroom. MA thesis, NY: State University of New York.

Danielson, C. (2011). *Enhancing professional practice: A framework for teaching*, (2nd ed). Alexandria, VA: ASCD.

Elmahdi, I. (2003). Computers as roommates: The Ohio university residence hall computer project and the lives of first-year students. (Unpublished doctoral dissertation). Ohio University, Ohio. https://etd.ohiolink.edu/rws_etd/document/get/ohiou1080658294/inline

Fawzi, H. (2010). *Bleeding edge challenges: Limits on using CALL in EFL classrooms at the tertiary level*. In Egbert, J. (2010). CALL in limited technology contexts, CALICO, 9, 227-239.

Fies, M. & Marshal, J. (2006). Classroom response systems: A Review of the literature. *Journal of Science Education and Technology*, *15*(1), 101–109. http://doi.org/10.1007/s10956-006-0360-1

Irving, K. (2015). Technology-assisted formative assessment. In M. J. Urban and D. A. Falvo (Eds.), Improving *K-12 STEM education outcomes through technological integration* (380 – 398). http://doi.org/10.4018/978-1-4666-9616-7.ch017

Popham, W. J. (2011). *Classroom assessment: What teachers need to know*. Boston, MA: Pearson.

Preszler, R.W., A. Dawe, C. B. Shuster, and M. Shuster. (2007). Assessment of the effects of student response systems on student learning and attitudes over a broad range of biology courses. *CBE—Life Sciences Education. 6*(1), 29–41. http://doi.org/10.1187/cbe.06-09-0190

Ramsey, B., Duffy, A. (2016). *Formative assessment in the classroom: Findings from three districts*. Michael and Susan Dell Foundation and Education, *1*. Retrieved from https://education-first.com/wp-content/uploads/2016/05/MSDF-Formative-Assessment-Study-Final-Report.pdf

Ravitz, J. (2015). CILT2000: Using technology to support ongoing formative assessment in the classroom. *Journal of Science Education and Technology*, *1*(3), 293-296. Retrieved from http://www.bie.org/images/uploads/general/4fee92438c81d1d02ec7fdf785461c2f.pdf

Roschelle, J., Penuel, W., Abrahamson, L. (2004). Classroom response and communication systems: Research review and theory. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA, April, 2004. Retrieved from http://humansphere.com.sg/pdf/an/Classroom%20Response%20and%20Communication%20Systems.pdf.

Schell, J., Lukoff, B., & Mazur, E. (2013). Catalyzing learner engagement using cutting-edge response systems in higher education. *Cutting-Edge Technologies in Higher Education, 6.* 233-261. http://doi.org/ 10.1108/S2044-9968(2013)000006E011

Thomas, J., Lopez-Fernanda, V., LIamas-Salguero, F., Martin-Lobo, P., & Pradas, S. (2016). Participation and knowledge through Plickers in high school students and its relationship to creativity. UNESCO-UNIR ICT & Education Latam Congress 2016. Retrieved from http://research.unir.net/unesco-congreso/wp-content/uploads/sites/76/2016/06/u2016-REYNAJaraby.pdf.

Woike, B. (2007). Content coding of open-ended responses. In Robins, R. Fraley, C. Krueger, R. (Eds). *Handbook of research methods in personality psychology* (292-307). New York: Guilford Press.