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The Effectiveness of Using Interactive Multimedia Based on Motion Graphic in Concept Mastering Enhancement and Fashion Designing Skill in Digital Format

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Abstract—This This research is related to the effort to design a more representative learning system to improve the learning result of digital fashion design, through the development of interactive multimedia based on motion graphic. This research is aimed to know the effect of interactive multimedia application based on motion graphic to increase the mastery of the concept and skill of the students to making fashion designing in digital format. The research method used is quasi experiment with research design of Nonequivalent Control Group Design. The lectures are conducted in two different classes, namely class A as the Experimental Class and class B as the Control Class. From the calculation result after interpreted using Normalize Gain, there is an increase of higher learning result in student with interactive learning based on motion graphic, compared with student achievement on conventional learning. In this research, interactive multimedia learning based on motion graphic is effective toward the improvement of student learning in concept mastering indicator and on the aspect of making fashion design in digital format.

Keywords—interactive multimedia, motion graphic, fashion design in digital format

1 Introduction

One of the indicators of the modern system of learning in the second millennium era today is by making innovations that emphasize change [15], and the most rational form of change to adopt is to integrate the various components of learning both in the managerial system and learning techniques that develop the principle of modernity and technology with principles and theories of learning. However, the exploration of conventional teaching skills in the form of one-way-transfer of knowledge from teacher to students is still the choice of most teachers in teaching. Another weakness in fulfilling its competence, is that many teachers are not oriented to the development of technology in developing the subject matter [3]. These conditions resulted in less developed learning results obtained by students, because the materials that should be facilitated by technology like computer devices such in fashion design subject, still running conventional system in the implementation.

Currently, the development of information and communication media, both hardware and software occur rapidly, so that conditions have resulted in shifting the role of teachers, where currently teachers can no longer serve as the only source of information for learning activities of the students. Relate with it, then the teacher needs a media that can be utilized as an alternative source of information. One of the technology products that can be used as an innovative media in the learning process is the computer. The existence of today's computers has helped teachers in various interests related to their duties in designing, implementing and evaluating learning. Computers have been widely used in the teaching and learning process, with one goal that the quality of education going one step ahead with advances in technology. With computer-based learning, it is expected to help learners who have a slower learning speed (slow learner) in order to learn effectively, because computer can display the information that need to be repeat again and again, while for faster learners (fast learner) can stimulate learning activities [23].

Fashion Design like other design field, in its making is oriented by using computer technology (Computer Aided Design / CAD), so as to produce characterize fashion design in digital format and effective to be applied in the process of making of fashion product [16]. In this regard, the rational step needs to be taken in order for the learning process to succeed effectively, is to develop a learning program that optimizes all components of the teaching and learning process. An innovation is needed in the learning process that can motivate students to actively construct a knowledge so that the learning process it self becomes more meaningful. Meaningful learning will make students more master the material or concept given and will last longer in the memory of the brain. Such capability will be helpful in facilitating learning the concepts and skills in a lecture, especially in practical class. One component of education that can be developed in the learning process and assumed to have a pretty good influence in efforts to implement the achievement of teaching objectives on the fashion design in digital format, is to develop effective and efficient learning media, so the students have certain competence accordance with the purpose to be achieved [16].

Now Learning media is more diverse, ranging from conventional media such as books or traditional props to modern media audio visual form in cassettes, videos, and other modern visual device. Learning media used to optimize the teaching and learning process, strived to be able to grow creativity and motivation in learning activities to improve the quality of education [14]. One of the media used in learning and believed to be more exciting students interest in lectures is interactive multimedia learning. Learning media is also one of the alternative means that can optimize learning activities based on computer technology [13]. This interactive multimedia application is conditioned to present learning materials with a more interesting and informative display, so it is expected to facilitate and increase student interest to learn [6].

Efforts are made to obtain maximum results on the learning of making fashion design in digital format needs to be designed and developed by optimizing the use of innovative learning media and related directly in the mechanism of computer-based learning [11]. Efforts are made is expected to improve the quality of learning and can motivate students to actively constructed knowledge and skills in the making of fash-

ion design in digital format, so that the learning process in students becomes more meaningful. The use of multimedia in addition is assumed to increase the mastery of the concept of the fashion design process, is also expected to develop students skills in making fashion design in digital format.

Information technology in education is applied in the form of interactive multimedia in the form of software (software), which provides facilities to students to learn a material. The use of interactive multimedia applications in learning will improve the efficiency, motivation, and facilitate the active learning, experimental, consistent learning, with student-centered learning [3]. The use of interactive multimedia in learning is also very possible to improve the thinking ability that expected. In general, the benefits that can be gained through the use of interactive multimedia is the learning process can run more interesting, more interactive, the amount of teaching time can be reduced, the quality of student learning can be improved and the learning process can be done anywhere and anytime, and can improve students logic ability [17].

Wiyono [26], with research on interactive multimedia found that the improvement of mastering the concept of students who follow the learning using cooperative learning group with help from interactive multimedia is significantly higher than the students who follow the conventional learning. Sutarno [17], found that the improvement of mastery of the concept and critical thinking skills of students who follow the magnetic plate learning using online interactive multimedia is significantly higher than the students who follow the conventional learning.

This research is specifically done to develop the improvement of the concept and skill of fashion designing in digital format that is closely related to the ability to optimize the use of computer. This research is considered to have a high urgency, related to the demands of the world of fashion industry that is currently beginning to switch to the parameters of digitization in the process of product development, one of them is in the design area. Digital logic is considered richer because it contains programs with various facilities that can help the designers in generating more accurate and complex design ideas.

1.1 Fashion Design in Digital Format

Application of design will be linked with various objects associated with human needs such as architectural design, product design, interior design, fashion design and so on. Fashion design as a form of design to fulfill human needs for products and clothing, today has been transformed from the conventional parameters of the design basis, in digital format parameter. Aside from the fashion design as one of the manifestations of the creative process, it is empirically demonstrated changes format (visual display) a revolutionary. The manual design parameter in the previous decade still widely explored on the various interests of its design, is starting to shift and change the format to the digital format design (made by the process of computerization). Manufacture of computer-based fashion design, providing a visual and tangible image characteristics, so the details that exist on the clothing can be visualized with more expressive [24].

Entering the early 1990s there was a shift in the parameters of the fashion design process, which at that time the process of designing fashion began to be directed using a computer device. With computer technology a designer can freely explore and experiment in creating innovative fashion designs and can accommodate market demand. Computer design is a network of technological devices that are capable and versatile, so that a designer who has mastered computer technology in fashion design process, in general will be able to generate and realize ideas faster than when done in other ways. This is very supportive in realizing the production targets and efficiency that must be fulfill by fashion industry [18]. Digital logic is often judged to be richer as it contains software programs from world-class "libraries" of thinkers. For example, when a designer will design a certain type of clothing, then a collection of Clipart or Art Work such as facilities of fiber type, textures, motifs, colors, model line and models detail of clothing parts can utilized. Designers have the opportunity to create several variations, modifications and various creation from designs that have been made earlier as needed. With the expertise of it's maker, the design computer has been equipped with various facilities to help designers produce a more complex and can be re-formulated (edit), so designers do not have to repeat form scratch when the image is not exact with their desire [18]

Regarding to the criteria in the design element description and accuracy, then the computer medium is ideal in providing a real advantage on speed and flexibility. So many advantages that can be displayed from digital technology in the design area of fashion. However, design computers can't create images spontaneously/instantly, because these systems contain a number of very complex programs, so that every software program must be understood and mastered, then the device is linked to create an interaction pattern between its functions [18]. The mastery of the computer system in fashion design is a process that is not simple to understand, and it is inevitable that the condition should be anticipated through a set of specific learning process, in order to obtain a set of competencies in processing the design of fashion in digital format.

A digital image is a representation of a two dimensional image with a series of limited number of image or pixel element values. Pixel values typically represent color levels, gray scale, altitude, image sharpness, etc. Each pixel is a number represented as a DN (Digital number) that describes the average capacity of light in a relatively small space in a working area. The range of DN values is usually 0 to 255. The size of this area affects the reproduction of details within a working area [8]. Regarding to digital formulations in fashion design, there are several advantages that can be captured visually from the appearance, namely:

	Fashion Design Manual Format	**Fashion Design Digital Format**
Creation Techniques	Design made manually using drawing tools	Design made using computer
Generated Effect	➢ Artistic ➢ Show designers personal design style ➢ Flat drawing (2D)	➢ Modern ➢ Shows the arrangement of character's element/ material in more real way ➢ More expressive, because it can visualize designs model character more real ➢ Image have more volume on it (3D)
Product Diversification	➢ Difficult: Need repeating process from beginning ➢ Accuracy level is low	➢ Easy: Process can be done faster ➢ Accuracy level high
Design Form		

Fig. 1. Diversification fashion design product in digital format

Another advantage of this fashion design in digital format is its ability to be made in various variations with relatively little time to make it happen. These conditions provide many advantages when its developed on the design process in the fashion manufacture industry field, because it can increase productivity with unlimited creations. Therefore it is advisable for students who study the field of fashion design study around the world to master the technology of making design using computer.

Fashion designs are presented in digital format, in the manufacturing process involving aesthetic design, technical aspects and mathematical calculations, meaning that the design of clothing format digital format is not limited to theoretical graphics creation, but also need support practically. In traditional teaching, the effects of images and graphic structures can't be displayed visually, as are the printed books they serve as references, providing only a few of the required expressions, so they both exert an unfavorable effect on improving students understanding of material design subject [22]. In such situations it is urgent to develop multimedia learning devices to help students understand the teaching of digital format fashion design, thereby increasing the mastery of their concepts and skills in designing fashion in digital format.

1.2 Interactive Multimedia

The popularity of computer, network and multimedia technology is now believed to have opened various channels for students to enrich their knowledge, as well as to increase the competence of the field of science it is engaged in [22]. Through multimedia, teachers could present the information in an innovative manner and motivate

the students to learn quickly. Delivering the topic using multiple media could be more effective than doing it through a single medium [2]

Interactive multimedia is a multimedia equipped with user-operated controller tools, so users can choose what they want for the next process, like in interactive game and CD applications. The description in advance describes an important concept, that is, if the user gets the flexibility in controlling the multimedia, then the device is categorized as interactive multimedia. The most important characteristic of interactive multimedia is the students not only pay attention to media or object, but also required to interact during learning [10]. Diartono [2] describes that interactive multimedia combines and synergizes all media elements consisting of: a) text, b) graphs, c) audio, d) video, e) visual effect, f) sound effect, and g) interactivity.

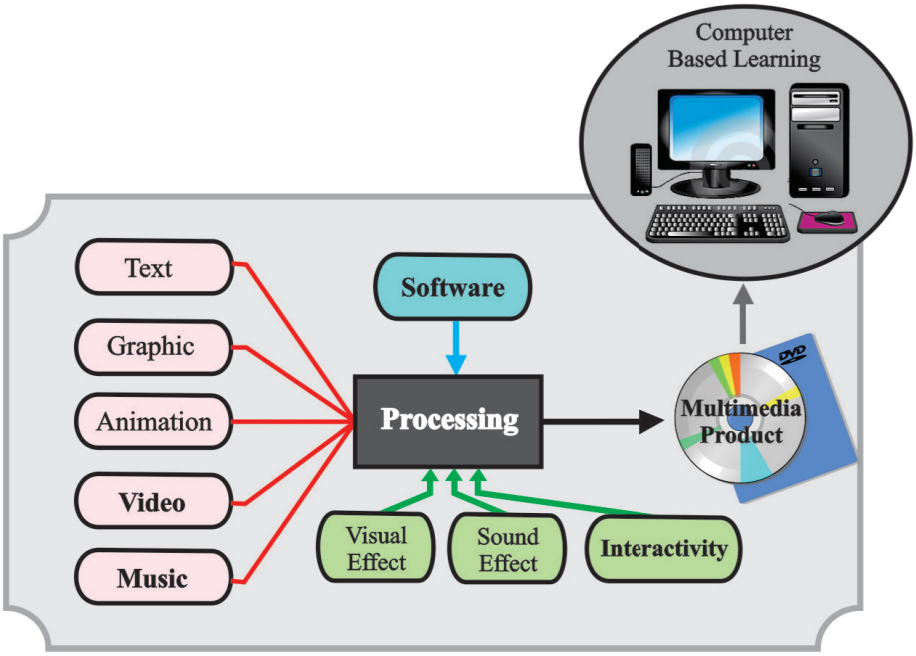

Fig. 2. The developing process in learning multimedia based on computer

Empirically interactive multimedia provides many benefits to the learning process, andthose benefits are: (1) Interactive means that multimedia program is programmed or designed to be used by individual students (independent study), (2) Giving individual affective which mean more affective in a more individual way, never forgetting, never bored, very patient in performing instruction, as desired, (3) Increasing motivation to learn (4) Giving feedback (response), and (5) Because interactive multimedia is programmed for self-learning, its utilization controls are entirely within the user. However in some areas interactive multimedia has several deficiencies, that is: 1) Development requires a professional team and (2) Development takes a long time with a lot of money [12].

Utilization of multimedia technology as an interactive learning method, is one of the learning tools for students, has some basic strengths, namely: [6] a) Mixed. Media using multimedia technology, various existing conventional media can be integrated into one type of intermediate media, such as text media (whiteboard), audio, video, which if separated will require more media. b) User control. Interactive multimedia implementation technology (IMMI), allows users to browse the teaching materials, according to the ability and background knowledge he/she had, in addition to making users more comfortable in studying media content, repeatedly. c) Simulation and visualization. Simulation and visualization is a special function possessed by interactive multimedia, so with animation technology, simulation and visualization of computer, users will get more real information from an abstract information. In some curriculum requires a complex, abstract, dynamic and microscopic process, so that by simulating and visualizing the learner will be able to develop the mental model in its cognitive aspect. d) Different learning styles. Interactive multimedia has the potential to accommodate users with different learning styles.

Looking at the various advantages offered by interactive multimedia on design learning, it is believed that the software developed in guiding the design students to learn the making of design with computer technology will provide a positive impact in improving students understanding and skills in making digital format fashion design in design education institutions in different parts of the world.

1.3 Motion Graphic

Motion graphics are actually part of animation techniques, where motion graphics is one of the categories of animation fields. Michael Betancourt, a film theorist, in an article titled The Origins of Motion Graphics reveals that motion Graphic is a graphics medium operated using video recording or animation technology to create the illusion of motion or rotation, and is usually combined with audio for use in multimedia projects for various purposes of publication, one of which is used as a medium of learning. Basically motion graphic means moving picture. Called a moving image because in the process of making it used many images sequentially and manipulated in such a way so it looks as if the image can move. The aim is to deceive the human eye into believing that there is movement. As an illustration can be found in a unmoving image, then the image is moved through changes made regularly and slowly, thus giving the impression of life [19]. Motion graphics are often used for television commercials, opening bumper, or for the purposes of visualizing various events.

The making of multimedia based in motion graphic is a continuous process, which is done through three stages of the process. Anwari [1] describes the process as follows: First, the pre-production stage, the making of concepts, scripts, and storyboards. Second, the stage of production, including the making of layout and character creation and key animation or key movement. Third, post production, which sometimes need to synergize with other production houses.

2 Methodology

The method developed in this research is Educational Research and Development (R & D), is a development of multi-media interactive learning on learning Fashion Design, to improve the understanding of concept and skill of fashion designing in digital format. Borg and Gall (1983) define R & D in education as "a process used to develop and validate education product", a process used to create, develop and validate research products. Both further states that:*... our use of term product include bot only material objects, such a text book, instructional films and so forth, but it also intended to refer to established procedures and processes, such as methods of teaching or methods organizing instruction*. [4]

The design of this study applied two groups of respondents, namely the Experimental Group and the Control Group. Both groups were pre-tested to determine the initial state of the respondents, whether there was a difference between the Experimental Group and the Control Group. The design pattern applied in this research refers to Pretest-posttest control group design concept proposed by Sugiyono [16], can be seen as follows:

Table 1. Design of Research Class Design Treatment

Class	Design	Treatment	Test	
			Begin	***End***
Experiment	O_1 X_1 O_2	X_1	Yes	Yes
Control	O_3 X_2 O_4	X_2	Yes	Yes

X_1 = Using Interactive Multimedia
X_2 = Using Conventional Learning

The difference test of two averages of two samples was conducted to determine whether between the Experimental Group and the Control Group there was a difference of N-gain (normalized gain) according to Hake (Widodo: 2010), were:

$$(\boldsymbol{N-gain}) = \frac{\%\ \boldsymbol{actual\ gain}}{\%\ \boldsymbol{potential\ gain}} = \frac{\%\ \boldsymbol{skor\ postes} - \%\ \boldsymbol{pretes}}{\boldsymbol{skor\ maksimum} - \%\ \boldsymbol{skor\ pretes}}$$

In this research, N-gain descriptive analysis using N-gain criterion according to Hake (Widodo: 2010) is shown in the following table:

Table 2. Category level of N-Gain

Limitation	Categori
$g > 0{,}7$	High
$0{,}3 \leq g \leq 0{,}7$	Medium
$g < 0{,}3$	Low

3 Result and Discussion

3.1 Result

The Development Result of Interactive Multimedia Design Based in Motion Graphic in the Digital Format of Fashion Design Learning. The development of multimedia based in motion graphic packed in learning software that can used to support the fashion design learning in digital. The following are some example of interactive multimedia based on motion graphic display in the making of fashion design learning that have been developed:

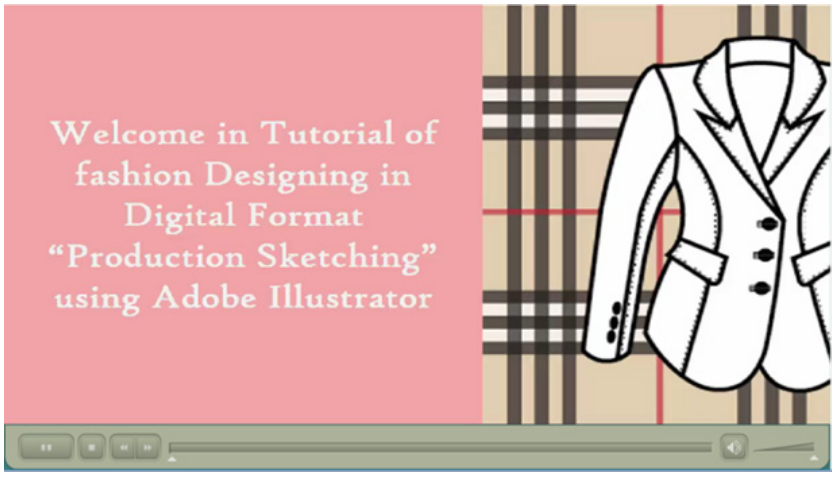

Fig. 3. Display interface of the making of production sketching design practice

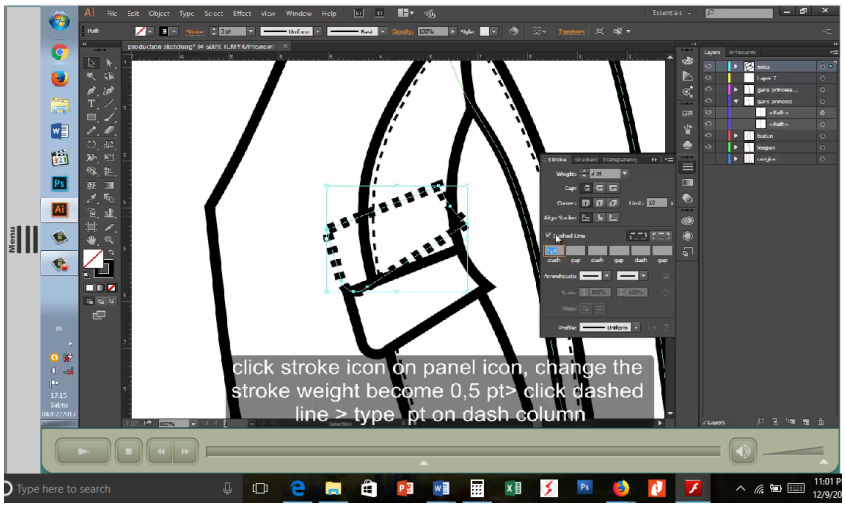

Fig. 4. The Tutorial of Making Production Sketching Design in Digital Format

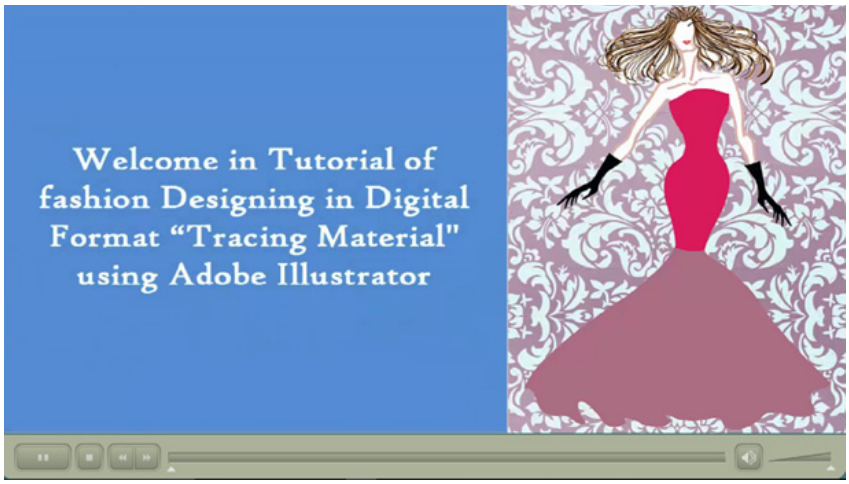

Fig. 5. Display interface of the Tutorial of The Making of Fashion Illustration in Digital Format

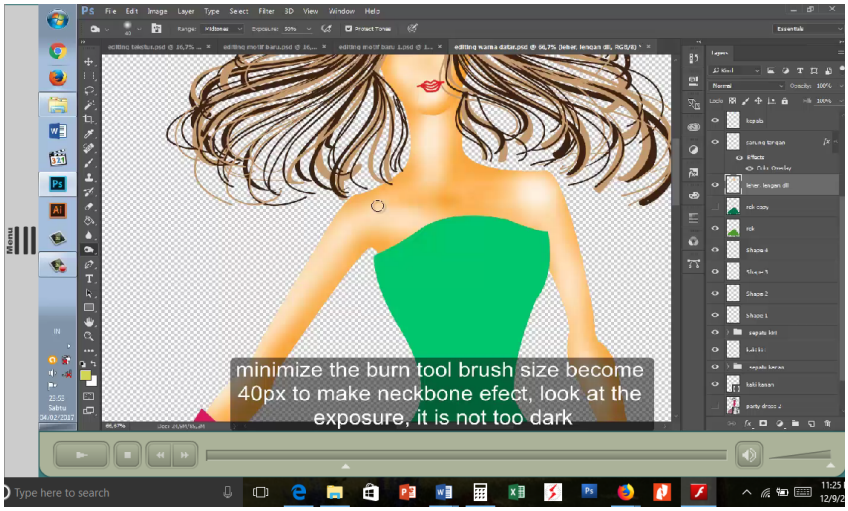

Fig. 6. Display of One of The Scene from Tutorial The Making of Fashion Illustration Design in Digital Format, to make 3D effect on its body

Data of Mastering the Fashion Design Concept. Based on the data processing of research results on the initial conditions of mastering the fashion design students showed: in the experimental group the average initial ability is 23.06 while in the control group 23.38.

In the next process, different treatments were given to the Experimental Group and Control Group. The Control Group was guided by the conventional method in the learning process, while in the Experimental Group applied the learning using interactive multimedia based on motion graphic.

Based on the calculation of the increase of learning result using Normalized Gain obtained the average increase of higher gain value in Experimental Class that is 71.31%, compared to average gain of gain value in Control Class equal to 65.24%, as illustrated in Figure 7.

Fig. 7.

Data of Fashion Design Making Skill in Digital Format. Based on the result of data processing of the research on the initial condition of the students ability in the fashion designing in digital format shows: in the Experimental Group the average of the initial ability is 29.00 while in the Control Group 25.58.

In the next process, different treatments were given to the experimental group and control group. The control group was guided by the conventional method in the learning process, while in the experimental group applied the learning using interactive multimedia based on motion graphic.

Based on the calculation of the increase of learning result using Normalized Gain after the treatment, the average gain of higher gain in the experimental class is 77.16%, while the average gain of the gain value in the control class is only 55.07%, as illustrated in Figure 8.

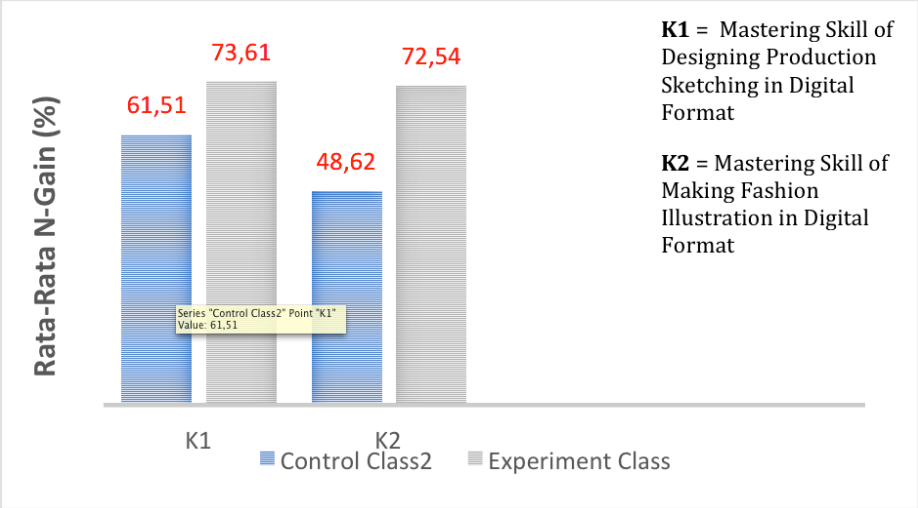

Fig. 8.

3.2 Discussion

In this study, the data collected is adapted to the needs of the analysis, namely the analysis of conceptual mastery and the skill of making the fashion design in digital format of the students of Fashion Desgn Education Program Study which is taught using interactive multimedia in the Experimental Class, and the learning without using interactive multimedia in the Control Class. Here are the results of research from the influence of the use of interactive multimedia to the mastery of the skills of making the fashion design in digital format:

The Influence of using Interactive Multimedia in Mastering the Concept. The material of the Fashion Design concepts discussed in this research consists of three sub-materials it's Fashion Design Elements, Fashion Design Principles and Fashion Design Format. The average gain of N-gain for the Experimental Class is 71.31% and the Control Class is 65.24%. The average N-gain for the Experimental Class is included in the high category, while in the Control Class included in the moderate category. Based on these data it can be seen that the average N-gain for the Experimental Class is higher than the average N-gain of the Control Class. The comparison result of the average of N-Gain in mastering the concept in the experimental class and control class for each sub material, obtained the largest N-Gain average in Fashion Design Element sub material, while the smallest N-gain of both classes is obtained in Fashion Design Format sub material. This is allegedly due to the characteristics of each sub-material that affects the delivery of the material in the interactive multimedia used. Format Design sub material has a high degree of difficulty in understanding, because the material contained very specific aspects of technical mastery of the fashion design, especially in Design Production Sketching, in the form of an understanding of 1) developing in the format/shape of fashion design,

2) the concept of the forming and accuracy of the parts of fashion products, 3) the material concepts in the manufacturing process of the garment industry, 4) the concept of the standard size of garment products, and 5) the concept of labeling of garment products. Different from the concept mastering of Fashion Design Elements and Principles which tend to be easier to understand because it more relate to daily life in the use of clothing, the concept mastering of fashion design formats need more detailed review and analysis, especially since this material is closely related to the manufacturing process of clothing products in the garment industry. The data acquisition shows that learning using interactive multimedia is able to provide a better learning experience to the learners, especially from the interesting display of material that presented and time to learn that is not limited by the segment of time in the classroom learning.

The Influence of Multimedia Interactive in the making of Fashion Design in Digital Format Mastering Skill. Psychomotor skills indicator is expressed by Sudrajat (2008) that psychomotor-related subjects are more movement-oriented subjects and emphasize physical reactions and hand skills. The skill itself shows a person's skill level in a particular task or set of tasks. The approach of motor skills to its implementation is related to the concept of process skills, which is a management of teaching and learning activities that focus on active and creative student involvement in the process of obtaining learning outcomes. This approach to process skills is seen as an approach that many experts best fit into the implementation of learning, in order to cope with the growth and development of science and technology. Process skill is the whole directed scientific skill (both cognitive and psychomotor) that can be used to find a concept, principle or theory to develop a pre-existing concept, or to denial an invention (Trianto, 2007). According to Mulyasa (2007), Approach Process Skills is a learning approach that emphasizes the learning, activities, and creativity of learners in acquiring knowledge, values and attitudes, and apply them in everyday life. Learning using a process skill approach is a learning process designed in such a way that students can find facts, build concepts and theories with students' own process skills and scientific attitudes.

Initial test and final skill tests results in the making of fashion design in digital format resulted in average N-gain of the Experimental Class at 77.16% and the Control Class at 55.07%. The average N-gain for the experimental class included in the high category, and the control class is the medium category. Based on these data it can be seen that the average N-gain for the experimental class is higher than the control class. The results of the data analysis show that the use of interactive multimedia on the learning of making fashion design in digital format effective in improving the skills of designing fashion in digital format, because the interesting display of this learning media can increase the interest and motivation of learners to learn. Apart from that learners can do the learning process wherever and whenever they want it, without the limited time of classes and classrooms. Indicator of the skill of making fashion design in digital format, divided into 2 qualifications 1) the qualification of production sketching design, which are: a) the overall fashion form accuracy; b) the accuracy of model detail; c) the ability to predict the size of clothing parts, d) the ability to create and visualize the critical point of the clothes part, e) the

ability to include standard sizes, f) the ability to analyze the use of the main material and supporting material, g) the ability to determine the type, material and label laying, and 2) the qualification to forming the design of fashion illustration: a) the ability to create structures/illustrative shape of designs that will be made, b) the ability to deform the anatomical parts of the design, c) the ability to display aesthetic aspects on the design format, d) the ability to perform color editing, pattern, textures and special effects on the design format created.

4 Conclusion

This paper describes the various advantages offered by interactive multimedia devices in teaching fashion design in digital format, and applied to learning activities in the design class. The system designed in this paper helps to enhance design student's understanding of technology, which is oriented towards the student's interactive learning process, by providing interactive learning resources supported by multimedia software. Through data processing research, it can be seen that the resulting software is able to stimulate interest and encourage students to learn, able to guide the learning process of students and help in improving student learning outcomes in the form of mastery of concepts and skills to fashion design in digital format

5 Closing

Based on the results of research and discussion shows that the use of interactive multimedia based on motion graphics significantly influence the improvement of learning outcomes in making fashion design in digital format, the real implementation of the learning process of fashion design becomes urgent to be done immediately. In addition to the conclusion above, to obtain better results expected time planning in learning is one thing that must be carefully set by the next researcher, because many unexpected things that can arise in the learning activities.

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Construction and Implementation of Teaching Mode for Digital Mapping based on Interactive Micro-course Technology

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Abstract—The era of "Internet + education" has caused reforms in teaching ideas, teaching modes, and learning styles. The emergence of micro-course technology provides new strategies for integrating learning styles. Task-driven digital mapping teaching, known as traditional classroom organization, has poor teaching effect due to single learning style and strategy. A new teaching mode for digital mapping was constructed in this study based on micro-course technology by combining interactive micro-course technology and digital mapping teaching to adapt to the demands of modern teaching. This teaching mode mainly included four modules, namely, micro-courseware, micro-video, micro-exercise, and micro-examination. It realized the hierarchical teaching of knowledge points in digital mapping course, simplification of basic principles, simulation of engineering cases, and self-evaluation of learning outcomes. The teaching mode was applied to 114 students from the Mapping Engineering Department of Henan University of Urban Construction. Results indicate that the proposed teaching mode based on interactive micro-course technology promoting the independent after-class learning of the students, stimulating their learning enthusiasm, enhancing their practical abilities of the students, and improving the effect of teaching. This mode of teaching provides a new concept for the teaching mode reform of other courses in mapping engineering.

Keywords—interaction, micro-course, digital mapping, teaching mode

1 Introduction

Micro-learning has been gradually introduced into the lives of people in recent years given the popularization of informationized education and the rapid development of the Internet. As an effective resource for micro-learning, micro-course is highly appreciated by learners [1]. Micro-course is a short and incisive network video teaching course with flexible and free learning styles. It uses micro-teaching video as the major carrier and is mainly designed for specific knowledge points or teaching nodes of courses. The development of micro-course expands the connotation and denotation of traditional teaching mode. It is the key of teaching mode reform in universities and colleges at present [2] [3].

Digital mapping is an important course in mapping engineering. It plays the basic role in undergraduate teaching and lays the foundation for deep learning and study of mapping engineering. Currently, digital mapping mainly adopts the traditional mode of teaching, that is, teaching–demonstration–exercise, in many universities and colleges. However, this traditional mode of teaching has the following limitations. Relative simple teaching mode cannot sufficiently meet the demands of modern classroom teaching. Moreover, in this mode, teachers are the center in teaching activities, whereas students play a passive role in learning. Digital mapping neglects the subjective role of students and lacks interaction [4] [5]. Therefore, designing, developing, and applying interactive micro-course into teaching of digital mapping is an important research topic.

2 State of art

The concept of micro-course was developed by Penrose from San Juan College in New Mexico. This concept laid the foundation for the development of the micro-course theory. Recently, many educational institutions have begun to exert great efforts in the design and development of micro-video teaching. The most well-known is that of Salman Khan, founder of Khan Academy and launched a number of online video courses that offer free, high-quality network learning resources to learners around the whole world [1]. Moreover, the development of online teaching using micro-video has allowed educational scholars to further explore the application of micro-video in classroom teaching, including the realization of independent learning of learners by using micro-video in teaching during reform of classroom teaching mode.

Relatively, micro-course began late in China, and relevant studies have been reported. Liang is one of the early scholars who studied micro-course in China. He was the first Chinese to propose and believe that the concept of micro-course would surely become a new mode of teaching and learning style [6]. Moreover, Xie discussed the characteristics of interactive teaching using micro-video and system model and summarized the advantages of this mode of teaching through a contrastive analysis between interactive teaching using micro-video and video demonstration lessons [7]. Jin presented the construction of connotation of a main course system for different majors based on interactive micro-course [8]. The aforementioned research achievements suggest that existing studies on micro-course teaching in the world still have some shortcomings. (1) Given that Chinese studies on micro-course began late, most of the existing studies have focused on concept, meaning, feature, and other superficial discussions of micro-course but rarely involved its design and application. (2) Existing studies on micro-course mainly focus on videos but neglects the subjective role of students and lacks interaction. Thus, interaction in micro-course must be improved further. (3) To some extent, micro-course is applicable to teaching studies [9]. It is suitable to studies with simple concepts but needs further investigation when applied to complicated courses.

In the present work, a teaching mode for digital mapping is constructed based on interactive micro-course technology by combining interactive micro-course technology and digital mapping teaching. This mode of teaching mainly includes four modules, namely, micro-courseware, micro-video, micro-exercise, and micro-examination. It realizes the hierarchical teaching of knowledge points in digital mapping course, simplification of basic principles, simulation of engineering cases, and self-evaluation of learning outcomes.

3 Construction of the teaching mode for digital mapping based on interactive micro-course

On the basis of interactive micro-course and knowledge points in digital mapping course, a teaching mode for digital mapping based on interactive micro-course technology should include the core elements, namely, survey and analysis, design of interactive micro-course, and evaluation. The teaching mode for digital mapping based on interactive micro-course is shown in Fig. 1.

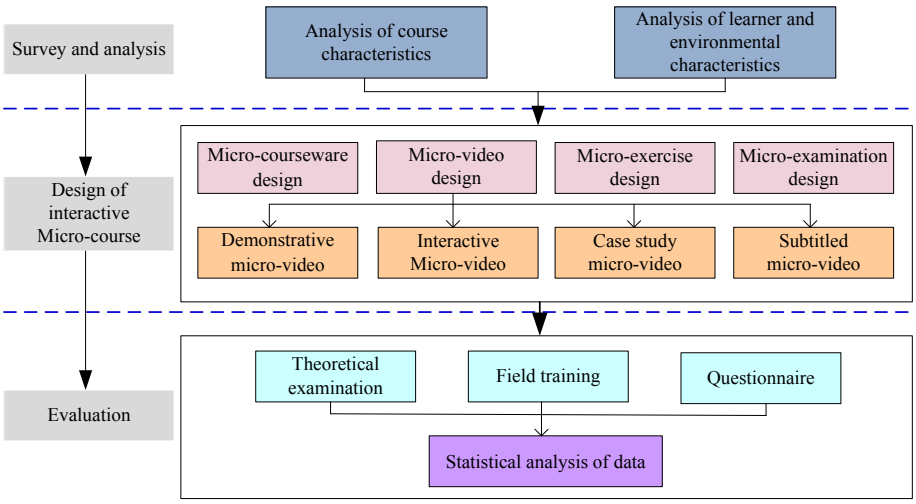

Fig. 1. The teaching mode for digital mapping based on interactive micro-course

3.1 Survey and analysis

Analysis of course characteristics. The digital mapping program in Henan University of Urban Construction includes theory teaching, classroom experiment, and production internship. This course focuses at large-scale digital mapping and introduces its principle, method, and applications comprehensively based on the elaboration of basic principles, basic theories, and measurement methods of surveying. The teaching content emphasizes on the integration of theories and practices and involves

an extensive scope of knowledge and application fields [10]. In view of course contents, the characteristics of digital mapping are manifested in two aspects.

Strong logicality in formula derivation. For example, distance measurement by using phase method calculates distance according to the phase changes of continuous sinusoidal signals emitted by the total station instrument during reciprocal propagation on the measured distance. The calculation is as follows.

Sinusoidal signals of the total station instrument,

$$u = V_m \sin(\omega t + \varphi_0) \tag{1}$$

Where V_m denotes the amplitude, ω is the angular frequency, t represents time, and φ_0 is the initial phase.

Phase at emission,

$$\Phi_1 = \omega t_0 + \varphi_0 \tag{2}$$

Phase at reception,

$$\Phi_2 = \omega t_0 + \varphi_0 + 2\omega t_D \tag{3}$$

Phase difference,

$$\Delta\Phi = \Phi_2 - \Phi_1 = 2\omega t_D \tag{4}$$

Therefore,

$$t_{2D} = 2t_D = \frac{\Delta\Phi}{\omega} \tag{5}$$

Combining with $D = \frac{1}{2} \cdot v \cdot t_{2D}$, yields

$$D = \frac{1}{2\omega} \cdot v \cdot \Delta\Phi \tag{6}$$

In addition, given

$$\omega = 2\pi f \tag{7}$$

$$v = \frac{c}{n} \tag{8}$$

And

$$\Delta\Phi = N \cdot 2\pi + \Delta\varphi \tag{9}$$

The distance measurement formula of the phase method is

$$D = \frac{c}{4\pi fn}(N \cdot 2\pi + \Delta\varphi) \tag{10}$$

Strong practicality. In traditional teaching method, teachers are mainly responsible for teaching theories and demonstrating operations, which mainly focuses on imitation. The application of interactive micro-course technology can make intuitive micro-video or micro-courseware, such as operation of surveying instruments, three-dimensional coordinates collection, topographic control surveys, total station instrument-based digital mapping data collection, and software mapping. Such teaching

mode allows students to have interactive operational learning during and after class, thereby stimulating their learning enthusiasm and learning efficiency [11] [12].

Analysis of learner and environmental characteristics. Most students of digital mapping course major in mapping engineering. Students are generally good at operation. According to a class survey, 100% of the students have smart phones, and 92% of the students have laptop or computers. Most of these students are willing to have contact with live video, micro-video, and other network resources. Moreover, Henan University of Urban Construction basically completed campus informatization and digitalization with a wireless network that covered the entire university. Through this development, students can connect their mobile devices to the Internet at any time and place within the campus.

3.2 Design principle of interactive micro-course

Learning on micro-course is mainly an independent learning behavior of learners. The course design shall focus on the subjectivity of students and guiding role of teachers and follow the following principles to achieve a satisfying effect of learning.

1. Explicit objective and content integrity. The design of micro-course shall include explicit learning objective and complete teaching design. It shall divide the entire course content into small knowledge modules that gradually extend and form a series of connected hierarchical micro-courses.
2. Interaction. The one-way propagation of traditional teaching mode changes and interactive teaching is realized, thereby transforming the learning style of learners from passive to active. The design shall create learning scenarios and interaction links, and provide corresponding tasks, interaction questions, interaction simulation training, and evaluation test, except for teaching using micro-video.
3. Practicability. Digital mapping is a course with strong practicability. After mastering the basic theoretical knowledge of the course, learners shall operate surveying instruments to combine theoretical knowledge and practical content. Therefore, attention shall be paid to practical application during the design of interactive micro-video.

3.3 Design of interactive micro-course

The interactive micro-course mainly has four modules, namely, micro-courseware, micro-video, micro-exercise and micro-examination.

Micro-courseware design. Interactive micro-course guides students toward independent learning, that is, knowing their learning objective and task and applying the knowledge points they have learned. Therefore, the design of micro-courseware shall cover micro-course subjects, learning objective, learned knowledge points, and hierarchical relationships of knowledge points. For example, distance measurement by using the phase method is an important knowledge point in digital mapping and requires students to master the distance measurement principle of total station instrument. It involves electromagnetism, physics, and other theories. Moreover, many

formulas and strong logics are involved. Hence, a micro-courseware for distance measurement is created based on phase method to display the deduction process of mathematical expressions thoroughly, as shown in Fig. 2.

Moreover, some abstract and difficult principle knowledge points are transformed in digital mapping into vivid and beautiful animations by using two-dimensional animation manufacturing software and attached with lively interpretation and texts. An animation micro-courseware is designed. The micro-courseware for quick, short-step measurement principle by using the polar coordinate method is shown in Fig. 3.

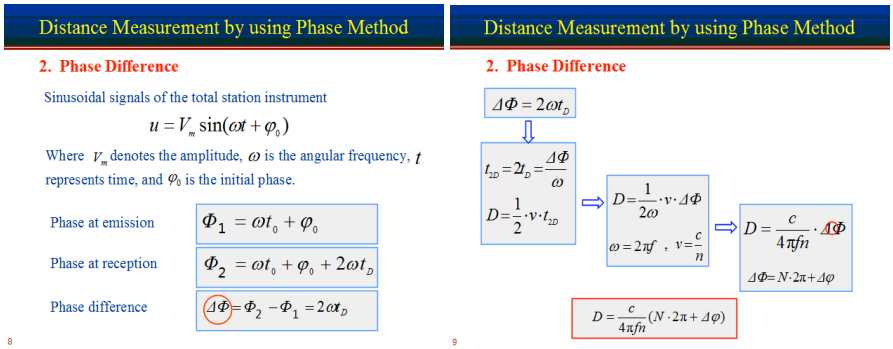

Fig. 2. Micro-courseware of distance measurement based on phase method

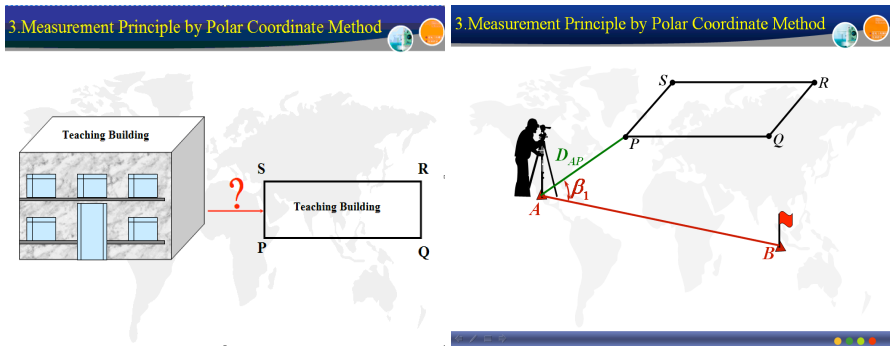

Fig. 3. Micro-courseware of measurement principle by polar coordinate method

Micro-video design

Demonstrative micro-video. Topographic data acquisition by using total station instrument is an important knowledge point in digital mapping. It mainly includes centering leveling of instrument, input and orientation of station data, and data acquisition of topographic characteristic points. The input and orientation of station data will directly influence the accuracy of data acquisition in the late period. Hence, a demonstration teaching video of the Reid and South total station instrument is created, as shown in Fig. 4.

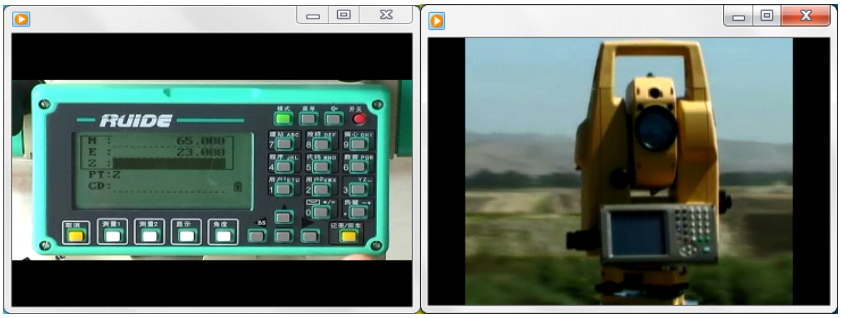

Fig. 4. Micro-video demonstration of the operation of total station instruments

Interactive micro-video. The teaching mode of simulation theoretical teaching and practices, interactive penetration, and gradual advancing is adopted for knowledge points that combine theories and practices in digital mapping [13]. The teaching mode that combines teaching and demonstration is applied in making the micro-video. For the convenience of interaction, two functions are applied to realize interactive micro-video. The first function is the bullet screen of the video. Here, students could discuss and express evaluations to specific contents in the video in real time while teachers could make further analysis and interpretation according to these comments to solve existing problems timely. The second function is the insertion of corresponding examination questions in the middle of the micro-video to test the mastery of learners regarding previous contents. For example, the micro-videos of large-scale topographic field data acquisition applied the point measurement method, the collection of quick, short step points, and the drawing of surface features at proper nodes, except for the bullet screen, by using a total station instrument and South field survey drafting of topographic map.

Case study micro-video. Production internship is an important part in the teaching mode of digital mapping. Students have to practice in an actual engineering environment. Therefore, micro-video shall be combined with actual engineering in specific production unit so learners can combine the technologies and specific engineering that they have learned, such as digital mapping tasks for the municipal administration building in the new urban district of Pingdingshan (Henan Province), Xiangyun Park, Baiguishan Reservoir National Wetland Park, closely through the learning of the micro-video, as shown in Fig. 5.

Subtitled micro-video. Subtitle is often added in micro-videos, except for corresponding teaching contents, such as opening subtitle, middle prompt texts, and end subtitle. The opening subtitle is often used to display topic information and key points of the micro-course, such as data acquisition by total station instrument. A subtitled micro-video is shown in Fig. 6.

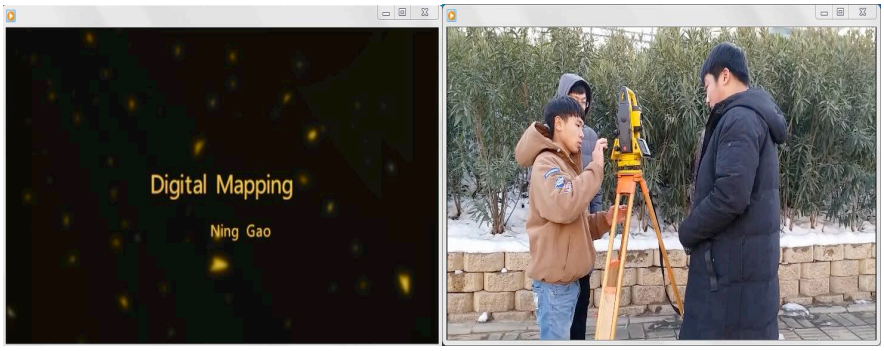

Fig. 5. Micro-video of production internship

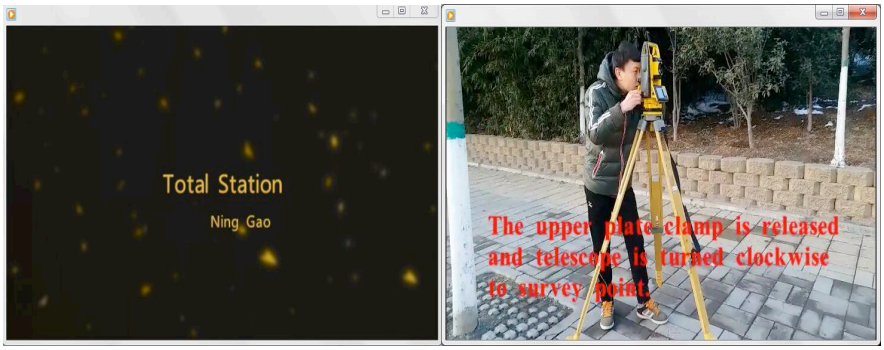

Fig. 6. Subtitle micro-video

The middle subtitle mainly interprets knowledge points that are difficult to understand and provides prompts to key operation steps that can help students to remember them. The end subtitle summarizes and reflects that problems of the micro-video.

Micro-exercise and micro-examination design. To ensure that students learn, interactive technology should be used to realize, exercise, and examine the functions in micro-course. Key attentions are paid to two aspects during the design.

During micro-video playing, questions or linkage of assisting teaching resources pop up. Students have to answer these questions to continue playing the micro-video.

To evaluate the effect of learning man–computer interactive exercises and examinations are offered after watching the micro-video, which requires meticulous design in content and form. The examination has diversified forms of question, including gap filling, calculation, and choice, true-or-false, definition, short-answer, and comprehensive questions. For the convenience of interaction, learners can check their scores and answers after submission and evaluate their learning outcome according to the scores they have obtained.

4 Application and analysis of effect

To comprehend the practice performance of interactive micro-course in digital mapping, the proposed teaching mode is applied to the teaching of digital mapping in the second semester of the academic year 2016–2017.

4.1 Respondents

Students of two parallel classes in mapping engineering from the Henan University of Urban Construction are selected as respondents. Classes 0614151 (57 students) 0614152 (57 students) are referred to as ordinary class A and experimental class B, respectively. The proportion of male and female students is generally equal. The two classes are taught by the same teacher and taught with the same content, schedule, and credit hours.

4.2 Statistical analysis of data

Data are collected from experimental class B. After implementing the micro-course teaching mode in digital mapping, the interaction module receives the maximum comments, that is, 607, showing an average value of 10.6. Clicks of the micro-video reached 127 clicks/lesson and the reading times are higher than 100 times/lesson. Approximately 95.83% participated in exercises, examinations, and discussions independently. Particularly, the comprehensive practice videos are browsed by more than 229 times and received more than 115 comments. The videos realized the goal of independent learning effectively. Moreover, these videos not only exhibit considerable effect of teaching and realize individualized and systematic learning of students effectively but also meet the requirements of high interaction, strong experience, and high participation.

4.3 Questionnaire on the effect of teaching

Interest on micro-course learning and knowledge points of experimental class B are surveyed through questionnaires to investigate the effect of the application of interactive micro-course in digital mapping.

The contents of the investigation are as follows: a) investigation on learning interest and interest on knowledge points; and b) key theories, difficult theories, knowledge points that combine theory and practices, instrument operation demonstration, instrument learning, software learning, and engineering cases.

The statistical results are presented in Fig.7 and Fig.8. Approximately 96.49% of students are interested in interactive micro-course. Students pay high attention to knowledge points that combined theories and practices, as well as engineering cases.

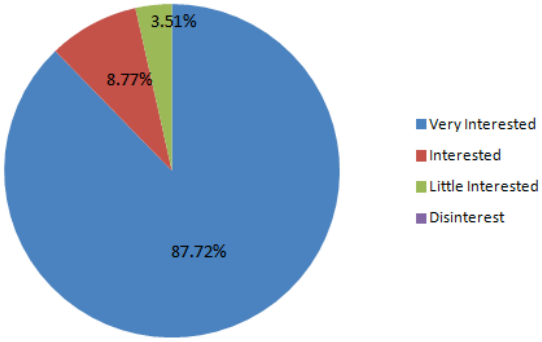

Fig. 7. Questionnaire on learning interest

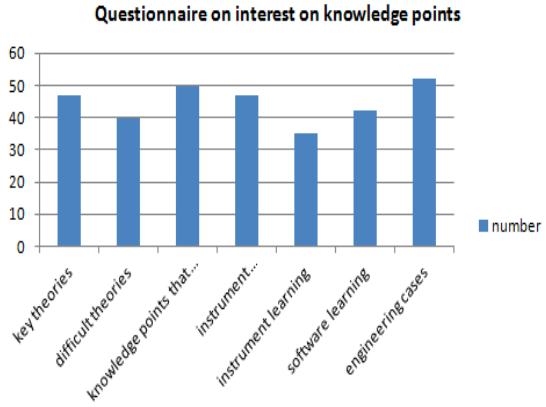

Fig. 8. Questionnaire on interest on knowledge points

4.4 Contrastive analysis of academic performances between the experimental and the ordinary classes

A parallel test is conducted to the two classes after they are taught to examine the effect of interactive micro-course teaching mode and evaluate the mastery of students and skilled application of field data acquisition using total station instrument and software mapping. The testing contents included theoretical examination and field training. Field training is conducted in the gymnasium of the Henan University of Urban Construction in the range of 100 m * 100 m (1:1000). The field training area is shown in Fig. 9, and the statistics of the test results are shown in Table 1.

(a) Gymnasium (b) Survey control point

Fig. 9. Field training area

Table 1. Contrastive analysis of academic performances between ordinary and experimental classes

	Test contents			
Test class	***Average academic score in theory examination***	***Field survey data collection time using total station***	***Software mapping time***	***Terrain accuracy***
Ordinary class A	78	80 min	55 min	91%
Experimental class B	86	55 min	35 min	96%

Table 1 shows that experimental class B achieved better average academic score than ordinary class A, reaching a good standard. In field training, experimental class B takes 25 min shorter to accomplish field data acquisition compared with ordinary class A, and the mapping accuracy is significantly high. With respect to software mapping, experimental class B takes 20 min shorter than class A and the mapping accuracy reaches 96%. These results suggest that the interactive micro-course could actually increase the learning efficiency of students and help them solve actual problems.

5 Conclusions

To address the shortcomings of traditional teaching mode for digital mapping, interactive micro-course technology was applied into teaching, from which a new teaching mode was constructed. This mode includes four modules, namely, micro-courseware, micro-video, micro-exercise, and micro-examination, and was applied to digital mapping course in mapping engineering in Henan University of Urban Construction. The conclusions are drawn as follows.

1. Interactive micro-course teaching is a new teaching mode that can meet the learning demands of different learners, provide large spaces for free choice, and allow teaching in accordance to aptitude.
2. Interactive micro-course teaching provides students with explicit learning objectives and tasks by issuing micro-courseware, micro-video, micro-exercises, and micro-examination, thereby making complicated engineering cases vivid and objective. This mode of teaching is conducive for the independent learning of students.
3. Interactive micro-course teaching increases the theoretical level and practice ability of students and expands their learning horizons.

This study is merely a preliminary exploration in the application of micro-course in digital mapping. Relevant studies are expected to attract more scholars to provide effective learning resources and environment for learners, and thus facilitate the training of innovative and productive talents.

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Classification Technique of Interviewer-Bot Result using Naïve Bayes and Phrase Reinforcement Algorithms

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Abstract—In recent years, both foreign and national companies tend to conduct English-based interviews when recruiting new employees. Consequently, college graduate must be ready for English-based interviews during the process of seeking employment. To meet these requirements potential candidates tend to practice conversing in English with someone who is proficient in the language. Nevertheless, it is not easy to have someone who is not only proficient in English, but also have a good understanding of common interview questions. This paper presents the development of a machine which is able to provide practice on English-based interviews, specifically on job interviews. Interviewer machine (interviewer bot) is expected to help students practice speaking English appropriately for job interview. The interviewer machine design uses words from a chat bot database named ALICE to mimic human intelligence that can be applied to a search engine using AIML. Naïve Bayes algorithm is used to classify the interview results into three categories: POTENTIAL, TALENT and INTEREST students. Furthermore, based on the classification result, the summary is made at the end of the interview session by using phrase reinforcement algorithms. By using this bot, students are expected to practice their listening and speaking skills, also to be familiar with the questions often asked in job interviews so that they can prepare the proper answers. In addition, the bot users could know their potential, talent and prospects in finding a job. Hence, they could apply to the appropriate companies. Based on the validation results of 50 respondents, the accuracy degree of interviewer chat-bot (interviewer engine) response obtained 86.93%.

Keywords—Job interview; Words classification; Natural language processing; Phrase reinforcement algorithm; Naïve Bayes algorithm.

1 Introduction

Competing in the global economy has given companies the need to recruit employees who are proficient in English. However, many of the prospective employees are facing difficulties in meeting the required English skills of the companies. Lack of facilities that support the students practising English in the educational environment will greatly affect the number of students who have the ability to communicate in English [1]. To date, the students' English skills, especially for a job interview, were only trained traditionally in English courses or English clubs which are managed independently by the students. There has not been a specialized training aimed at improving and measuring students' ability to communicate in an English-based job interview. Thus, a breakthrough software program that could significantly improve students' ability to speak English is highly needed, particularly those related to a job interview, aiming at increasing the opportunity of passing the job interview [2]. The development of technology and human lifestyle allows people to conduct online conversations (chat) in English through the internet. Communication could be in the form of text (text chat) or voice (voice chat). Users could send messages using text or voice to the online receiver, then the receiver could also reply with text or voice [3]. Artificial intelligence is created and inserted into a machine (computer) so that the machine could perform the task of conversing similar to humans. One of the artificial intelligence areas is Natural Language Processing (NLP) which enables the computer/answering machine the ability to read and understand the language used by humans. The NLP system requires computational linguistics ability to process the input resulted in an output that can understand human language as natural as possible. One of the machines that was created using this system is ELIZA, which is developed into today's chatterbot named ALICE (Alicebot) by Wallace. The AIML programing language is used in the first generation of Alice bot as a basic implementation of the system [4] [5] [6] [7] [8] [9] [10]. Artificial intelligence in the ALICE system used by the interviewer-bot to create the basic ability to interact with humans. The ALICE system was then integrated with Naive Bayes method that serves to classify the responses given by the users into groups of assessors with the assessment results. Then the classification results were processed using Phrase Reinforcement Algorithm to obtain conclusions of each assessor group [11] [12] [13].

Motivated from above researches, this paper presents the development of a machine which is able to provide practice on English-based interviews, specifically on job interviews. In summary, the contributions of this work are described as follows:

a) We propose an alternative solution to the student's lack of ability in an English-based job interview.
b) We build interviewer-bot application using PHP framework. This application will make a positive contribution and interactive services to enhance the students' potency, especially the ability to answer questions during the job interview in English [14] [15].

2 Related Works

Intelligent Tutoring Systems are computer programs aiming to provide personalized instruction to students. One of the mostly used is chatter-bot, a machine which provides conversational practice for users. The most popular chatter-bot on the internet, ALICE (Artificial Linguistic Internet Computer Entity) is written in AIML (Artificial Intelligence Markup Language), an open XML language. Burguillo, *et al*. in [16], the authors use of AIML-based bots for tutoring purposes in open e-Learning platforms i.e. Claroline or Moodle as the basic idea of the research. Burguillo, *et al*. in [16] developed two different user-friendly bots that already integrated in Claroline and Moodle, aim at not only to help students learn, but also support the lecturers on their teaching. A tutor bot (T-Bot), which is developed for students, could analyse the requests in written text and provide suitable answers about the course contents. On the other hand, evaluation bot (Q-Bot), developed for the professors, used questionnaires to track and supervise each student's learning progress.

As stated before, chatter-bots are human-like conversational-based software programs. It could be used as a conversation partner in specific knowledge domain depending on the software designer. The AIML, Artificial Intelligence Markup Language, is a XML derived language mostly-used to build chatter-bot knowledge bases on a case-based reasoning and textual pattern matching algorithms. In [17], a novel algorithm is implemented on an Italian-based chatter-bot to automatically generate AIML knowledge bases to answer the frequently asked question (FAQ) text file and a glossary of terms. This chatter-bot could be applied in e-learning to assist users navigate the learning system in the form of speaking avatar, such as in a distance learning session. The students could ask the digital assistant, in this case the chatter-bot, questions about the learning materials on the form of text based question and answer system.

Access to an institution's or company's information system is generally performed by manual navigation on the website menu and content built by the institution or company itself. Along with the development of technology and the company's desire to expand their services to customers, information can also be obtained through a chat between user and a virtual customer service. This study aims to build chatter-bot which serves as a virtual customer service that provides information to users with access to database query and website content. The research resulted on a chatter-bot prototype built using the O program, which is AIML interpreter based on PHP programming language and MySQL database. Artificial intelligence (in this case, the ALICE system) used by chatter-bot to form its basic ability to interact with humans. The advantage of this chatter-bot is the speed to access information; because data are sent and received by users in form of a text. Additionally, since its data searching methods; crawler (get an index or a link on a web page) and grabber (obtain data or information on an index or link) are not dependent on the development method used in an information system, chatter-bot can be easily integrated with any web information system. This chatter-bot had been tested in terms of verification, validation, and prototype testing. From the results, we concluded that this chatter-bot prototype was working properly, in accordance with the planning purpose, and reached the user satisfaction level required by the Turing Test. Chatter-bot system that

has the artificial intelligence ability could positively support the website as a form of customer service to improve user satisfaction of getting the required information either from the information system website or its database [18] [19].

Massive Online Open Courses (MOOCs), introduced in 2008 become one of the reason of the conversational bot development. Conversational bot solves one of MOOCs' drawbacks as it could replace the interaction between the students and the real instructor. Lim and Goh in [19] developed a MOOC-bot which is a prototype of MOOCs conversational bot and integrated it into MOOCs website to respond to the students' questions using text or speech input. MOOC-bot used AIML, took advantage of its ability to create suitable answer and easily adopt in the new domains. MOOC-bot system architecture consists of knowledge base equipped with AIML interpreter, chat interface, MOOCs website and Web Speech API to provide speech recognition and synthesis capability. The initial MOOC-bot prototype has the general knowledge from its predecessor – ALICE, such as frequent asked questions and a content implemented by Universiti Teknikal Malaysia Melaka (UTeM). Aside of the basic ones, it could be used at the same time by multiple sites, serves 24/7 in different time zones, and has multiple knowledge domains. MOOC-bot evaluation conducted based on the competition questions from Chatterbox Challenge (CBC) and Loebner Prize. The result showed that it was able to provide correct answers and had the capability to prolong the conversation.

3 Rudimentary

3.1 Naïve Bayes Algorithm of Classification

In this study, Naïve Bayes algorithm is used to classify the result of a job interview session between the user and the interviewer-bot. There are three categories of conversation, which are interests, potential and talent. Each category has the following classification: interest (not interested, lack of interest, interested, very interested), potential (unskilled, less skilled, skilled, highly skilled), and talent (visual, psychomotor) [11] [12]. Classification category is done by calculating the probability using Bayes Theorem. There are 10 of the 30 conversations of "interest" categories that belong to "very interested" to the job conversation. There are 18 of the 30 conversations that contain words listed on the "interest" categories such as "expect", "willingness", "effort", "interest", "concern", "enthusiasm", "support", "provide". Five conversations containing the words listed on the "interest" categories classified as "very interested" conversations. If there is a conversation that belongs to "interest" category made by the user and the interviewer-bot, then the probability of the conversation classified to a "very interested" conversation and contains the words: "expect", "willingness", "effort", "interest", "concern", "enthusiasm","support", "provide", is calculated using the simple form of Bayes' theorem: [20]

P(A)= The probability of a conversation belongs to "very interested" category

P(B)= The probability of a conversation contains words listed on "interested" category ("expect", "willingness", "effort", "interest", "concern", "enthusiasm", "support", "provide") → keyword.

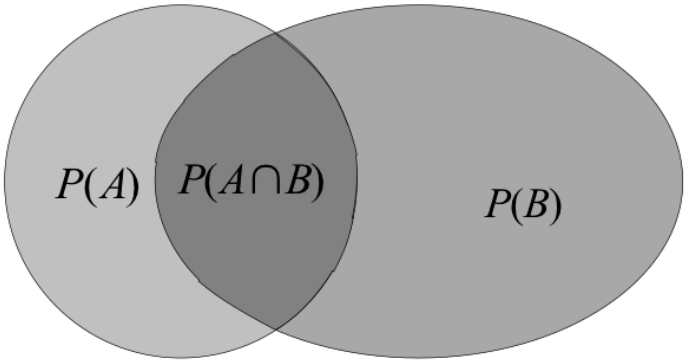

Fig. 1. Probability of occuring conversation

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B)} \quad (1)$$

Thus, we have the following

$$P(A|B) = \frac{\frac{5}{10} * \frac{10}{30}}{\frac{18}{30}} = \frac{1/6}{3/5} = \frac{5}{18} = 0.27$$

3.2 Naïve Bayes Approach

Based on the calculation results, these conditions could be applied to solve the problems using Naïve Bayes approach as in [12] [21]:

```
There are five conversations containing the words ("learn", "moti-
vate", "improve") →keyword_B. These 5 conversations classified as
"very interested" within the "interest" categories.
The probability of a conversation contains the words ("expect",
"willingness", "effort", "interest", "concern", "enthusiasm",
"support", "provide")and ("learn", "motivate", "improve") →key-
word_A
```

The above problems become more complex, so it can no longer be solved by using a simple form of Bayes' Theorem, hence the modification formula is required:

$$P(A|B_1, B_2) = \frac{P(A|B_1 \cap B_2) * P(B_1|A) * P(A)}{P(B_1|B_2) * P(B_1)} \quad (2)$$

where $P(A)$ = very interested, $P(B_1)$ = Keyword_A, and $P(B_2)$ = Keyword_B

To simplify the problem, it is assumed that that the incidence of the emergence event of words listed inkeyword_*A* is not relying solely on the emergence event of words listed inkeyword_*B* on the conversation. So the above formula can be simplified into

$$P(A|B_1,B_2)=\frac{\frac{5}{10}*\frac{5}{10}*\frac{10}{30}}{\frac{18}{30}*\frac{6}{30}}=\frac{250/3000}{108/900}=\frac{0.083}{0.12}=0.694$$

The probability value means the possibility that the response given by the user during job interviews with the interviewer-bot contain words that are listed on keyword_*A* and keyword_*B* and classified as a"very interested" conversation. The above calculation is made to classify a conversation of “interest” categories belongs to a "very interested" conversationby using the probability of words contained in that conversation.

Naïve Bayes approach is done by making the assumption that the events of a words list group is not relying solely on the appearance of the others. This was done to simplify the probability calculation.

3.3 Phrase Reinforcement (PR) Algorithm

The PR algorithm used in this study refers to the implementation of Phrase Reinforcement used on Microblog to make a conclusion using these steps: the algorithm begins with the initial phrase, which is stating a topic that will be used to determine a conclusion. This topic usually is a trending topic or not. By using the initial phrase, Phrase Reinforcement algorithm submit a query to Twitter.com to get tweets containing the phrase. If the searched terms were just discussed on Twitter, the maximum Twitter data that could be taken is 1500 tweets (which are containing the search terms). If the searched terms had already discussed, for example the topic was discussed a few days, weeks, months or years ago, the Twitter data obtained is less than 1500 tweets, or it may not even exist at all. From these data, the algorithm will do the selection procedure to remove spam or unwanted tweet. Selection is an important step because spam and unwanted tweet can influence the conclusion drawn by the PR algorithm. Spam and unwanted tweets are selected using Naïve Bayes Algorithm which trained using spam data obtained previously from Twitter.com. Tweets contain non English term are also eliminated as well as the tweets that have the same content, because this study only focused on the conclusion stated in English [7] [13].

3.4 Naïve Bayes and Phrase Reinforcement

Drawing a conclusion from the interview results between user and interviewer-bot needa modified PR algorithm. Since the objective of this study is not to infer from Twitter.com, but from conversation logs that have been made previously between the user and the interviewer-bot, then the conversation logs were classified using Naïve Bayes algorithm prior to classify each category into sub-categories, for example:

a) Interest: not interested, interested, very interested
b) Potential: not trained, less trained, trained
c) Talent/intelligence: logical-mathematical, visual-spatial, physical-kinesthetic, musical, interpersonal, intrapersonal, naturalist and existential.

These algorithms also make the selection of unwanted conversations, through the stop words and stemming process. After the conversations grouped and passed a selection process (the result can be referred to as training conversation), the PR algorithm could be used. The main idea of the algorithm is to generate sorted acyclic chartsof all conversations (in one sub-category of the same category) drawn from training conversation. These charts are arranged around a central point contains the initial phrase that will be used as a reference of the conclusions. Modifications made in this process because the training conversation does not have the same phrase / word in every conversation. Step-by-step modification of these algorithms can be explained as follows:

a) Initial phrases/words used as conclusion terms are replaced with a set of keywords defined in the Naïve Bayes algorithm section. Sample keywords for "interested" sub category within "interest" category are "expect", "willingness", "effort", "interest", "concern", "enthusiasm", "support", and "provide".
b) Words similar to these keywords (specific to the words appear after keywords) will be processed deeper to get the weight of each word appear on conversation. This procedure applied to the words appear before and after the keyword. The process could be explained as follows:
   - Words that appear before keyword will be processed whether the words contain negative meaning or not (containing word "Not").
   - Words appearing after the keyword will be used as the focus of user' object about one of the keywords. For example: "expect", "willingness", "effort", "interest", "concern", "enthusiasm", "support", "provide".
   - Calculate the conversations weight that contain determined keywords. This weight is the calculation result of the frequent appearance of a keyword in training conversation. This step is done for each node or a number of N training conversations. Each selection done on each conversation will create a node that originated from keywords contained in each training conversation.

If the node is already established, then the selection process is done to the node that contains keywords > 1 and keyword = 1 or keyword = 0. It is the initial step to deduct a conclusion of all selected nodes. Here are the steps taken for each number of keywords:

For a node that contains keywords > 1 and positive meaning. Selections are made only to words appear after the keyword. For example, there are some conversations such as:

- I concern about world of journalism.
- I don't have any concerns about teaching.
- I concern in outdoor activities.

The above conversations contain the keyword "concern" with positive and negative meaning. Analysis of the *training conversation* results*:*

- **Concern** |about the world of journalism.
- **Don't** have any **concerns** |about teaching.
- **Concern** |in outdoor activities.

Positive meaning, concern (2), means:

```
"He concerns about the world of journalism and outdoor activities"
```

Negative meaning, don't concern (1), resulting in:

```
"He does not concern about teaching"
```

For a node that contains keywords = 1. Summary made directly from the keywords and the word that came afterwards, with the pronoun "She/He" and the process of changing the verbs used for the subject of "He/She"

For a node contains keywords = 0. Summary will be made, the same as the one for the node that contains keywords = 1, but not classified into sub-categories. On the other hand, the summary results will be analyzed by admin then put into the existing sub-categories.

The implementation of the appearance of different words lists and in different categories needs a formula that will calculate the probability of words lists in each category. Categories having the highest probability of the appearance of words lists (keyword) can be calculated as:

$$P(B_1, B_2, B_n) = A_{max} P(A) * \prod_{i=1}^{n} P(B_i|A) \quad (3)$$

where:

$P(B_1, B_2, B_n)$	Classification with 1st keyword, 2nd keyword, ... n^{th} keyword
$A_{max}\ P(A)$	Probability of maximum argument of a category A
$\prod_{i=1}^{n} P(B_i\|A)$	Probability of a keyword appears in a category

The following section presents implementation of this study.

4 Implementation

The implementation section is divided into two processes i.e. training and elimination of stop words and stemming which is discussed as following:

4.1 Training

Training is used to show several conversation examples to a particular category and its results will be used to calculate the probability of the next conversation classification. Here is a training example of "interest" category:

```
"not interested": I don't know anything about this company.
"not interested": I work in different field that does not related at
all to this job.
"interested": I have done project that related to this job before.
"interested": I like to share with people and work with them in team.
"very interested": I'm detailed person and enthusiastic about world
of journalism.
"very interested": I'd like to work in job that provides opportuni-
ties to meet a lot of people   and learn from them.
```

Each subcategory of "interest"category has conversations examples that indicate which conversation belongs to "not interested", "interested", and "very interested" subcategory. The more conversation examples trained in each category, the more accurate the probability of the next conversation belongs to the category.

4.2 Elimination of stop words and stemming

This step is used to eliminate the words often said in conversation and did not have a specific meaning related to the determination of categories; for example the words: the, on, it, that, you, to, be, if, what, there, since, and others. Thus, after the removal of the stop words, the words having special meaning associated with a particular category could be obtained. For instance, for the conversation of "very interested" subcategory within the "interest" category, words having special meaning associated with this category are detailed person, enthusiastic, opportunities, and others. These words are stored in a file, which is used as a reference at the time of software implementation. The next step is the word removal procedure to form the origin words (stemming). This algorithm does not consider word context and conversation grammar. For example, learn, learns, learned, learning has a different context but have the same origin of the word is "learn". This would be a problem because the conversation is done at different times, place and circumstances. Hence, there should be a method to eliminate the words in the form of past tense, continuous, or plural into its origin.
Naïve Bayes classification flow chart for one of the categories ("interest") has the same calculation with the other categories; the difference is the number of subcategories used in each conversation category. The Naïve Bayes classification flow chart for one of the categories shown in Figure 2.

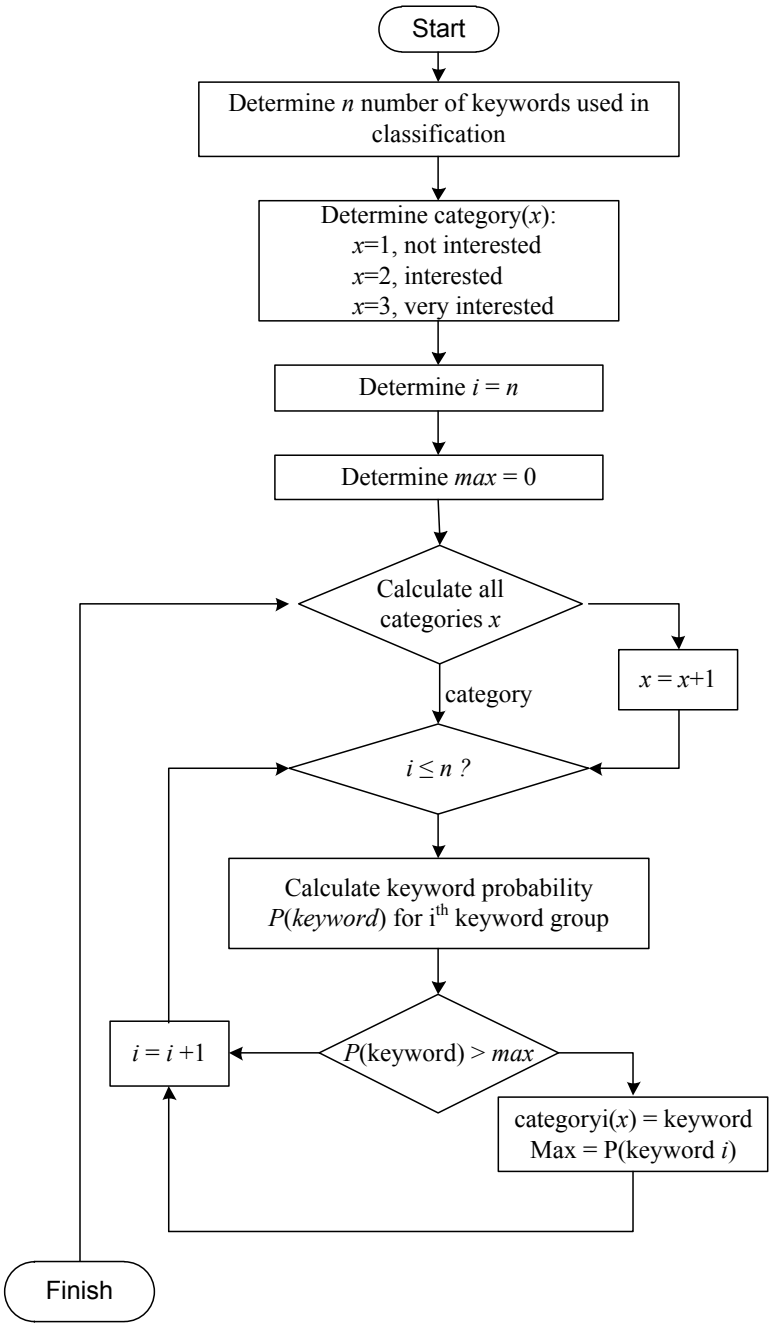

Fig. 2. Naïve Bayes algorithm flowchart

5 Results and Discussion

Software testing includes test verification and validation.

5.1 Verification Test

This test is intended to determine whether the translation of conceptual models into software applications, in this case an interviewer-bot, has been carried out properly or not. Verification test is done by comparing sub system model base design with algorithms, also by comparing the algorithms with program lists. The comparison process is performed in order to be aware of the relationship between design base models, algorithms, and coding (program lists) when the program starts. The result shows that the system has been in accordance with the analysis and design as well as meeting the required functionality in the interviewer-bot system.

5.1. Validation Test

This test is intended to evaluate the function suitability of the system, whether the function of interviewer-bot in these systems can be met by providing input and analyzing output or whether the response given is in accordance with the desired one. In validation test, the result of the response given by the interviewer-bot is compared with the response given by the user based on statements or answers related to the word or phrase related to the data, interests, potentials, and talents; and also word or phrase that is not related to the user' private data, interest, talent, and potential.
The test is also conducted by comparing the responses given by the interviewer-bot, which includes:

- Topic relevance between the users' input words or phrases with the response words or sentences given by the interviewer -bot.
- Response by interviewer-bot if the input or sentence is not related to the user' private data, interest, potential, and talent.
- Response time required by the interviewer-bot to give a statement or an answer to the user related to the user' private data, interest, talent, and potential, and vice versa.

Validation test is performed by giving questionnaires to 50 respondents who did chat without knowing that interviewer-bot is a software. User satisfaction rate is calculated by:

- Questions number 1-6 and number 12 tests the interviewer bot response.
- Question number 7-11 test interviewer bot response time.

In summary, the results are given in Table 1 as following.

Table 1. Questionnaire result of 50 respondents

No	User satisfaction parameter	Response percentage
1	Questions' topic	89%
2	Answers or responses related to users' interest	88%
3	Answers or responses related to users' potential	87,5%
4	Answers or responses related to users' talent	90,5%
5	Answers or responses notrelated to users' data, interest, potential, and talent	93%
6	The relevance between users' input with interviewer-bot responses	83,5%
7	Immediate response related to users' data	77%
8	Immediate response related to users' interest	78%
9	Immediate response related to users' potential	87%
10	Immediate response related to users' talent	79%
11	Immediate response not related to users' private data, interest, potential, or talent	83%
12	Were you satisfied being interviewed by the interview-bot?	77%

From table 1, result based on the rate of interviewer-bot response and response time shows that users can access the system and utilize features on the interviewer-bot website. The average satisfaction rate for interviewer-bot response is 86.93% while the average satisfaction rate for response time or the speed of interviewer-bot giving answer is 80.8%. The averages of the two responses are still above the average satisfaction rate required by the Turing Test, which is 70%. Thus interviewer-bot is worthy to be called Virtual Job Interviewer with Artificial Intelligence. Here is an example of the test results for the interviewer-bot responseduring interviews with users:

```
Human    : Hello
System   : Hi there!
Human    : How are you?
System   : I'm, doing fine thanks. How are you?
Human    : I'm fine, are you crazy
System   : I think the polite term nowadays is "mentally ill".
Human    : you monkey
System   : I haven't heard anything like that before.
Human    : I love you
System   : Thanks I like you a lot too my friend.
```

6 Conclusion

This paper presented the development of a machine which is able to provide practice on English-based interviews, specifically on job interviews. The implementation of Naïve Bayes classification method and Reinforcement Phrase algorithm in AIML-based O Program software has accuracy level of interviewer-bot response by 86.93% as proven through validation test by 50 respondents who conducted chats without knowing that Interviewer Bot is a software. The response indicating that the Naïve Bayes method and Reinforcement Phrase algorithm can be used to classify the inter-

viewer-bot interview result. In addition, interviewer-bot system has the intelligent ability so it could contribute positively for students practicing interview in English.

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Analysis Approach to Identify Factors Influence Digital Learning Technology Adoption and Utilization in Developing Countries

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Abstract—The Internet has given learners the ability to learn anytime and anywhere at their own pace facilitated by interactive and adaptive software. Digital learning technology is more than just providing students with a laptop. Digital learning requires a combination of technology, digital content, and instruction. This study aims to identify and observe the impact and mediation of top management support in relation to the successful adoption of digital learning technologies in developing countries. A questionnaire was designed and distributed to rate the successful adoption and utilization of digital learning technologies in developing countries and data was analyzed using structural equation modeling. This study provides empirical evidence and explains many complex factors, such as user awareness, perceived usefulness, perceived ease of use, and information communication technology infrastructure, in the context of top management support to facilitate the effective utilization of a digital learning technology. Mediating the top management support between adoption of a digital learning technology and user awareness, perceived usefulness, and perceived ease of use provides clear and crucial evidence to support the effective adoption of a digital learning technology.

Keywords— digital learning technology, e-learning, developing countries, emerging learning technologies adoption success

1 Introduction

Digital learning technology (DLT) is defined as any type of learning that facilitated by instructional practice or by technology that makes effective use of technology and gives students some element of control over place, time, path and/or pace. Digital learning technology provides a unique opportunity to enhance the quality of education in a cost-effective manner. DLT encompasses intelligent tutoring, game-based learning, accessing digital content, collaborating locally and globally, assessment and reporting online, and Massively Open Online Courses (MOOCs) etc. [1].

DLT improves the level of students' participation during the learning process and allows them to learn at their own pace and organize the order topics for the study plan, thereby resulting in more independent learning. However, the globalization of the DLT is paralleled with the dramatic developing in the using of the internet and other technologies as supported tools [2].

The adoption and utilization of digital technologies in the educational system and the internet have provided an unprecedented opportunity to create advanced education around the globe [3]. Developing countries are categorized as such because their rank in the United Nations Development Program (UNDP) Human Development Index is low. There is a growing need for developing countries to adopt and utilize emerging technologies in learning. However, developing countries are slow to adopt new technologies, particularly with regard to DLT. There is also a significant need for educational institutions in developing countries to upgrade traditional education to improve learning processes [4]. The developing countries are a region which has suffered both financially, economically, and technologically compared to the rest of the globe and the process of DLT adoption facing challenges and obstacles in almost all the developing countries and is rather still at initial stages and slow growing in some cases due to a number of factors such as, personal, organizational, and technological challenges. However, in such countries, adoption and utilization of DLT in educational institutions are at an early stage [5].

The adoption and utilization of educational technology in the developing countries faced many difficulties in the educational system and it does not always lead directly proportional increases in student learning outcomes, therefore, it is very important to investigate and understand the critical success factors in order to optimize student outcomes [6].

This research examines various reasons for the success/failure of DLT adoption processes in Libyan organizations. Critical factors that contribute to developing countries not utilizing DLT successfully can be identified by investigating the proposed research questions and by addressing factors that lead to the success/failure of such systems.

1.1 Research problem and question

The research problem is related to the rapid development of information systems and technology. In particular, we focus on whether developing countries, such as Libya, can take advantage of such developments. The study identifies and examines the reasons why DLT fail in Libyan educational institutions and the following question summarize the research problem.

What factors are responsible for DLT failures in countries with less developed economies, such as Libya?

2 Literature review

Recently, researchers attempted to identify challenges that hinder effective implementation of DLT in developing countries and have conducted qualitative and quantitative analyses focusing on e-learning integration in developing countries to pinpoint factors that influence the successful adoption and utilization of DLT. On one hand, each study considered a certain case to investigate this phenomenon. On the other hand, each developing country has apparent differences in its economic state, the level of education, and culture. Therefore, further investigation and analysis are required, especially in countries where little or no research has been conducted.

Top management support (TMS) is related to the apparent level of general support offered by top management. Ragu-Nathan et al. [7] defined top management support as the degree to which senior executives understand the significance of information technology/information system functions and are involved in the system activities. Loonam et al. [8] reported that top managers play a vital role in supporting information technology systems. Top management support involves providing the essential authority required for project success. With top management support, more institutions adopt and implement DLT successfully [9].

User awareness (UA), i.e., user perception of a DLT adoption process, is an important factor [10]. The adoption and utilization of new technology in an educational institution can face challenges that are related to user awareness [11]. In most cases, users without proper knowledge or awareness of the new technology or system being adopted will have a negative attitude toward the successful adoption and utilization process; consequently, they are less likely to fully welcome the new strategy. However, users with effective awareness will perceive the system or technology positively, which facilitates easy, convenient, and smooth implementation [12].

Davis [13] defined perceived usefulness (PU), as "the degree to which people believe that the use of a particular system would enhance their job performance." Perceived usefulness is a significant factor affecting the acceptance of an information technology in an institution in a developing country. Redfern [14] defined perceived usefulness as the level of faith a person has in a particular system that has been implemented to increase productivity and improve work performance.

Perceived ease of use (PEOU), refers to the degree to which people believe that the use of a particular system would be effort free [13]. In this context, effort relates to how easy or difficult it is to learn to use the new system.

Information and Communication Technology (ICT) is a major component of information technology management and considered in a beginning stage in the developing countries particularly in the field of the learning process and teaching. However, many such institutions have not benefited from ICT investments [15]. Rai [16] identified information communication technology infrastructure as a key agent of the business value that a firm can realize from its collaborative innovation relationships.

The growing use of ICT and the Internet in the developing countries by the individuals, government, and non-government has changed several things from the traditional to the digital world [17]. Libya as one of the developing countries tries to benefit from using ICT in all sectors, particularly in education sector. there is lack of pro-

grams and studies that measure the successful adoption and utilization digital learning systems to improve the educational process in Libyan [18].

Akinnuwesi [19] investigated factors that influenced the intent to use biometric technology in developing countries and found that perceived ease of use was important. In addition, they found that user awareness was also influential. However, the study concluded that perceived usefulness had no impact on the intent to adopt the biometric technology.

Ali [20] explored the utilization and adoption of information technology in non-technologically advanced countries. They pointed out that some approaches related to technology acceptance and usage in advanced technological cultures may be applicable to developing cultures. They also emphasized that acceptance and usage could be improved by effective end-user training and top management support. In addition, they revealed that the success implementation of information technology systems is strongly influenced by the opposition of users to the perceived change that is related to a new technology implementation and adoption.

Sife [21] discussed the challenges for integrating learning technologies in higher learning institutions with examples from Tanzania as developing countries. The study explored the challenges and obstacles for integrating learning technologies in higher learning institutions as, awareness, administrative support, technical support, and staff training and development. The study is argued that universities in developing countries should adopt learning technologies to improve both teaching and learning processes. Technical and cost issues should be taken into account for each specific technology when integrating ICTs in teaching and learning process.

Khan [15] presented a comprehensive review of international articles relating to barriers encountered when introducing ICT into classrooms in Bangladesh as developing country. The study revealed that ICT infrastructure and staff training are among the factors influencing the success of educational technology systems. A study by Elzawi [9] investigated the factors affecting Internet use by staff members, how the internet affects research and teaching, and the level of Libyan research into IT development and implementation. The study found that the training programs and technical skills play a significant role in the successful adoption of ICTs. Tarus [1] discussed the challenges experienced by Kenyan public universities in the implementation of e-learning systems. The study findings revealed that e-learning comes with some challenges that must be addressed by Kenyan public universities before successful implementation can be realized and recommended possible solutions towards successful implementation of the digital learning system.

Our study aims to explore the factors that affect the adoption and utilization of DLT in Libyan public universities in the learning process. To achieve the main objectives and based on the results of the reviews on literature regarding adoption theories and the literature, the study maps a path model, which includes the critical factors to be considered for successful adoption and utilization of DLT in the educational sector in Libya. Based on the literature and enlightened the foundation in building a mediation path model for TMS between DLT and PEOU, PU, and UA as discussed previously, we proposed the following hypotheses.

H1. TMS mediates the link between PU and DLT.
H2. TMS mediates the link between PEOU and DLT.
H3. TMS mediates the link between UA and the use of a DLT.
H4. TMS is significantly influenced by and directly linked to DLT.
H5. ICT infrastructure is significantly influenced by and directly linked to DLT.

3 Methodology

We designed a questionnaire to rate the successful adoption and utilization of DLT in developing countries and the rating scale was determined by reviewing the literature to identify scales used in previous studies. The questionnaire was distributed to 210 participants at Zawia University in Libyan. All participants were full-time students and participation was optional, and no identifiable private information was collected. The sample was selected randomly from different study levels. The response rate was 91.4% (192 out of 210). The rating scale was Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5) and the obtained data were processed and analyzed using the Statistical Package for Social Software and Linear Structural Relations.

4 Analysis and discussion

4.1 Descriptive statistics

Construct validity is defined as the degree to which a test measures what it claims or purports to be measuring. Internal consistency reliability is defined as "a measure of how well the items on the test measure the same construct or idea" [22]. Both construct validity and internal consistency were examined using Cronbach's alpha (.797). Cronbach's alpha typically ranges between 0 and 1. As Cronbach's alpha approaches 1.0, the internal consistency of the items in the scale increases [22]. Variables were checked to ensure that they met the assumptions of normal distribution and multicollinearity. Multicollinearity refers to the linear relationship between two or more variables, including the orthogonality among the variables [23]. This relationship is also referred to as collinearity or ill-conditioning. Multicollinearity was assessed by examining the Variance Inflation Factor (VIF) and tolerance. Here, tolerance is a measure of collinearity and is always greater than or equal to 1. No multicollinearity issues were observed, and the assumption about reasonable independence among predictor variables was satisfied (Table 1).

Table 2 summarizes that the simple correlation R value = 0.602, which indicates a good degree of correlation, and the R^2 value = 0.363, which indicates the extent of the total variation in the adoption of DLT, indicating that the dependent variable adoption of the DLT was influenced by 36.3% by the independent variables TMS, UA, PU, PEOU, and ICT Infrastructure.

Table 3 shows the ANOVA results. As can be seen, the probability level of significance is 0.000. Therefore, the probability value is much less than 0.05. Top management support, user awareness, perceived usefulness, perceived ease of use, and information communication technology infrastructure simultaneously showed a significant effect on the adoption of the DLT.

Table 4 shows the obtained coefficient values. As can be seen, significant values were obtained for top management support (0.000) and ICT infrastructure (0.001) and no significant values were obtained for user awareness (0.112), perceived usefulness (0.065), and perceived ease of use (0.960).

Table 1. Tolerance and VIF

Coefficients[a]			
Model		**Collinearity Statistics**	
		Tolerance	***VIF***
1	TMS	0.679	1.473
	UA	0.615	1.625
	PU	0.654	1.529
	PEOU	0.784	1.276
	ICT Infrastructure	0.625	1.601

a. Dependent Variable: Adoption of DLT

Table 2. Model summary

Model	**R**	***R*²**	**Adjusted *R*²**	**Std. estimate error**
1	0.602[a]	0.363	0.346	0.54311

a. Predictors: (Constant), TMS, UA, PU, PEOU ICT Infrastructure.

Table 3. ANOVA results

ANOVA[a]						
Model		***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
1	Regression	31.249	5	6.250	21.18	0.000[b]
	Residual	54.864	186	0.295		
	Total	86.113	191			

a. Dependent Variable: Adoption of DLT

b. Predictors: (Constant), TMS, UA, PU, PEOU, and ICT Infrastructure.

Table 4. Coefficient values

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	***Std. Error***	***Beta***		
1	(Constant)	1.207	0.306		3.940	0.000
	UA	−0.112	0.070	−0.119	−1.595	0.112
	PU	0.146	0.079	0.134	1.855	0.065
	PEOU	0.004	0.070	0.003	0.051	0.960
	ICT Infrastructure	0.267	0.082	0.242	3.271	0.001
	TMS	0.411	0.066	0.442	6.228	0.000

a. Dependent Variable: Adoption of DLT

4.2 Analyzing mediating effects

To analyze the mediating effects of the observed variables (i.e., user awareness of the importance of the DLT, perceived usefulness, perceived ease of use, and information technology infrastructure), we began by modeling the simple effect of each independently observed variable on the dependent variable (i.e., the successful adoption of the DLT).

On the basis of the regression weights of the investigated variables (Table 5), top management support was identified as a mediating variable in the relationships among perceived usefulness, perceived ease of use, user awareness of decision support system importance, and the successful adoption of the DLT. The mediator variable (i.e., top management support) was input to a model for path analysis.

Table 5. Coefficient Regression weights

			Estimate	S.E.	P
TMS	<---	PEOU	0.272	0.073	***
TMS	<---	PU	0.329	0.082	***
TMS	<---	UA	0.228	0.069	.001
DLT	<---	ICT Infrastructure	0.255	0.068	***
DLT	<---	TMS	0.428	0.058	***

4.3 Model fit and path analysis

We used a model to map the relationship between variables and test the fit of a hypothetical model to the empirical data. The path analysis technique was used to test pathways through which variables affect each other and test the validity of the model (i.e., fitting), as shown in Figure 1.

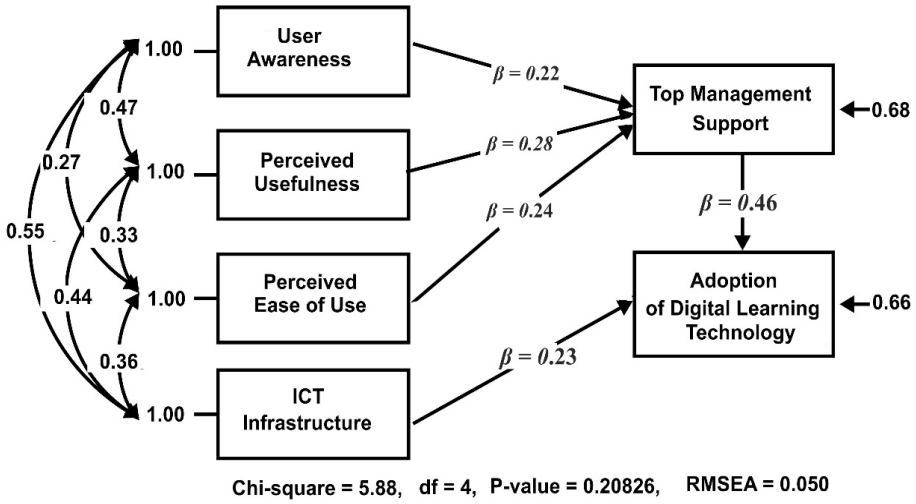

Fig. 1. Path model

Although there is some disagreement over which specific tests are "best," it is commonly recommended that researchers examine more than one fit statistic when evaluating model fit [24]. For example, X^2, Goodness of Fit Index (GFI), and Normed Fit Index (NFI) or Comparative Fit Index (CFI), NNFI, and SRMR tests have been recommended by McDonald and Ho [24]. CMIN is a Chi-square statistic that compares the tested model and the independent model to the saturated model [25]. The overall fit of the model was assessed using the chi-square test fit indexes. Here, chi-square = 5.88, degrees of freedom df = 4, and the probability level p-value = 0.21. The Root Mean Square Residual (RMR) is the square root of the difference between the residuals of the sample covariance matrix and the hypothesized covariance model [25]. The RMR for our model was 0.010 (note that smaller values are better). The GFI indicates the proportion of variance in the sample variance–covariance matrix that is accounted for by the model. Here, values that are 0.99 or higher indicate well-fitting models [25]. The GFI for our model was 1.00. The Adjusted Goodness of Fit Index (AGFI) is an alternative GFI index in which the value of the index is adjusted relative to the number of model parameters. AGFI values close to the GFI value indicate well-fitting models [25]. The AGFI for our model was 0.95. The NFI assesses a model by comparing the $\chi 2$ value of a model to the $\chi 2$ value of a null model, and values of 0.9 or higher indicate a good fit [25]. The NFI for our model was 0.99. The CFI is a revised form of the NFI that considers sample size. Note that values closer to 1.0 indicate a good fit [25]. The CFI for our model was 1.000. The Root Mean Square Error of Approximation (RMSEA) estimates a lack of fit compared to a saturated model. RMSEA values in the range 0.08 to 0.10 indicate a mediocre fit, and values less than 0.08 indicate a good fit. The RMSEA for our model was 0.050. Model fit is indexes summarized in Table 6.

Table 6. The summarized model fit indexes

Fitness index	Value	Acceptance Value	Acceptability
Chi-square fit	5.88	Less is better	Accepted
Goodness of fit index (GFI)	1.00	Greater than 0.9	Accepted
Adjusted good of fit index (AGFI)	0.95	Greater than 0.9	Accepted
Root-mean-square residual (RMR)	0.010	Smaller is better	Accepted
Relative fit index (RFI)	0.95	Greater than 0.9	Accepted
Normed fit index (NFI)	0.99	Greater than 0.9	Accepted
Incremental fit index (IFI)	1.00	Greater than 0.9	Accepted
Comparative fit index (CFI)	1.00	Greater than 0.9	Accepted
Root-mean-square error of approximation (RMSEA)	0.050	Less than 0.08	Accepted

4.4 Hypothesis testing

Structural equation modeling was used to analyze the hypothesized direct relationships of six variables considered in this study. The results (Table 7) indicate that there is a positive significant relation and link between TMS and PU ($\beta = 0.28$, t = 4.023, p=<0.000), TMS and PEOU ($\beta = 0.24$, t = 3.709, p=<0.000), TMS and UA ($\beta = 0.22$,

t = 3.282, p=<0.001), and TMS and the adoption of a DLT (β = *0*.46, t = 7.423, p=<0.000). In addition, the link between ICT Infrastructure and DLT adoption was positive and significant (β = *0*.23, t = 3.727, p=<0.000). Moreover, the results explicitly demonstrate that the strongest positive link was between TMS and the adoption of a DLT. Therefore, hypotheses H_1 through H_5 were proved.

Table 7. Hypotheses testing

			β	S.E.	t	P
TMS	<---	PU	0.28	0.082	4.023	***
TMS	<---	PEOU	0.24	0.073	3.709	***
TMS	<---	UA	0.22	0.069	3.282	.001
DLT	<---	TMS	0.46	0.058	7.423	***
DLT	<---	ICT Infrastructure	0.23	0.068	3.727	***

The path model and hypothesis testing revealed that user awareness, perceived usefulness, and perceived ease of use had a positive significant indirect effect on successful adoption of the DLT through their impact on top management support. However, information technology infrastructure showed a positive significant direct effect on the successful adoption of the DLT. These findings show that top management support has a positive direct effect on the successful adoption of the DLT, which is consistent with the findings of a previous study [20]. The findings relative to the impact of user awareness on the successful adoption of the DLT are consistent with the findings of other previous studies [19]. We found that perceived usefulness and perceived ease of use have a positive indirect effect on the successful adoption of the DLT, which is also consistent with the findings of previous studies [9], [15], [21]. However, this contrasts with the findings of Akinnuwesi et al. [19], who revealed that perceived usefulness has no impact on the intent to adopt the biometric technology. The results of this study indicate that information technology infrastructures have a positive direct effect on the successful adoption of DLT.

5 Conclusions

This study has outlined the impact of a set of factors influencing the successful adoption of DLT in developing countries. By understanding the influence of these factors, managers can formulate effective schemes to implement and use technology and increase the usage of a DLT. Based on the model fit indexes, we consider that our findings will be of value to top-level managers and may help decision makers avoid DLT failures by understanding the factors that affect the adoption and usage of technology, the relations between these factors, and how these factors can be measured. In addition, our findings may help institutions predict user awareness and technology acceptance prior to investing in technology and predict whether the investment will be accepted and used. For such a system to be successful, a proper ICT infrastructure must be developed to facilitate smooth adoption and implementation processes. The findings of this study could contribute to theoretical modeling by giving new insights into the theory and modifying the DLT adoption theories. This study has provided

important insights into understanding information technology/system adoption and utilization in public institutions in developing countries. This study also provides a guideline for an institution's management to encourage the use of new DLTs. This study proposed to improve a successful adoption and utilization of the particular educational services that are supported by adopting new technologies by deepening the knowledge about factors influencing or facilitating their adoption and utilization for developing nation in general, and for the Libyan country in particular.

6 Research limitations and future work

The study targeted only government institutions. However, the impact of organizational aspects on the adoption of DLT could differ in non-government institutions. In addition, our data were collected from a single country, and the impact of considered factors on the adoption of DLT can differ among developing countries.

An additional investigation could be conducted to determine the moderating and mediating effects among other elements, such as task characteristics, cultural characteristics, environmental characteristics, internal and external end-user training, and technology acceptance factors. In addition, future research could effectively employ different methodologies, such as focus groups, interviews, and longitudinal studies, to examine factors that influence the adoption and utilization of DLT.

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The Effects of Static and Dynamic Visual Representations as Aids for Primary School Children in Tasks of Auditory Discrimination of Sound Patterns. An Intervention-based Study.

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Abstract—It has been proposed that non-conventional presentations of visual information could be very useful as a scaffolding strategy in the learning of Western music notation. As a result, this study has attempted to determine if there is any effect of static and dynamic presentation modes of visual information in the recognition of sound patterns. An intervention-based quasi-experimental design was adopted with two groups of fifth-grade students in a Spanish city. Students did tasks involving discrimination, auditory recognition and symbolic association of the sound patterns with non-musical representations, either static images (S group), or dynamic images (D group). The results showed neither statistically significant differences in the scores of D and S, nor influence of the covariates on the dependent variable, although statistically significant intra-group differences were found for both groups. This suggests that both types of graphic formats could be effective as digital learning mediators in the learning of Western musical notation.

Keywords—bimodality, static-dynamic presentation, discrimination of music patterns, music education

1 Introduction

It has been affirmed that the frequent use of multimedia materials in the classrooms makes it necessary to carry out highly specialized research in order to determine which features of media - and their combinations - best facilitate learning [2], [11]. Much research has been carried out across certain disciplines on the effects of unimodal and multimodal presentations of information in learning processes, using either sound, dynamic images, static images, text, analog representations, and/or notations. However, related studies regarding music education, such as those on bimodal modes of displaying information, are scarce and have given inconclusive results, as shown in the literature review below. The present study has attempted to address the question of whether there is any effect of either static images or dynamic images used as aids in the discrimination of musical sound patterns by primary school students. The main

goal of this study was to contribute to the knowledge on the relative effectivity of different modalities of presenting musical information, one of the critical factors for the design of digital objects as mediators in the learning processes.

2 Literature Review

2.1 Presentation modes of musical information

The investigations on the presentation of information in learning situations in the music classroom show heterogeneous conclusions, among which stands out the relationship between modes of presentation and other aspects and/or specific elements.

Some studies have suggested that using sound exclusively as a unimodal presentation mode is most effective for learning activities [3], [23], [26], while others show no differences with respect to the display mode used [22]. Furthermore, some researchers have also pointed out that video information could possibly consume so many cognitive resources as to prevent the subject from focusing attention on stimuli of the audio mode [22], [23].

Other authors have reach different conclusions, arguing that discrimination of all auditory stimulation is facilitated when presented together with a visual image [14],[18]. According to these studies, the emphasis placed visual information when learning through ICT naturally reflects the preference for stimulating perception through sight above the other senses, but it can also cause confusion in the perception of tasks due to the division of attention [11],[30].

Cognitive styles have been researched as potentially influential variables. One study examined the effects of visual or auditory presentation of information on students with either auditory or visual learning styles [20],[16]. The results showed that both the learning and the subsequent recognition of melodic phrases were enhanced when the display mode corresponded to each participant's individual learning style.

It can be assumed that the discrepancies in the results of the aforementioned studies are likely the result of differences in stimuli used and the way in which they were presented [18].

2.2 Multimodal stimuli

It has been suggested that multimodal information presentation could help to avoid the limitations of memory work [5]. In fact, there are some authors who defend the combination of audiovisual stimuli for educational purposes [1], [7], [17], [30]. Nevertheless, the great diversity of visual elements makes it difficult to reach to a consensus on their effects in combination with auditory stimuli [6]. Some studies, for example, are based on moving images formed by video recordings of concerts [23], [22], while others employ animation [4], sequences of movies [21], or stills, drawings, musical scores, texts, objects, landscapes or buildings in which a concert took place [16].

2.3 Static versus dynamic visual information

The subject of this paper, the question of whether musical sound images would be best accompanied by static or dynamic images, has not been clarified by previous research in this area, The most important theories to explain the effects of the different modalities of learning are Multimedia Learning Theory (MLT) and Cognitive Load Theory (CLT) [2], [11], [12]. MLT is based on three assumptions: 1) Visual and auditory information is processed through various channels of information. 2) The processing capacity of each channel is limited. 3) Learning is considered to be an active process [24], [35].

CLT focuses on the limitations of cognitive processing. According to CLT, static images can facilitate learning processes provided that only relevant information is presented and it is possible for the learner to control both the pace and the order of the images [37]. CLT also suggests that dynamic media can reduce the exterior cognitive load, attract attention, increase motivation, and minimize the effort needed in the construction of mental representations [4], [15], [26].

The results of some studies not related with sound or music have shown significantly greater performance in learning with the use of dynamic media (animation) than with static media (text only) [5], [11], [12], [31]. In this regard, it has been suggested that the more complex the learning content, the greater the benefit of using animations [2]. It has also been asserted that dynamic media is only beneficial when it is designed to reduce the cognitive load and generate mental models of the concept being taught, thereby offering visualizations that correspond to a meaningful mental model. The media must also be consistent with the experience and prior knowledge of the students in order to avoid information, animations, and other elements that are not needed to understand the concept. Moreover, it has been suggested that interactivity, from the point of view of the demand for memory, should result in a lower cognitive load and should improve understanding [2], [33].

Other studies do not support this hypothesis, showing either no significant intergroup differences [9], or differences in favor of the use of static visual media [24], [36]. It can therefore be assumed that the processing of dynamic media by students could generate some potential disadvantages [19], [25]. As an example, students could perceive the animations in a superficial way without really processing them due to lack of cognitive challenge or, on the other hand, be unable to process the material in a satisfactory manner due to excessive cognitive challenge. In addition, if the speed at which an animation presents information is greater than the speed of students' understanding, it could lead to excessive demand for cognitive resources, meaning that resources for other high-level tasks would be unavailable, resulting in the impossibility of understanding [10], [28]. In this sense, certain investigations related to reading comprehension have shown the importance of regulating the information according to the cognitive needs of the students [13], [27].

Apart these recurrent themes in the literature, it has been suggested that learning could be facilitated if the modes of presentation correspond to students' individual differences [12]. As an example, it was suggested that dynamic images may be more

effective than static images for people with low spatial ability [2]. Nevertheless, results of other investigation show no effect of this variable [9].

Taking all the current literature into account, it can be seen that the relationship between modes of presentation and learning is not clear.

3 Method

3.1 Design

A pretest-intervention-posttest design was adopted for the collection of data. The impossibility of performing a random assignment of subjects to the experimental groups forced the adoption of a quasi-experimental strategy (intact groups).

3.2 Subjects

The research subjects were 5th grade pupils (N = 48; 23 boys and 25 girls) from 2 intact classes of a primary school in the city of Valencia, Spain. Two groups were formed: D (dynamic) and S (static). The D group was given dynamic images as aids in intervention sessions for the discrimination of melodic patterns, while the S group used static images. Prior to conducting the study, the school was presented with a letter containing a brief description of the study and a petition, in which ethical codes to be respected were declared. The information included the aim of the study, a description of the role of the students, a confirmation of the absence of any kind of personal risk, and the assurance of the anonymous and confidential use of information collected in the research, i.e. ensuring that both the results and the personal data of the students would be used exclusively for this study.

3.3 Variables

The independent variable was the information presentation mode, the levels being the static and dynamic images. The dependent variable was the score in tasks of discrimination of tonal melodic patterns. Age, gender and previous musical experience were treated and analyzed as intervening variables (covariates).

3.4 Instruments

A questionnaire was prepared for the measurement of intervening variables (age, gender and previous musical experience).

A pre-posttest was created in order to measure the subjects' ability to perceive and correctly identify melodic patterns. This test, taken by the students before and after treatment, included ten items designed exclusively for this study, in which students were required to listen to and identify tonal melodic patterns. In both the pretest and the posttest, these patterns were presented both as audio and as static images.

More specifically, the test consisted of a printed sheet with 10 consecutively numbered items. Each question showed static images representing a certain tonal melodic pattern (fig. 1). Each question had 4 response options, only one of which was correct. The static representation of each response option consisted of five circles corresponding to the five sounds in the pattern. The heights of the circles in the images were proportional to their sound frequency, corresponding to the following spatial metaphor: the higher the pitch, the higher the circle on the diagram. The circles were linked by a line, thus forming a melodic pattern profile. Western notation was not used to avoid the potential influence of previous musical experience, which could have otherwise acted as an intervening variable, systematically altering the effects of the dependent variable.

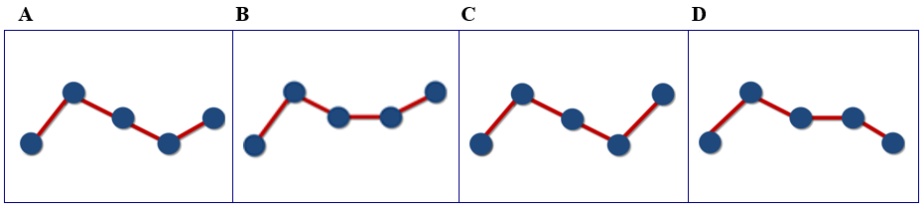

Fig. 1. Static representations of melodic patterns in auditory discrimination tasks in the pretest-posttest. In Figure C, the pattern *do-sol-mi-do-sol* is represented.

A number of precautions were taken in order to reduce the number of potential variables that could influence results. Firstly, in the test, the maximum number of events per pattern was limited to 5 to avoid a potential saturation of sensory memory [29]. Secondly, a clarinet was used to record the sounds, as its tonal quality has a very limited harmonic range and therefore the pitch frequencies produced were sufficiently accurate. Thirdly, the diatonic scale of C major was used for all patterns. Finally, isochronous sounds (sounds with the same duration) were used to avoid any effect of rhythm in the discrimination and recognition of patterns because otherwise, the results of this study could have been invalidated [8]

The pre-posttest had construct validity (similar scope and difficulty in the content of the intervention tasks) and scores were evaluated by three professors of music based on a 5-point scale with two criteria of evaluation for each item of the test: suitability and applicability (agreement inter judges k =.785).

In addition, 8 intermediate tests were designed to be administered in each of the intervention sessions. Each intermediate test consisted of 1 printed sheet with 4 items, testing perception and identification of tonal melodic patterns. The items were numbered consecutively and each contained four response options, similar to the configuration of the pretest-posttest (fig. 1). The students in the D group were presented with dynamic images along with the sound patterns, while those in the S group were presented with static images.

A climate of normality for the pupils was created in order to promote the internal validity of the experimental design. More specifically, the content was taken from the syllabus in the school where the experiment took place and moreover, the activities in

the intervention sessions were run by the regular music professor who normally teaches the two groups of subjects (D and S).

3.5 Materials

Audiovisual stimuli for each experimental condition were designed and rendered with a video editing software application. The video signal was played by a video player software device and routed to a video-projector, while audio signal was routed to a high quality PA System.

3.6 Procedure

The study began with the administration of a questionnaire that collected data from the subjects for the measurement of the intervening variables: age, gender and previous musical experience. As aforementioned, this data was taken into account as covariates in the analysis of the results [16], [17], [32].

A week later, the pretest was administered. Each subject heard a tonal melodic pattern, which was repeated four times, and then had to choose the image which, in his or her view, correctly represented the pattern. There was a 10 second interval between the completion of each test item and the beginning of the following item.

Immediately after the pretest, the subjects were explained how the intervention was going to continue. Practical demonstrations were used to explain the activities of the 8 intervention sessions, which began the following week.

The sessions took place once a week, always on the same day and in the same time slot during class (mornings). The duration of each session was approximately ten minutes. Each session followed the same protocol: 1) review of the learning content from the previous session; 2) presentation of the new learning content, meaning subjects listened to and visualized tonal melodic patterns, performing eight discrimination tasks consisting of patterns of 5 sounds, each of which was repeated five times and presented with sound and either static images (S group) or dynamic images (D group); and 3) completion of a test with 4 discrimination-recognition tasks of tonal melodic patterns in each group's corresponding level of each experimental condition. The resulting scores of the discrimination-recognition tasks in each session were used in the statistical analysis. A week after the last intervention session, the posttest was administered.

4 Results and analysis

The effects of the two levels of the dependent variable, static image presentation (S) and dynamic image presentation (D), were measured in three different moments by the pretest, intervention tests and posttest described earlier (table 1).

The effects are presented through the means and corresponding standard deviations in the three moments of measurement (fig. 2). The intra-group differences were measured in relation to the results of the intervention activities in the different mo-

ments of measurement through a one-factor ANOVA for repeated measures (with the Greenhouse-Geisser correction for non-sphericity), taking a confidence level of 95% (common in the Social Sciences and Education).

Table 1. Mean scores of the groups S and D in the three moments of measurement.

		Pre-test	Intervention	Post-test
Static	Mean	7.12	7.63	8.46
	N	26	21	26
	SD	2.085	1.111	1.679
Dynamic	Mean	7.50	7.60	8.36
	N	22	15	22
	SD	2.064	.798	1.497

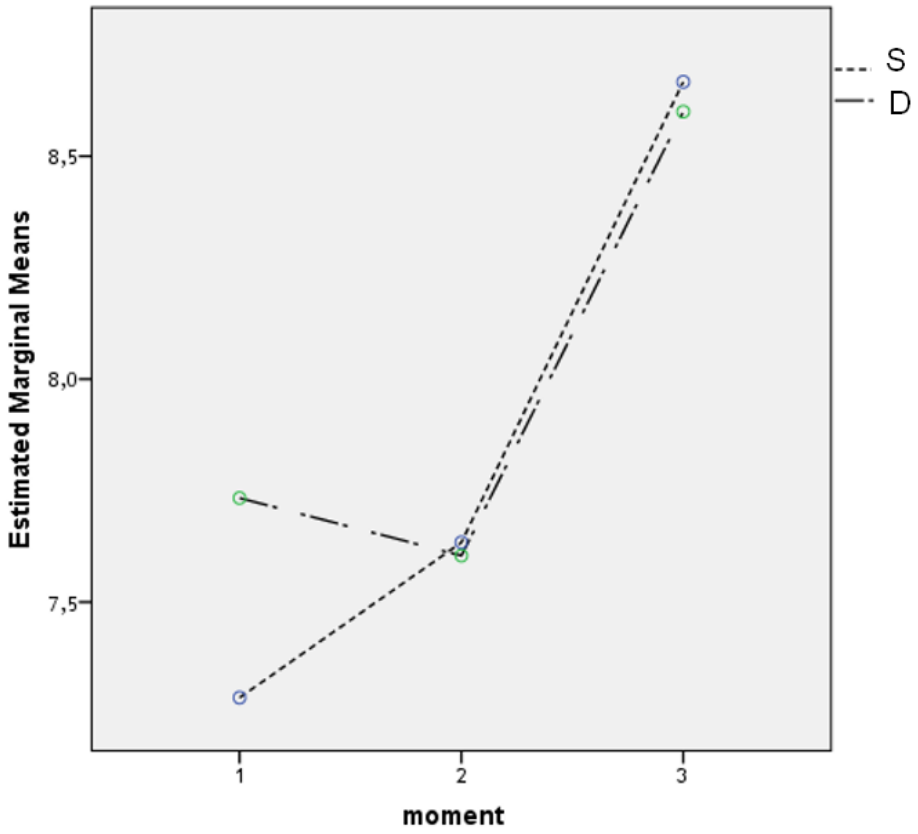

Fig. 2. Means obtained by E (static) and D (dynamic) groups in recognition of melodic patterns for the three moments of measurement (1: pretest; 2: training; 3: post-test; max score = 10 points).

Data returned by one-factor ANOVA showed that no significant differences were found between the groups S and D (F=.56, p = .529). However, there were significant differences between the three different moments of measurement (pretest-intervention-posttest) (F=10.45, p < 0.001). Therefore, it can be suggested that both types of visual aids facilitated the discrimination of tonal melodic patterns.

An ANCOVA was carried out in order to estimate the possible effect of age, gender and previous musical studies. The possible interaction of these covariates with the moment was also considered (i.e., the possibility that the effect of the variable on the graphic recognition of sound patterns could vary over time according to the covariate). No significant effect was initially observed. However, after eliminating the covariates with higher p-values (those with less significance) one by one, the resulting model included the interaction of the covariate "previous musical experience" with the "moment". The effect of previous musical experience was significant (F=7.61, p =.016) with higher scores coming from pupils with more musical experience. Therefore, the model confirmed the effect of the moment (F=6.57, p =.005). Meanwhile, no significant interaction between the moment and the previous musical experience was observed (F =2.57, p = .096). In other words, it can be assumed that the better performance of students with more musical experience with respect to those with less experience was proportional over time as measured in the different moments.

Table 2. Interaction between the variables Moment and Group.

	F	**p-value**	**Effect size**
Moment	10,45	,000	,235
Moment * Group	,56	,529	,016

5 Conclusions

The results of this study do not support the superiority of either of the two audiovisual modalities –audiovisual dynamic or audiovisual static- as aids in the process of improving students' ability to identify, discriminate or to associate tonal melodic music patterns to a non-musical representation. This is consistent with respect to other research [5],[12],[24],[36]. A possible cause of the absence of significant inter-group differences could be found in the nature of the dependent variable [18] which, in this study, was the discrimination of musical sound patterns and eventually the association of patterns to a non-conventional representation. It should be noted that neither the concept nor the types of tasks involved in the aforementioned investigations were similar to the variable studied in this work.

As a minor finding, statistically significant intra-group differences occurred, which suggest that both types of visuals helped the subjects in the discrimination and recognition of sound patterns. This supports research findings [14],[18],[38],[39] which suggest that bimodal presentation modes can facilitate the auditory discrimination of melodic lines through two mechanisms: 1) not increasing -or even decreasing- the external cognitive load in the tasks of perception, discrimination and association; and 2) reinforcing aural stimulus without distracting the attention of the students [11],[29].

A possible alternative explanation for the improvement in the groups' performance is due to the fact that, regardless of the mode of presentation of audiovisual information, the intervention sessions required the students to work in a more regular manner and more frequently than in ordinary classes. In this study, therefore, the eight regular sessions of the intervention could have improved the capacity of subjects in relation to the tasks regardless of the mode of presentation of information. If true, it would therefore not be possible to suggest that bimodal presentation is superior to other sensory modes. Another consideration is that students may tend to focus more attention and cognitive resources when involved in activities which take place in relatively short periods of time and which they know will be evaluated by a researcher (in order to please the researcher and obtain desirable results) - i.e, the results could be partly due to the bias of expectation or external motivation - [37].

The individual differences between the students, represented in this study by the covariates age and gender, did not influence the results in either of the experimental conditions. However, previous musical experience did affect results obtained in the analysis of the three measures of dependent variable.

This could be explained by the fact that responses from musicians and non-musicians are very different when listening to the same musical stimuli for reasons that include not only training, experience, ability and musical memory, but also other features such as personality and maturity [21]. Nevertheless, there is also research on the influence of different presentation modes on the perception of music which suggests that both musicians and non-musicians have very similar responses [21].

A recommendation for future research would be the replication of this study with a larger sample in order to obtain a higher level of external validity. Another recommendation is to replicate this study with students from different socio-economic backgrounds in order to explore the potential influence of this variable. In future research, it would also be recommended to control the complexity of the learning content and to increase the number of sessions. Finally, it would be appropriate to approach cognitive styles as a variable in order to determine if there is any correlation of this variable with the given results.

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Perceptions of Students for Gamification Approach: Kahoot as a Case Study

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Abstract—A novel learning experience that increases student motivation can be created in a learning environment that includes a gamification approach to assess competence. Student perception on gamification were surveyed to determine the best application of this method, the environment necessary for its use, and the manner by which the application should proceed. The effect of a gamification approach on student achievement through intra-class competition was assessed using quantitative and qualitative methods. In this study, the Kahoot application was the preferred gamification method used. Participating students included 65 undergraduate students studying at the Department of Preschool Teaching. The findings showed that inclusion of a gamification method increased the interest of students in the class, and increased student ambitions for success. This method was also found to have a positive impact on student motivation. Furthermore, the results of this study indicate that the Kahoot application can be used effectively for gamification of lessons. In conclusion, the gamification method has an impact on students that renders them more ambitious and motivated to study.

Keywords—gamification, perception, motivation, achievement

1 Introduction

In October 2010, an innovative new trend emerged [1, 2] in the media that aimed to improve the participation of students in classroom activities and promote particular behaviors, called gamification. The aim of gamification is to make the learning process more attractive to learners. A novel learning experience that increases student motivation can be created in a learning environment that includes competition. Motivation is an important element leading to student success in most learning designs, including gamification. Thus, a more effective learning process can be produced if gamified designs that consider the element of motivation are added to learning spaces [3].

The fact that traditional methods of providing motivation are no longer valid has been made evident through published psychological writings and self-help books, and by research studies [4]. What makes the gamification method more attractive is that it causes an internal trigger by changing perceptions [5]. In Daniel H. Pink's book *Drive: The Surprising Truth About What Motivates Us (2012)*, the method by which games affect our internal motivation is clearly explained. Games are successful because they encourage users by focusing on social, cognitive, and emotional results [6]. There are games in which generally humorous elements are interspersed [[7], addressed personally, designed elaborately, and which include increasingly difficult questions. Increasing difficulty requires cognitive effort, enhanced skills, and an increase in the participation of users. Supportive experiments that are fun, engaging, and rewarding are worth incorporating into learning, particularly for Generation Y. Gamification is becoming more attractive to these age groups [8]. When questions normally expected to be difficult are presented to the student in a fun and humorous learning environment, the classroom benefits from the novel techniques.

Motivation can be examined in two different psychological space, intrinsic and extrinsic. Intrinsically motivated students do not require external motivating factors; these students provide their own motivation. External factors play a positive role in students who are externally motivated. Either positive or negative effects can be observed in environments with external factors. Examples of such factors that may affect motivation include gifts, praise, achievement, appreciation, and rewards, among others [9].

In gamification studies, it was found that apart from physical awards an internally motivated goals setting and competence could have important effects on work engagement [10, 11]. It has been argued that computer technologies are convincing for permanent changes in human behaviors, they may have an effective role combining with motivation [12, 13]. Gamification applications may be justified as necessary for students to think, create alternative atmospheres, and for creating a competitive environment [14].

Gamification can be explained through three distinctive concepts; dynamics, mechanics, and components [15]. Game mechanics have rules and rewards, they arouse certain feelings (curiousity, competitiveness, frustration, happiness, etc.) in the player.

In most of the gamification attempts; point, badges and leader-boards are used in order to convince the participants and change their behaviors [16]. Attention must be paid that the elements were not games and how those factors of the game are combined for making the game entertaining. Understanding the roles, motivations and behaviors of the users, requires looking beyond the game's design components such as game mechanics and dynamics [17]. The most common game mechanics are given in Table 1. Education is given as an applied result at the K-6 level. These mechanics provide game dynamics and desire, as well as motivation, and lead to the feelings outlined in table 1.

For gamification designs to have a positive impact on educational results, the learning environment much combine dynamics, mechanics, and the appropriate components. In other words, a gamification application in which all these components are used could facilitate a needs-oriented learning process in the classroom.

Table 1. Game Mechanics and Game Dynamics [18]

Game Mechanic	Game Dynamic
Points	Reward
Level	Status
Trophies, Badges, Achievements	Achievement
Virtual Goods	Self-expression
Leader Boards	Competition
Virtual Presents	Altruism

Analyzed the student differentiation in gamified education during a part of systematic, effective and long term studies [19]. Letting students choose their own ways and get their lessons from the trial and errors has been reported as very important. This can give different opportunities for students through providing alternative ways during the whole levels of the lesson for learning and grading. As the lesson improves in time, the experience occurs as more competitive if the success is signified and awarded more.

In a study aiming at analyzing the gamified learning environment according to its design, application and other variables, it was aimed to design an online learning environment which includes different gamification components and also to identify the flow, emotional participation, motivation and success of the participant on this environment and lastly to search elements which give importance to success on these online environments. A route model was tested which included the effects of variables on each other and related hypothesis and also how much did the emotional participation and motivation estimate the success was tested in the study. According to the correlation analysis results in the study; the flow and emotional participation explained %68 of the motivation variant. Also; the flow, emotional participation and motivation explained %22 of the success variant. In addition to this; the flow towards motivation and success has a positive and meaningful effect and also the emotional participation had a positive and meaningful effect on the motivation [20].

Another study aimed at determining the effects of online game Kahoot which was about scientific word learning. The objective is to analyze the effect of scientifically word learning based online game -Kahoot- on students who had difficulty in learning physical science lessons in secondary schools. The results show that; all students' word distribution increases when the Kahoot is played twice a week. The use of Kahoot increased students' focus and task behaviors. The results of student satisfaction research showed that, the students liked playing Kahoot and found it easy to use [21]. Gamification is not only limited in terms of game design and game research [22]. Many scientists wanted to have a more systematic research about the gamification tools, tools and methods [23, 24].

This research aims to allow students to evaluate the Kahoot application integrated into the existing learning environment. The Kahoot application is the most preferred gamification program and our goal was to determine the effect of this gamification approach on student achievement and determine their perception.

2 Practice

Kahoot, is a popular e-learning tool that can be easily used for providing meta-cognitive support, liveliness in class and student attendance in higher education which need limited lecturers and student education. The free online learning platform has been accepted worldwide with more than 30 million users and it is based on behavioral design methodologies and is current user centered [25]. Kahoot is an educational software example using game based pedagogy that has possibility for preparing online questionnaires, discussions or exams as well as providing students to cooperate in terms of research topics [26].

Kahoot is a learning game conducted in the classroom with the student. It can be defined as the response system of the student. Multiple choice questions may be formulated in debate format using the Kahoot application, and can be played with all students [27-29]. In the Kahoot application, the students press a button for the right answer to a question prepared before the class and projected on the board using an internet-enabled device (e.g., tablet, laptop, mobile phone, etc.). Students receive points for every correct answer given. If the classroom activity is well prepared, students willingly play along and motivation in the classroom is increased.

In a study titled as "Using Kahoot! in the Classroom to Create Engagement and Active Learning: A Game-Based Technology Solution for eLearning Novices" it has been shown that the undergraduate and graduate students were satisfied with the use of this game according to their answers and experiences regarding the use of Kahoot [25].

Kahoot is an easy program to join, and can be used to create quizzes with an interface designed in English. Teachers must sign up on "getkahoot.com" to create a simple game environment, but students are not required to sign up. The program is free and simple to join. The Kahoot application is easily formed after signing up and games created and shared by other users can be seen. Approved Kahoot games can be used in classroom activities. Future study questions equivalent to classroom lecture notes can be prepared by Kahoot. Each student determines his/her own nickname when logging in. Students whose nicknames appear on the board show increased motivation, ensuring more active participation. The tables allow the possibility of solving problems faster and of viewing them on the screen.

The ability for students to log in without downloading the application is another advantage. Kahoot is a program into which various media can be integrated, such as videos. A classroom discussion environment can be easily constructed for students by presenting them with visual media accompanied by music, sound, and photographs. However, like other programs Kahoot has limitations. For example, access to Wi-Fi is a requirement may cause communication gaps in classroom activities.

The stages of signing up on this platform and creating a basic level quiz are given below:

1. A free account is created on getkahoot.com.
2. The user chooses from the **quiz**, **discussion,** or **survey** options. A name is given to the Quiz and the user returns to the home screen, where answers are entered.

3. Questions (**+add question** on the bottom right) and answers (**incorrect** under the right answer should be changed to **correct**) are added. After adding questions, the time is set and **settings** then clicked on.
4. The **language** and **primary audience** sections are selected and **cover image** is clicked. Choosing a cover photo is optional.
5. The quiz is ready to be taken after clicking **done**.

2.1 Teaching the Lessons

The teacher shared the course content questions in the classroom with the Kahoot online question-and-answer technique to repeat and reinforce the topics for the last 20 minutes of each lesson. Below is a description of how to handle lessons with the Kahoot application in the classroom.

How to play Kahoot in the class?

1) Choose Kahoot that you want to play: Teacher logs into his/her Kahoot account on the computer connected to the projection, as shown in Fig. 1.

Kahoots are formed on "My Kahoots" before or Kahoot games created by other users can be listed. A new Kahoot can also be created, as shown in Fig. 2.

Kahoot that you want the students to play can be launched by clicking on "**play**" button. **Launch** "launch" screen will appear.

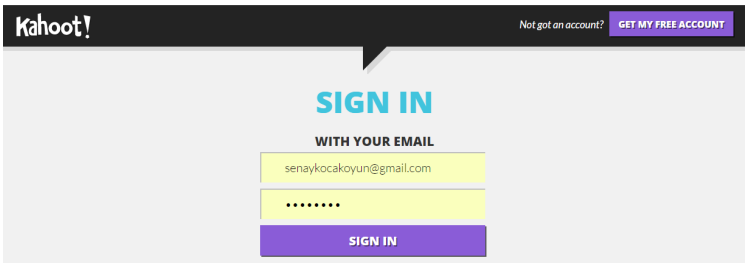

Fig. 1. Sign In

Fig. 2. Create a new Kahoot

2) Reflect the game with projection: Game is projected on the board by the computer connected to the projection in a way that all the classroom can see. Students are asked to have their usable devices (tablet, mobile phone and computer) ready in advance. All devices that have access to the internet can be used. Mobile applications for mobile phones and tablets of Android and IOS operating systems are also available. Various options are available for teachers in this field. **Randomize Order of Questions** and **Randomize order of answers in each question** are specific options for teachers. Moreover, it offers additional options such as **Advanced Options**. **Automatically move through questions** feature can be adjusted. Game will start with the participation of students when clicked on **Launch,** as shown in Fig. 3.

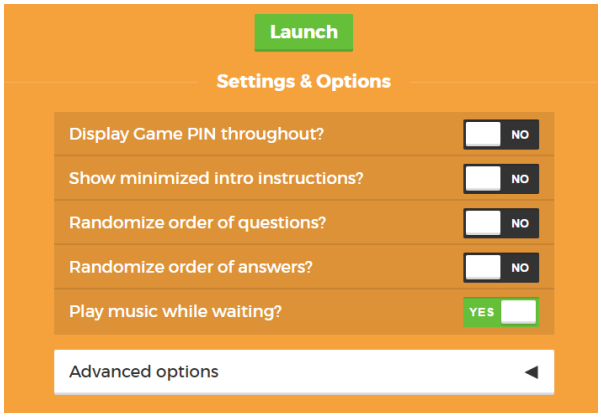

Fig. 3. Launch Game

3) Students join the game: Students do not need to sign up. They can directly play the game. A randomly created password is shown on the screen of the teacher connected to the projection. The password given after how the students will join the game is explained will be valid for this session only, and a new password will be created for each game. Students are expected to log in on **kahoot.it** , write their password and then write their "nicknames" for the game and enter the game. The names and number of the students who entered the game are shown on the screen of the teacher, as shown in Fig. 4. After all the students join the game, game is started by **Start Now** button.

Fig. 4. Participation of students in the game

Students get higher points depending on their speed. In the beginning, only the question is shown for 5 seconds. In this way, students are expected to think. Then, picture, video or answer options depending on the question are shown and then the timer starts. Four different shapes in four different colors will be seen on the devices of students representing multiple choice questions. When they click on the button with their right answers, the timer will continue for their friends to answer. When the time ends, the results will be automatically shown in the classroom.

4) Obtain feedback for the question: Information about the general level of the class was obtained. The number of students who gave the correct answer to the question asked was seen in Fig.5. The information bar that indicates the number of students who chose each answer choice also gave the number of students who answered the question incorrectly or confused the answers. In this case, teacher has the right to start a classroom discussion or to review the topic. The reason why these questions are answered wrong is discussed after each activity. Moreover, the students could see whether they answered the questions correctly, their scores and their position in the ranking. The rankings of the students were shown in the scoreboard when clicked on Next.

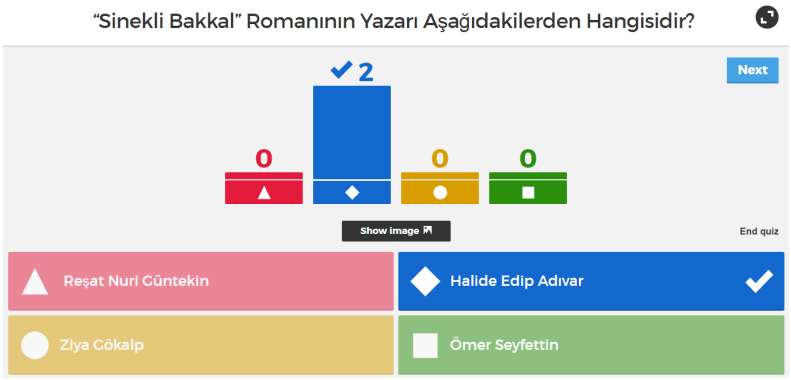

Fig. 5. Obtain feedback for the question

5) Scoreboard: First five players were shown on the scoreboard respectively after each question. Lower rankings were not shown regardless of the number of students in the class. Each question is worth up to 1000 points. As the timer works, scores start to decrease accordingly with the time. The faster the questions are answered, the higher the obtained scores are. The scoreboard shows the points collected until that moment, as shown in Fig. 6.

Teacher must click on **Next** button to move to the next question. The student who clicked on **End** button and won was seen. The name of the winner students is seen on the board in a big font and this motivates the students more. At this stage, the students are asked to evaluate their experience for the final feedback. By clicking on **Feedback and Results** button in Fig. 7. the way how the students felt in this exercise can be seen.

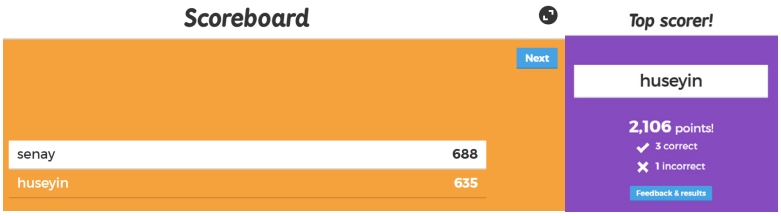

Fig. 6. Scoreboard and Feedback & Results

Evaluate the experience: At the end, all the feedback obtained from all the answers is shown simultaneously on the board. **Final results** they can be seen by the "final results" button.

- **How fun was it?** "How fun was it?" Rating from 1 to 5
- **Did you learn something?** "Did you learn something?" Yes – No
- **Do you recommend it?** "Do you recommend it?" Yes – No
- **How did you feel?** "Tell us how you feel" Happy – Normal – Sad

Fig. 7. Evaluating experiences

6) Download the results: While the final version of the scoreboard is shown on the board, each students will receive a personal feedback on his/her individual device. They will be able to see the number of questions they answered correctly, their ranking and total score. Teacher can download this scoreboard to his/her own computer. In this table, correct answers will be green, incorrect answers will be red as shown in Fig. 8.

	A	B	C	D	E	F	G	H
1								
2	STUDENT	CORRECT ANSWERS	INCORRECT ANSWERS	SCORE	Romen Rakamında Hangi Sayı Yoktur?	Aspirinin Hammaddesi Nedir?	Romanının Yazarı Aşağıdakilerden	Uygarlıklarından Hangisi Yazıyı İcat
3								
4	huseyin	3	1	2106			Halide Edip Adıvar	
5	senay	2	2	1541			Halide Edip Adıvar	
6								
7	OVERALL PERFORMANCE							
8								
9	% TOTAL CORRECT ANSWERS	63%						
10	% TOTAL INCORRECT ANSWERS	38%						
11	AVG SCORE	1824						
12								
13	SWITCH TABS BELOW TO VIEW YOUR END OF GAME RATINGS & INDIVIDUAL QUESTION BREAKDOWN							
14								

Fig. 8. Download results in your computer

In order to play the same game again, **Play again** button can be clicked on, in order to play another game, **Play a different Kahoot** button can be clicked on.

3 Methods

3.1 Purpose of the study

The purpose of the study was to evaluate the effect of a gamification approach on student perceptions. By using the game based learning environment, the students' use of the Kahoot have been evaluated for their perspectives, the opinions and experiences of undergraduate students have been researched and lastly experimentally the students' opinions and thoughts were put forward within the qualitative and quantitative methods. For this aim; the following questions were investigated:

1. What are the general perspectives of students about gamification?
2. What are the perspectives of students about the effectiveness of Kahoot? How do the students view/evaluate the Kahoot application?
3. What do students feel are the advantages and disadvantages of gamification?
4. What are the opinions and perception of students at the end of the application based on their experience?

3.2 Setting

The course that implemented the Kahoot platform by the teacher. At the end of each lesson, the questions given in the course for that week were presented to the students through the Kahoot application. In addition to the experimental work, students are required to write evaluation notes in order to have qualitative data and note learning experiences about the course. Both qualitative and quantitative data were collected. To determine the perceptions of the use of the Kahoot Platform, a survey was conducted following completion of the trial phase. The results were analyzed and percentages calculated.

In this study, the effect of a gamification approach on student perfection was experimentally researched using quantitative and qualitative methods. Students who participated in the research were undergraduates studying Preschool Teaching at the Ataturk Faculty of Education. Both Scale and qualitative questions were developed by the researchers. Quantitative data were analyzed using SPSS 22. Qualitative data were analyzed using Nvivo. Qualitative data analysis was analyzed by grouping interviews in vivo codes.

3.3 Participants

Fifty-five female and 10 male students who were studying Preschool Teaching at the Ataturk Faculty of Education participated in the study, as total of 65 participants. The age average of 4th year students attending the study has been found as 22.

3.4 Instruments

A scale for the measurement of the effect of a gamification approach on student achievement by classroom competition has been developed, and is formed of 3 dimensions. In total, 65 items are available. Dimensions are divided into the following subcategories: "General Perceptions about Gamification Method" (32 items), "The Effectiveness of Kahoot Application" (23 items), and "Evaluation of Kahoot Environment" (10 items). Three dimensions are also evaluated by students by using a 5-point Likert-type scale (completely agree, agree, indecisive, disagree, and completely disagree). An answer of "Completely agree" by the student is associated with a score of 5 points. A validity and reliability study of the scale was performed, and the Cronbach alpha value for internal consistency was 0.96. The qualitative aspect of the study research consists of 4 questions. These questions are as follows: "In which lessons can gamification be used?" "Were the performed activities remarkable? Why?" "What are the advantages and disadvantages of gamification method?" And "how did you feel about being in continuous competition with your friends?" The duration for gathering all answers for questions and to direct them, has been recorded through the oral interview and these interviews later saved on the documents. Afterwards these qualitative data were analyzed using Nvivo.

3.5 Data analysis

Quantitative results are shown as the means and standard deviation (SD) and qualitative data are shown as frequencies and percentages. In this way, the effect of a gamification approach on the perceptions of students investigated.

4 Results and Discussion

4.1 Student perceptions on the gamification method

The responses given by students to questions about gamification are shown in Table 2. When a gamification method was used in all the lessons together with the Kahoot application, the students answered "completely agree" to all the questions. Examination of the data showed that inclusion of a gamification method increased the interest of students in the classroom (M=4.52, SD=.58), and students studied more to become successful through the gamification method (M=4.33, SD=.71). In addition, competition in the classroom was found to improve student motivation (M=4.36, SD=.62) and communication with the goal of becoming more successful in the classroom (M=4.44, SD=.58). Using gamification methods in other classes was thought to be of likely benefit (M=4.35, SD=.64) and using a gamification method on a smart phone made the students feel better (M=4.33, SD=.69). The reward system was thought to be motivating (M=4.35, SD=.59) and students improved themselves through gamification in areas that they feel deficient in by observing their achievement status (M=4.35, SD=.64). Using a blended learning method enabled the students

Table 2. Student Perceptions on Gamification Methods

	Items	Mean	SD
1	A gamification method increases my interest in the lesson	4.52	.58
2	I study more to become more successful via gamification methods	4.33	.71
3	Being placed in competition with other students in the classroom via a gamification method increases my motivation	4.36	.62
4	I communicate more with my friends to become more successful via gamification methods	4.44	.58
5	I want gamification methods to be used in other lessons as well	4.35	.64
6	Using a gamification method through my smartphone makes me feel better	4.33	.69
7	Rewards associated with gamification motivate me	4.35	.59
8	The gamification method allows me to see my achievement status and improve myself in the areas that I am weak in	4.35	.64
9	Use of a learning method blended with a gamification method helped me to understand the lesson better	4.36	.71
10	Gamification methods are fun	4.43	.66
11	Performing group work with a gamification method illustrates how achievement can be obtained through collaboration	4.24	.77
12	Winning badges through a gamification method makes me feel important	4.29	.74
13	Gamification methods contribute to information exchange among friends	4.29	.65
14	Information can be recalled more easily thanks to gamification method	4.33	.64
15	I feel bad if I am unsuccessful when a gamification method is applied	4.15	.64
16	I think my reputation in the classroom improves with the badges I win though gamification	4.24	.66
17	Each question I correctly answer improves my self-confidence	4.38	.62
18	Gamification methods help me to become more ambitious for success	4.36	.65
19	Gamification methods increase classroom competition	4.40	.60
20	Racing against time increases my speed in answering questions in the gamification method	4.50	.64
21	Gamification methods make me take on more responsibilities to become more successful in the lesson	4.41	.65
22	Sharing the score I obtain on social networks makes me feel better	4.21	.78
23	Applications used in gamification allow me to practice time-management skills	4.38	.65
24	Gamification methods enable me to learn difficult topics while having fun	4.38	.70
25	I force myself to learn when using gamification methods to improve group achievement	4.34	.69
26	The will to win increases by means of gamification methods	4.43	.70
27	Gamification methods will be successful if used in other lessons	4.38	.67
28	The formation of a competitive environment increases my motivation in the classroom	4.46	.66
29	Creating a competitive environment increases my interest in the lesson	4.18	.68
30	Using a gamification method for group work in crowded classes increases the level of competition	4.41	.68
31	Gamification methods increase interest in the lesson in crowded classes	4.24	.66
32	Gamification methods help identify areas of deficiency by collecting different data from individuals in group activities	4.40	.68

to understand the lesson better (M=4.36, SD=.71) and students felt that the gamification method was fun (M=4.43, SD=.66). Students felt that performing group activities using this method taught them how achievement could be obtained through cooperation (M=4.24, SD=.77), gaining badges made them feel important (M=4.29, SD=.74), and each question they correctly answered improved their self-confidence (M=4.38, SD=.62) and helped them to become more ambitious for success (M=4.36, SD=.65). The method increased the level of classroom competition (M=4.40, SD=.60) and competition increased their response speed (M=4.50, SD=.64). Students felt that they took responsibility for becoming more successful in the lesson utilizing the gamification method (M=4.41, SD=.65) and sharing the scores they obtained on social networks made them feel better (M=4.21, SD=.78). The application helped students to better manage their time (M=4.38, SD=.65) and to learn difficult topics by having fun (M=4.38, SD=.70) Students forced themselves to increase group achievement (M=4.34, SD=.69) and their desire to win was also increased (M=4.43, SD=.70). The students felt that the application could be similarly successfully utilized in other lessons (M=4.38, SD=.67) and that creating a competitive environment had the effect of increasing their interest in the lesson (M=4.18, SD=.68). The level of motivation was thought to be higher in crowded classes (M=4.41, SD=.68) and the gamification method was thought to identify areas of deficiency by collecting different data from individuals during group activities (M=4.40, SD=.68).

Many researchers have found that gamification can be used to affect the motivation and behaviors of individuals [30-34]. It has been shown that individuals focus on 1 topic within the allotted period for the game, and a gamified competitive learning environment increases student motivation [30].

Research on gamification has shown that gamification can be a beneficial and remarkable tool that motivates and encourages learning, and helps with solving problems in different fields and communicating with different groups [35-37]. Gamification renders education more enjoyable by encouraging social ties, learning processes, specialization ability, ambition to achieve success in the competitive environments, competition, and enthusiasm of changing status, while motivating students to solve problems and partake in educational activities [38]. It has also been shown that gamification can play a notable technological role in changing human behavior [12, 13]. In this study, students stated that the gamification method rendered them ambitious and accordingly increased the level of classroom competition. Gamification can be used as an appropriate method for changing human behavior.

4.2 Kahoot Application

The data presented in Table 3 suggest that the lessons carried out using Kahoot provide more permanent learning compared to learning in a traditional classroom environment (M=4.43, SD=.58). The data also show that Kahoot enhances student interest in the lesson (M=4.40, SD=.60) and has an effect on student success (M=4.49, SD=.53). Creating activities using Kahoot is more interesting (M=4.46, SD=.58) and using Kahoot leads to positive collaborative learning opportunities (M=4.52, SD=.66). Kahoot increases the productivity of the lesson (M=4.47, SD.61) and stu-

Table 3. The Effectiveness of the Kahoot Application

Items	Mean	SD
1. Lessons performed with Kahoot enable permanent learning compared to learning memory in traditional classroom environments	4.43	.58
2. Kahoot increases interest in the lesson	4.40	.60
3. Kahoot improves success	4.49	.53
4. Activities created using Kahoot are more interesting	4.46	.58
5. Using Kahoot makes for more effective collaborative learning	4.52	.66
6. Kahoot increases the effectiveness of the lessons	4.47	.61
7. Kahoot allows for comfortable self-expression	4.38	.67
8. Using Kahoot in education increases student motivation	4.43	.66
9. Kahoot enables active learning	4.50	.56
10. Question techniques in the activities performed by Kahoot provides the students with different perspectives	4.58	.55
11. Kahoot improves the rapid-thinking abilities of students	4.44	.66
12. Kahoot provides permanent learning in classroom activities	4.58	.52
13. Timely questions in Kahoot activities increase student excitement	4.36	.65
14. Kahoot gives students the opportunity to deliver richer content	4.46	.61
15. Using pictures in Kahoot applications allows the user to more easily understand the content	4.49	.56
16. Using videos in Kahoot application attracts greater student attention	4.36	.60
17. The background audio in Kahoot is distracting	4.13	.58
18. Sharing activities via social media increases motivation	4.39	.68
19. The scoring system of Kahoot increases the ambition of students to be a top-five scorer	4.35	.71
20. The use of Kahoot in the classroom encourages learners	4.53	.59
21. The active use of Kahoot builds student courage to participate in activities	4.46	.63
22. Activities performed using the Kahoot application allow for easy learning of the topic	4.52	.53
23. The color harmony of the buttons in the application is remarkable	4.52	.61

dents feel that they can express themselves more easily through the application (M=4.38, SD=.67). Using Kahoot in education increases motivation (M=4.43, SD=.66) and Kahoot provides active learning opportunities (M=4.50, SD=.56). The question techniques in the activities performed using Kahoot offer students a different point of view (M=4.58, SD=.55) and Kahoot improves the rapid-thinking skills of students (M=4.44, SD=.66). Kahoot also provides permanent learning in classroom activities (M=4.58, SD=.52), and student excitement is enhanced by the imposed time limits (M=4.36, SD=.65). A richer content is presented by Kahoot (M=4.46, SD=.61) and the inclusion of pictures in the Kahoot applications enables students to better understand the material (M=4.49, SD=.56). Using videos in the Kahoot application attracts the attention of students (M=4.36, SD=.60) but the background audio of Kahoot distracts students (M=4.13, SD=.58). Sharing activities on social media increases

student motivation (M=4.39, SD=.68) and being in the top five scorers of Kahoot increases ambition (M=4.35, SD=.71). Using Kahoot during classroom activities encourages students (M=4.53, SD=.59) and active use of Kahoot boosts the courage of students to participate in activities (M=4.46, SD=.63). The activities performed using Kahoot application enable students to learn more easily (M=4.52, SD=.53) and students feel that the color harmony of the buttons in the application is remarkable (M=4.52, SD=.61). Adopting an approach that takes into account visual elements for effective gamification designs would increase the prestige of the design. Moreover, a gamification methods based solely on gamification factors may facilitate the design process [3]. Studies of Kahoot have shown that the application is user-friendly, and that it is a platform from which both teachers and students can benefit. Kahoot was shown to be the best application for teachers to promote students in the classroom and integrate competition into the educational environment. Kahoot encourages learning and creates a fun and competitive environment [39].

Thomas (2014), Kahoot allows fast and easy access and is recommended for educators. He stated that creating activities with Kahoot is beneficial because they can be used to review old lesson content. He also noted that Kahoot can be used in many different fields and for different forms of evaluation, including research projects and presentations [29].

Turan & Goktas (2015) observed that one of students' most enjoyed elements in flipped classrooms is the Kahoot gamification application. In light of this, it can be concluded that gamification activities should be considered when designing lessons [40].

4.3 The Kahoot environment

Table 4. Evaluation of the Kahoot Environment

Items	Mean	SD
1. Password access of the application is easy to navigate	4.43	.61
2. Nickname access of the application is easy to navigate	4.36	.62
3. The application can be easily used on all platforms	4.32	.64
4. The time display of the activities in the application facilitates time management	4.30	.63
5. Activity results in the application can easily be shared	4.40	.63
6. Using the application through mobile devices is easy	4.41	.60
7. Activities may easily be created in the application	4.29	.60
8. Answers in the application can be easily given on smart phones	4.43	.58
9. Projecting the application on a board facilitates answering	4.46	.61
10. The design of Kahoot is simple and useful	4.47	.64

Students generally answered "completely agree" when evaluating the Kahoot environment, as shown in Table 4. Students found that password access to the application was easy to navigate (M=4.43, SD=.61), nickname entrance was easily provided (M=4.36, SD=.62), and the application could be easily used on all platforms (M=4.32, SD=.64). The time display for the application activities renders time management

easy (M=4.30, SD=.63) and the activity results are easily shared (M=4.40, SD=.63). The application is easy to use on mobile devices (M=.4.41, SD=.60) and the activities in the application are easily enjoyed (M=4.29, SD=.60). Moreover, the answers can be given easily using smart phones (M=4.43, SD=.58) and projecting the application on the board facilitates student answering (M=4.46, SD=.61). Finally, students felt that the design of Kahoot was simple and useful (M=4.47, SD=.64); particularly because students are not required to create an account to access the Kahoot quizzes and education can be easily provided through any device (laptop, tablet, Android or iOS) with a web browser.

Kahoot applications are easily created in a safe, competitive, attractive, and fun environment. The dual academic and psychological aims of this application can be achieved on all platforms. Furthermore, the application has a positive impact on students, as revealed by the feedback feature. Students report feeling excited when playing Kahoot in the classroom and impatient to connect the game [39].

4.4 Advantages and disadvantages of the gamification method

The advantages and disadvantages of the gamification method reported at the end of the student interviews are given below.

Advantages: The answers given by the students regarding the advantages of using a gamification method are as follows: It was fun and it made me study before coming to the class, which made me feel self-confident. Getting a higher score than my friend led me to study harder and actively participate in the competition (f= 53, 82%). It was exciting (f=57, 88%). The competitive environment created many positive feelings, including excitement, desire for class participation, and an eagerness and willingness to come to class (f=51, 78%). As competition- and race-containing games are preferred, these activities led us to become more active in the classroom (f= 47, 72%). It improved thinking skills and reduced answer response time (f=60, 92%). I felt like I was in a competition. I had the feeling that I could do it and that I could achieve a higher score (f= 46, 71%). It made us become more ambitious and feel like we were in a competition. It gave me the feeling that I must win. And therefore, it made me feel better (f=56, 86%). We had a good time with friends. It facilitated learning (f=61, 94%). We had feelings of winning and losing (f=58, 89%). It enabled us to consolidate what we learnt (f= 55, 85%). In other studies, students have similarly stated that they were pleased with the gamification method, with comments such as "I like the activities that were performed during the class. It made us consolidate what we learnt until now" [40]. Johns (2015) wanted university students to evaluate Kahoot in his study, due to interest in the application. He found that students generally came to the class with their own smart phones tablets and laptop computers and he had frequent opportunities for evaluation at the end of the class [41]. Gamification is a popular learning method from the perspective of students, because it allows them the opportunity to monitor themselves and engage in an enjoyable competitive environments. Gamification improves students' willingness to come to class; students who do not have their own devices can use other computers in the classroom.

As a popular student response system, Socrative, is a free, cloud based SRS that can be accessed on phones, tablets and laptops [42, 43]. This system provides teachers to evaluate small oral exams, personal fast quizzes and team games [44]. Like self-prepared exams, the others are also accessible as asynchronous at cafés, restaurants or places which has Internet access [45]. Kahoot is a game-like student follow-up system that would be used for making exams, discussions and questionnaires [39]. As multi-media tools such as video clips, music and images can also be added, this system is more dynamic than some other quiz generators. The students using Kahoot can save their time and take an exam so that they can compete with each other [46]. The total time needed for the right answers and their provision, is used in participant students' grading and sequencing [47]. This system has been reported as user friendly, entertaining, attractive and motivating for students [39, 46, 47].

Disadvantages: The answers given by the students regarding the disadvantages of using a gamification method are as follows: Problems with the internet connection caused problems in active participation. We remained behind because of the questions we could not answer (f=44, 68%). We could not answer some questions due to internet interruptions, although we knew the correct answers (f=43, 66%). The only problem we encountered was the internet (f=54, 83%). Sometimes the telephones were frozen (f=34, 52%). We had problems associated with the time limit (f=42, 65%). It has been argued that the only disadvantage associated with using the Kahoot application in a flipped classroom is that students can have problems connecting to the internet reliably at all locations [40]. There are also disadvantages that need to be recognized by educators and the students: there isn't any limit related to the number of character that you are going to use for questions and answers and the educators cannot ask end-to-end questions or cannot get open ended answers (this feature seems to be release very soon) [25].

4.5 Opinions and perceptions of students resulting from their experiences

General perceptions on gamification as a learning tool, assessed from the qualitative data collected during student interviews, are summarized below.

Gamification can be used during all lessons in which students have difficulties learning, so that students can easily learn by having fun. (F=50, 77%). Gamification can be used in preschool teaching, music and English lessons. It can be used to teach concepts in nursery schools (F=45, 69%). It can be used in all fields. Through gamification, students start to have fun and enjoy lessons that they previously disliked (F=55, 85%). Gamification can enable children to learn more easily, in a fun way. It is also important for the children to be self-confident in their social space and to spend time with their friends. Gamification may be difficult to employ in preschool-aged classrooms because the children are young, but it can be used when accompanied by teachers (F=48, 74%). We can use gamification methods for learning and teaching activities. Gamification helps the child to develop cognitive skills, such as thinking and problem-solving, increases creativity, helps children to experience winning and losing in a competitive environment with friends, and socialize (F=45, 69%). During the preschool period, gamification activities appropriate to the age group can involve

the use of pictures. Using gamification, the teacher may create questions and answers on the topic he/she struggles with explaining. In this way, the topic could be consolidated (F=49, 75%). Gamification methods can be used in all environments that have internet connection (F=55, 85%) and can be used in all fields of education. It is quite an effective method for consolidating topics, imparting a feeling of competition, and facilitating student socialization (F=50, 77%). Gamification can be used in all lessons in primary and high schools. It is likely to be particularly useful for increasing the competition in numerical lessons (F=43, 66%).

Gamification can be used for various educational reasons and in all lessons. Students learn topics more easily, and tackle difficult material in a fun way; consequently, it was concluded that gamification would be an appropriate learning method for all fields. Similar results were also found in a different study. Although numerical games were primarily used, gamification can be applied to many cases in daily life [48]. Students also reported that English could be used in learning. Motivation, one of the most important factors in foreign language teaching, is defined as a power that initiates and facilitates the language-learning process [49, 50]. Investigation of the evaluations of students from a different study revealed that the gamification application Kahoot is one of the most popular applications. It was concluded that students like to come to the class prepared, and they are motivated by the presentation of unexpected questions. Turan & Goktas (2015) also reported that students like the Kahoot application, as well as the fact that lessons are applied [40].

5 Conclusion

Rapid developments in technology can lead to the formation of a competitive environment, and this competitive formation can be harnessed through use of a gamification method in the classroom. In this study, student opinions on issues in the application of gamification methods, the environments that gamification should be used in, and the method by which gamification should be carried out were assessed. The data indicate that gamification of learning heightens student interest in the lesson, and encourages students to become more ambitious for success. Simultaneously, inclusion of gamification approached has a positive effect on student motivation. The students who felt that collaboration was very important during gamification supported and helped each other in learning. The students who could join this application by means of smart phones stated that the reward system increased motivation. Students were able to see their achievement status through gamification, and improve themselves in the topics in which they are deficient; moreover, combining a gamification approach with a blended learning method helped students to better understand the lesson. Winning badges made students feel important, and students found it easier to remember information when it was presented in a gamified manner. Competition helped students to improve their response time and enabled them to learn topics that were difficult to understand. These findings suggest that gamification can be effectively integrated into lessons using the Kahoot application. The ease of using Kahoot is one of its greatest advantages. Students stated that gamification could be easily used in all fields and

they reported that this method increased student studying before coming to class. Incorporating a gamification method in the classroom effectively makes students more ambitious, leading them to study harder. The major disadvantages of the application were technical, primarily being the speed of the internet and freezing of smart phones. Teachers can organize lessons that include gamification methods in the learning environment without technology or internet problems and they can easily motivate students to participate by bringing a competitive feeling to the environment. The ability of the teacher to attract students' attention is an important driver of student motivation. Student attention can be focused on different extracurricular activities using the Kahoot application. The incorporation of various gamification activities into lessons to help students concentrate on and adapt to lessons will motivate them.

The games are naturally described and they depend on rules, and this means that the students are trying to understand educator's expectancies and also trying to observe their own progress about the learning targets with the classroom activities. In other words, the benefits of playing games can be valid for different reasons of different students. At a course in higher education, the students' perceptions at game strategies were researched and the results show that; even though the students are exposed with the game mechanics in different ways they still benefit from these strategies [51].

In terms of mobile access of university students, Wi-Fi access and the closeness of students with computer games, the games such as Kahoot is a perfect choice for education. These types of e-learning tools, provide entertainment in class, supportive concept research and the positive energy which seems to be converted to motivation and increasing meaningfulness. This e-learning platform can create an attractive environment which provides active participation and supports learning [25].

5.1 Recommendations for individuals who use the Kahoot application

- To maximize effective and productive teaching using gamification methods, technical deficiencies of students and teachers should be eliminated.
- Teachers may benefit from presenting gamification activities at the beginning or end of the normal lesson plan to help the students consolidate the material.
- Motivating elements other than a scoring system can be added to the Kahoot application to increase motivation.
- Creating a team spirit in the classroom that the students feel will increase motivation. Gamification applications may be designed to bring about team spirit. It is important for the teacher to try to increase team spirit.
- When developing gamification activities, researchers should design environments that will encourage the student to think. In this way, students will be more active and the lesson will be more fun.
- Teachers should use the Kahoot application such that the students enjoy the experience. Students may find it useful to know that their teachers are supportive and willing to work with them in a positive competitive environment.

5.2 Recommendations for researchers and further study

- This study was conducted during the computing lesson in Preschool Teaching. It was observed that the study gamification method was embraced by students as presented by the teacher during the computing lesson. To better realize the effectiveness of gamification methods, activities for verbal lessons should also be prepared and researched.
- As students typically need activity adaptation time, future studies should investigate the time required to adapt to these kinds of activities.
- Including gamification applications where students can reveal themselves will allow students to become aware of their limitations and become more motivated in the learning environment.
- The process of integrating gamification methods into traditional education will have different effects on different audiences, including academics, school authorities, and students. Other studies of these groups should be investigated.

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Smartphone Habits and Behaviors in Supporting Students Self-Efficacy

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Abstract—The widespread of smartphones usage have increased the convenience of accessing information and knowledge sharing for higher learning students. University's students are exposed with the multi channels of knowledge from various sources primarily from online learning's resources. The study examines smartphone habit and behaviors, internet literacy, and mobile learning in relation to self-efficacy. Self-efficacy refers to the internal forces of a student's belief in the abilities in utilizing smartphone as educational aid in the context of mobile learning. This study deploys a quantitative approach in assessing the relationship between self-efficacy, internet literacy and smartphone's habits for of university students. Understanding student self-efficacy is important factor to deliver an effective ways in supporting mobile learning activities. In addition to documenting the findings of self-efficacy and mobile learning, the research also represents a model of internal and external factors that affects student self-efficacy to make mobile learning successful.

Keywords—Internet literacy, Mobile learning, Smartphone Habits, Self-Efficacy, Higher Education

1 Introduction

The popular machinery that resembles a computer and has the portability of a laptop but smaller in size is a cellular phone, which is known as a smartphone. In supporting educational technologies, many students are devoted to their smartphone. A smartphone is one of the technology that has improved massively over past few decade. Smartphone's capabilities and ability to move signals have become increasingly significant, thus, it is perceptible for people to carry and even some own more than one smartphone. The global amount of smartphone users almost attained to two billion in 2016 and is now predicted to exceed that value by 2017 [44]. The exponential rise of smartphone users has made it incontrovertible that people are getting more dependent on this technology that potentially affecting their mannerism in smartphone management especially for students. Though, the development of smartphones has

given students especially at higher level easy access to the Internet for varied purposes such as education, research, teaching, tutorials, social communications, etc.

However, there is a concern on student's belief to succeed in condition whereas a smartphone can become an educational aids in accomplishing their academic activities. The student belief about their capabilities to produce designated level of performance is referred to student self-efficacy. Self-efficacy is important factor for academic learning, critical thinking, performance and motivation. Students' with smartphone in mobile learning with a strong self-efficacy are more open to new learning approach and experiences [38] at the same time the students are more to new ideas and different learning opportunities [10, 26, 41].

Students are heavily relied on the mobile learning tools and its applications to support daily academic routines [35]. The capability to easily access academic contents through smartphone via Apps and other supporting mobile technologies [45]. It refers to smartphone self-efficacy that extent the ability to enhance educational aids at university level. It will depends on students' self-confident and user characteristics such as internet literacy computer literacy and prior experience and user's smartphone usage and habits. In addition, university environment has adopted varies of approaches to improve students' self-efficacy trough educational technologies of mobile learning such as online discussion, online project collaboration, or interactive multimedia teaching.

Thereby, the study conducted is to collect the responses from students at university and verify the influence of smartphones on their self-efficacy and mobile learning activities. The study is aimed to investigate the relationship between student characteristics of higher level students which determine the use of smartphone in the context of mobile learning. More specifically, the purpose of the study was to identify the relationship between:

- Smartphone habits and self-efficacy
- Self-efficacy and Internet literacy;
- Self-efficacy and mobile learning;

Although this study was conducted in Brunei, the proposed model and finding can be readily used by other researchers in different settings. In the next section, we present a review of related work. This is followed by an outline of the methodology. Next, we present our analysis and findings as well as the discussion. The final section represents the conclusion.

2 Theoretical Background

Self-efficacy plays important role in how students feel, behave, and think. Self-efficacy was originated by Bandura [7], it is personal's beliefs in their capabilities to produce desired effect by their own actions. Similarly, self-efficacy as a personal belief that an individual is capable of performing in an appropriate and effective manner to attain certain goals [37]. In this section we highlight on student self-efficacy in supporting mobile learning as educational aids for students at the university level.

2.1 Student Self-efficacy

Student self-efficacy is a construct that was developed within the context of Bandura's social cognitive theory. It is the belief that students have about their abilities and skills as to acquire information and process them into knowledge. Student's self-efficacy has become an important characteristic of the student and one strongly related to success in learning. Self-efficacy beliefs are among the knowledge structures that act as a pervasive influence on personal's successful development especially in academic performance [15]. Students' judgments of their capability to perform academic tasks, that is, their self-efficacy beliefs, predict their capability to accomplish such tasks [8].

Self-efficacy is a self-system that controls most personal activity, including appropriate use of professional knowledge and skills [24]. Since, university life can be demanding and stressful especially for a new student [34] that requires higher levels of independence, initiative, and self-regulation [14]. According to self-efficacy theory, there are four basic information sources of one's self-efficacy: performance accomplishments (i.e. past experiences), vicarious learning (i.e. modelling by others), verbal encouragement (i.e evaluative feedback), and physiological and emotional states [9]. Personal's level of emotional states are influenced on personal belief. Personal belief in a positive consequence of a particular behavior may be more important than the behavior has caused a positive consequence in the past [39]. Therefore, personal belief is only one component of self-efficacy to attain designated types of performances. For instance, a student student's belief and enthusiasm in using smartphone for learning activities can lead learning success because he may have high efficacy rather than students that have low self-efficacy believing smartphone is an interference in learning.

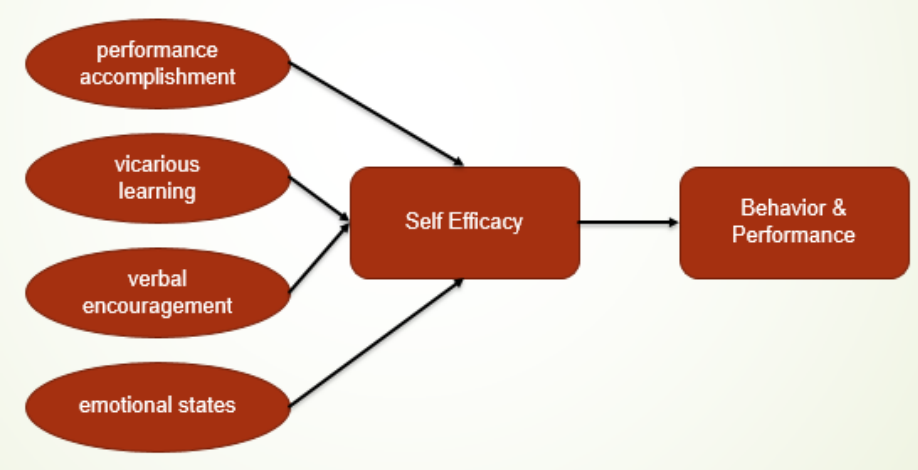

Fig. 1. Components of of Self-Efficacy (Source's: Bandura, 1997)

Self-efficacy has also been characterized by self-concept, including the terms of self-perception, and self-esteem. Self-perception defines how individuals think about themselves, which expresses the cognitive part of one's self (self-knowledge). Self-esteem generally expresses the emotional part as the evaluation component of self-concept. As a component of emotional attitude it determines how individuals feel about themselves.

Student self-efficacy is own believe, expectation, confident, or judgment concerning his or her ability to accomplish academic tasks and assessment. It is a personal judgments of own capabilities to perform a specified actions [43] and its beliefs about their ability to do the task [40]. It beliefs influence the particular courses of action a person chooses to pursue, the amount of effort that will be expended, perseverance in the face of challenges and failures, resilience, and the ability to cope with the demands associated with the chosen course [17].

In previous study showed that student self-efficacy was able to improve academic performance in specific cognitive areas was well developed, and it was also very clear that self-efficacy is much more than the reflection of content specific ability [17]. For instance, computer self-efficacy influences expectations and emotional reactions regarding the effective use of ICT [19,32]. Thus, people who feel that they are low in computer literacy are less likely to use them [5]. On the other hand, attitudes towards computer are linked also to self-efficacy since they are deemed to be a significant factor in the interpretation of the frequency and success with which individuals use computers [6, 19]. The study attempts to fill the gap by examining student self-efficacy in regard to smartphone habits and mobile learning.

2.2 Smartphone Habits and Mobile Learning

The most important feature of smartphone is communication. The accessibility to the Internet through smartphone has become a daily routine for people to an extent that is over-depended on. With a smartphone, people can communicate without concerning about the distance. Smartphones have been broadly adopted by mainly the youth [16]. Through the advancement made today, they are also used for other purposes such as entertainment, bills payment, audio and camera recording and internet browsing. These smartphones have become an adaption for all age groups, either younger generations or older generations. A study over 140 individuals in Spain, whose ages range between 20 to 60 years old and they found that smartphones are commonly used for their convenience in communication [18]. In Riyadh, a research that has been carried out on 450 individuals, age ranging between 18 to 55 years old [1], reported that smartphones are mostly utilized for their communication purposes and also entertainment purposes. An investigation of smartphones usage in UK, conducted by O'Hara et al (2014) on 20 people (17 to 49 years old), found that smartphones, specifically WhatsApp, is a place where individuals would express their problems to their peers.

Hence, smartphones are likely to become an addiction to both generations and the daily usage of smartphones has been studied by several researchers from other countries [12]. In short, smartphone have ben affecting on the reformation of daily activi-

ties execution making matters such as learning and working, effortless according to its outlook. With the advanced technology nowadays, it has made the citizen to become more dependent in smartphone. The excessive use of smartphone considered to be a problematic mobile phone use as behavioral addiction such as loss of control, tolerance and withdrawal [11]. Overuse of smartphone brings concerns to users' physical health. Long period of time looking into smartphone cause pressure on spine which is in a long term it becomes pain in neck.

There are majority of aspects that ratify the addiction of smartphone usage such as the type of smartphones used, the distinctive attributes and their gender for instance, the ways of using smartphones vary between males and females [21]. The excessive use of smartphones has resulted in the correspondence of social issues and smartphone addiction [30]. Teenagers spent more time to engage with their friends on a mobile phone especially when the parents are driving. They used the time to text-message with their friends or update their social networks [13]. Availability of Wi-Fi and cellular data services is rapidly growing which provides many option to stay connected everywhere at any time [35]. In addition, the wide range of applications available in smartphones advocates the habitual urge of staying connected to the Internet [36]. An addicted smartphone user stated that they feel anxious and tense when their smartphones are misplaced and it affects their well-being such as emotions, habits and thoughts [30]. Convenience means to perform task in an uncomplicated way without having to use so much energy. Students use smartphones to get information about anything easily just from the access of the Internet [20].

Smartphone is also applied in education either as a student or educators [31, 33]. With smartphone uses them as a teaching tool, methods and mechanism to spread information fast and easily. While on student perspectives it is definitely a big help to gather information just their fingertip [42]. Students are exposed to different ways of learning through the internet. They can access a lot of variety of information within a short period of time anywhere and anytime making learning a lot easier. ICT in general ICT has a good side in learning [27]. For instance, it saves up so much time in writing by comparing writing an essay on a paper and making one using word application. Writing on paper is tiring, even a single word may take up 3 seconds of the time while on the keyboard its only like 1.5 seconds. Another best thing would be how convenient word application is for highlighting wrong spellings but on paper, we have to proofread, even with chances of missing the wrong spellings which equals to losing marks [4].

Smartphones can be used as recording lectures, which aids in educational teaching and learning in the sense that presentations or lectures can be recorded using a video recorder [25]. The recorded lectures can then be used as a students' guidance as well as reference for their assignments or homework. What the study can revealed that the results students spend more time on the Internet through smartphone. Students also tend to be the more advanced users of smartphones [3]. In terms of activities done using smartphones, students mostly use instant messengers though students are more active on social networking sites and almost of the student sample use it several times for streaming and mobile learning [23].

However, even though smartphone connects people through social media but the interaction between people verbally decreases [28]. This affects the students or students-teacher bond where nowadays they spend nearly all of their time alone with mobile phone on their hand. They do not even concern of managing their time to make bond with their teachers or other students [24]. There is an issue of information reliability and quality in mobile learning. Is the information that we have received from this website correct? This is a big issue because due to the amount of information on the internet is vast, there are many information made by someone that could be misleading and false. Self-efficacy and confidence of students should in line with literacy level in using and sharing only reliable information [22].

3. Method

The study concerns the assessment of university students' characteristics of smartphone habits and how these characteristics affect the integration of mobile learning. A total of 1000 questionnaires were distributed both electronically and manually. The participants were 847 of university students from all academics majoring. The participants varies from undergraduate to postgraduate studies. The study was conducted in Brunei Darussalam, a country located on the island of Borneo and consists of four districts. The population of Brunei Darussalam is 348,200 comprising 53 percent men and 47 percent women, with 73.8% Malay, 14.8% Chinese, and 11.4% other ethnicities (AITI 2010). They were selected via the simple random sampling method in order to complete the questionnaire regarding the demographic questions and self-evaluation questionnaires. The purpose of the study was to investigate the relationship between smartphone habits amongst students at higher level institution and self-efficacy. Specifically the study investigated the following questions:

1. The relationship between self-efficacy and Internet literacy.
2. The relationship between self-efficacy and smartphone habits.
3. The relationship between self-efficacy and mobile learning activities.

The research instruments for the data collection were:

i) The questionnaire of students' demographic.
ii) The questionnaire of Internet usage and smartphone's activities.
iii) The questionnaire of mobile learning through smartphone.
iv) The questionnaire of smartphone's habits.
v) The self-efficacy scale. It includes 4 items that are usually scored using a three point response ranging agree, neutral, and disagree.

The survey was carried out on February 22nd to March 1st, 2015. All the data were analyzed using SPSS version 17.0. Data were analyzed to find out the descriptive analysis of subject matter and correlation between variables. The theory, concepts, and findings were then used to obtain an understanding of the phenomenon and as a basis for providing recommendations.

3 Findings

For the analysis of self-efficacy and university's student characteristics that determine numbers of hours spent on computer or smartphone and level of in Internet literacy. Table 1 indicated the mean, the standard deviation and correlation significance (p-value) for student characteristic and self-efficacy. Positive correlation between self-efficacy and students' internet literacy as well as hours of spent on smartphone. Hours spent on smartphone and internet literacy provide students a sense of confidence, accomplishment when they face a challenge or a new exposure of experience including mobile learning activities.

Table 1. Average, mean difference of Internet Literacy and self-efficacy

Variable	*N*	Scale max.	Mean	s.d.	self-efficacy
					p
Number of hours spent on computer or smartphone	857	3	2.01	0.699	0.026
Internet Literacy	857	4	2.36	0.751	0.050

n = sample size; p = statistical significance of correlation; $p < 0.05$.

Furthermore, each student has a different priorities and preferences in utilizing their smartphone usage which could have an impact in supporting mobile learning. Table 2 shows the results of the collaboration between self-efficacy and smartphone habits. Multiple variable analysis was used in analyzing self-efficacy and smartphone activities. The excessive use of smartphone, according to the study are mostly used for instant messaging, social networks and moderate level for mobile learning (Figure 2). The analysis shows that there is correlation between those activities and students self-efficacy. The personal feelings of the participants are mostly consistent. Another fact of smartphone addiction is the high rate of people checking their smartphone with no reason even at transport, restaurant, even restroom and claiming that they cannot live without their smartphones.

Table 3 indicates positive experiences with mobile learning will increase the feeling to succeed. We found inherent correlations of students' self-efficacy that helps in understanding how university students use their smartphone for mobile learning. Furthermore, we established that participants from agreed that they cannot live without their smartphone, and they have a tendency to use their smartphones in restaurants and at home.

Figure 2 shows that the ever-growing habits and usage on smartphones can be indicated by the amount of time for university students spend on their smartphones, the usage for social networking (SNS), instant messaging like WhatsApp, mobile news, mobile streaming, mobile commerce, and mobile learning.

Table 2. Correlation between self-efficacy and smartphone activities or habits

Variable	n	Scale max.	Mean	s.d.	Self-efficacy
					p
Social networks	857	4	1.74	0.741	0.048
Instant messaging	857	4	1.21	0.485	0.028
Gaming	857	4	2.762	1.054	0.039
Video streaming	857	4	1.870	0.816	0.015
Smartphone at transport	857	3	2.114	0.814	0.003
Smartphone at restaurant	857	3	1.685	0.696	0.020
Smartphone at restroom	857	3	1.697	0.723	0.091

n = sample size; p = statistical significance of correlation; $p < 0.05$.

Table 3. Correlation between self-efficacy and mobile learning activities

Variable	*n*	Scale max.	Mean	s.d.	Self-efficacy
					p
mLearning Apps	857	4	2.454	0.968	0.029
Smartphone at class/lecture/tutorial	857	4	2.224	0.944	0.007
Smartphone improve my academic work	857	3	1.962	0.677	0.010

n = sample size; p = statistical significance of correlation; $p < 0.05$.

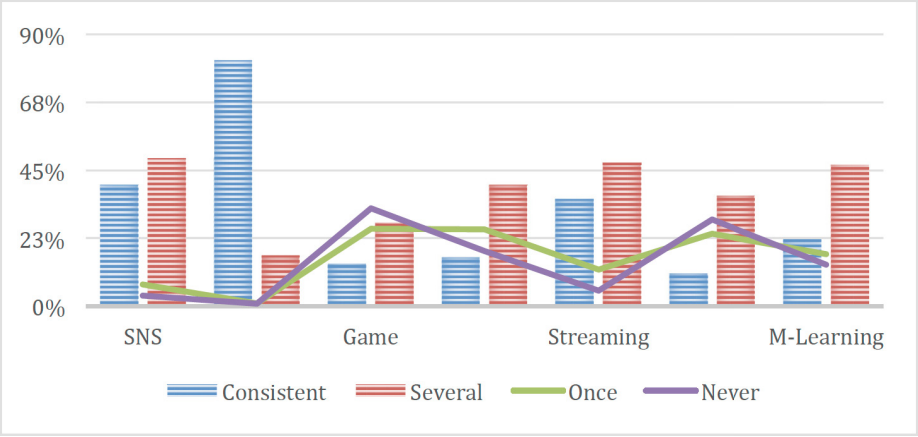

Fig. 2. Higher Learning Students on Smartphone Activities (Source: Authors' compilation)

4 Discussion

According to Bandura's theory, four sources of students' efficacy in the context of mobile learning the findings are performance accomplishment, vicarious experience, social persuasion, and Physiological and Emotional State. Performance accomplishment is shown from mastery smartphone experience. The study shows situations in which students demonstrate their own smartphone experiences from the excessive use of smartphone habits (Figure 2 & Table 2) and high Internet literacy's level (Table 1), thus proving that students are mastery smartphone users. Mastery smartphone experiences are the most influential source of self-efficacy information because indicating the reliable evidence of whether student to succeed in mobile learning experience. Success builds a robust belief in personal efficacy [7]. Vicarious Experience in mobile learning is obtained from observation or experience of others than own direct experience. Successful mobile learning experiences and observation through Canvas Instructure from respondents (Figure 1) generate confidences of students can learn from successes of other students, resulting their positive self-efficacy (Table 3). Students learn to be effective in mobile learning by modelling the habits (i.e smartphone habits) of other students being effective. Social Persuasion by facilitators and teachers that a student receives a positive feedback of any mobile learning activities will develop student self-efficacy. For instance, providing motivation and encouraging comments through mobile learning platform will affect student self-efficacy positively. Essentially, moral support builds a student's confident in self-efficacy relating to mobile learning approach. While, emotional states and physiological of each student influence self-efficacy judgments. For example, a student's enthusiasm for mobile learning can provide signal about anticipated mobile learning success. On the other hand, feeling of anxiety, stress, burdens, and other negative conditions can lead to negative judgments of students' capabilities and skills in getting value-added of mobile learning activities. Therefore, it differentiates between students self-efficacy from students self-confidence. A student could have high internet literacy may not be a successful if student negative emotional state come into play. In detail, we discuss of students self-efficacy in mobile learning at Figure 3.

4.1 Self-efficacy & Internet Literacy

Self-efficacy relates to belief about students ability to effectively perform required tasks to gain the value. The study reveals that self-efficacy has correlation with internet literacy simply because internet literacy level shows how confident students are in doing certain activities like mobile learning. It is evident that the reliant to smartphones will increase overtime since smartphones have easy access to the Internet [45]. Students use more online research because the Internet provides variety of information instantly, anytime and anywhere. Students gain more information online than offline and benefit more from online research and learning activities [2], as there are also the electronic versions of physical books available on the Internet. The study emphasis was on aspects of self-efficacy and time spent using smartphone for supporting mobile learning. Student's self-efficacy in the context of mobile learning is an

ability to succeed in accomplishing mobile learning activities by utilizing smartphone as learning aids. From the analysis above, students are active users of smartphones and they use it daily for various activities (Figure 2).

As shown at Table 1 that there is correlation between Internets literacy level of student and self-efficacy. Therefore, students with a greater level of internet literacy and self-efficacy tend to prefer educational technologies based on mobile learning as a platform of learning activities, whereas students with lower internet literacy and self-efficacy prefer more traditional learning methods such as face to face interaction, library research, or traditional lectures. It is supported by Looney, Valacich, & Akbulut (2004) that self-efficacy reflects considerable positive influence regarding technology self-efficacy that improves a significant level in the use and development of online research. Students feel that smartphone could improve their learning by enhance literacy skills such as post homework problems, practice exams, discussion group, live chat room, share files through email, etc. Internet literacy gives motivation effect which increase the learning interest. Student can do their research that has many more resources without having to go to the library. Self-efficacy helps students to not only rely on what the lecturer has given them but multi channels of knowledge resources are available. It confirms the study that there is relationship between internet literacy and the level of self-efficacy of students. With a few clicks of the keys on a smartphone, any answer to any question can basically be established. Powerful search engines provide a simpler and structured way to find the information that the students may need for their assignments or projects [45].

4.2 Self-efficacy & Smartphone Habit

The construct of self-efficacy has empirical attention with the smartphone habit in the context of mobile learning. Smartphone habit can improve students in general and students with disabilities in the learning process. The smartphone habits help beneficially students especially with disabilities to confidently engage and communicate towards other students and tutors with less barriers as a way for them to understand information easier. Regardless of the advantages of mobile learning, there are also some disadvantages of using it. An excessive use of smartphone including for mobile learning activities can impact to smartphone's addiction lead to anxiety, stress, and dependency. The overuse of smartphones can lead to addiction and disability to manage time wisely. The rise of the term "phubbing", a combination of the word "phone" and "snub", is caused by the growing numbers of students that seems to always be on their smartphone and ignoring the people around them. This affects their social skills, affecting their studies. Hence, awareness of moderate usage of smartphones should be initiated even though the designation of mobile learning is to make life easier. Apart from that, smartphone habits can interference learning activities in a way that student misuse smartphone where they are busy focusing on social networking site or playing games. Therefore, smartphone habit could reduce listening skills in the learning activities. Attentiveness can drop drastically in class when students have their smartphone. Their focus might shift from the lecture, to whatever they are doing on these gadgets. Students believe that smartphone can be an interference due to the existence of social

networking sites. They believe that social networking sites and instant messengers like WhatsApp can become a source of distraction and procrastination. The use of smartphone in learning can be a struggle in a way that there is a challenge of multi-tasking. The probability to switch back and forth between tasks really quickly does exist, thus conflict our minds to stay focused and make distractions significantly easier.

4.3 Self-efficacy & Mobile Learning

We cannot deny that smartphones are useful to people and it has been imbedded into their daily life. The main intention of mobile learning is for easier long distance learning with friends, teachers and even communities. Additionally, access to the Internet has never been easier and the vast amount of information is just at the tip of our fingers. Furthermore, there are mobile learning applications for almost supporting all modules of distance learning activities. Besides for communication, smartphones in mobile learning can also function as a video recorder to record lectures. There are many characteristics of higher learning students that may consider having self-efficacy in using mobile learning as educational aid.

There are many points of mobile interactions can happen through smartphone in helping students to improve their confident and understanding about a mobile learning not only from because of internal factors but also external forces. Figure 3 shows self-efficacy in mobile learning that offers a better way to increase student participation, confidence as well as engagement in the learning process is to be available to students beyond classroom interaction. People tend to be self-referent beliefs that are proactive and self-regulating rather than as reactive and controlled by biological or environmental forces [9]. Therefore, there are internal forces affect to student's self-efficacy such as feeling confidence, personal belief and habits, individual literacy, and conciseness. The higher internal forces for self-efficacy is the more student can utilize mobile learning which in turn will result to performance, accomplishment, and new experiences of using smartphone for educational aids.

Self-efficacy can improve also due to external forces such as rule or regulations from university to implement Learning Management Systems (LMS), promotion or marketing [45], and friends or families. Smartphones can successfully be used for mobile learning by using it to find for an answer from the Internet, submit assignments to lecturer via e-mail or LMS's platforms such as Canvas or Edmodo and organize all of students' works in a folder so works will be easier to find and then use it as a reference. Learning through smartphones can extend beyond the walls of a classroom or the confines of a class period. Students can easily share information with peers or lecturers. They are notified when something is posted on LMS's platforms and can easily come back and view what was being posted on their free time [45].

Furthermore, external and internal forces influence vicarious experience in student self-efficacy by modelling others do a task. Students with positive vicarious experiences in mobile learning will express more acceptance of mobile learning as educational aids. Conversely, students with negative vicarious experiences have more low attitudes towards mobile learning which in turn resulting smartphone as interference

in mobile learning (Figure 3). In term of social persuasion, a positive verbal feedbacks from external forces will impact to internal forces of feeling being encouraged and convinced to perform a task. Students tends to believe that they are capable of accomplishing mobile learning task. Positive feedback is important to improve sense of self-efficacy as it may help confidence of mobile learning as educational aids.

Whenever students participate mobile learning, they interpret their performance, accomplishment and experiences to develop beliefs about their ability to engage in similar activities. If these activities are consistently successful, they tend to raise self-efficacy or, conversely, if these activities typically produce failure, self-efficacy is likely to be lowered. Therefore, if a student originally has a low sense of efficacy, it will bring doubt about his abilities. Such doubt likely will result in failure in mobile learning scenario, and also reinforce low self-efficacy.

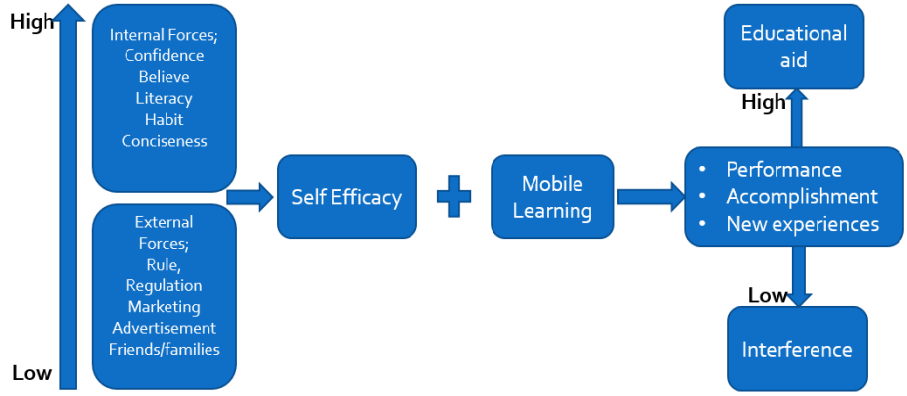

Fig. 3. Self efficacy in mobile learning (Source: Authors' compilation)

In addition, a low level of internal forces may result of smartphone as interferences for academics' achievement. The students may use it for other entertainments during the lessons and plagiarism could increase in numbers. In addition, not all mobile learning are valid and reliable. It need people with qualification in mentoring and facilitating of quality assurance in the online learning scenario.

5 Conclusions

A number of general conclusions can be drawn from this study. Different setting of demographic may lead to different experiences of students which in turn different level of self-efficacy either positive or negative outcome for higher learning students. According to a study, there is a significant convergent between the exponential use of smartphones and an academic activities especially mobile learning. There are points of smartphone in helping students to improve their confident and understanding about a mobile learning not only from because of internal factors but also external forces. Whenever students participate mobile learning, they will interpret their performance,

accomplishment and experiences to develop beliefs about their ability to engage in similar activities. While, similar activities are bounded with the smartphone habits and internet literacy level. If these activities are consistently successful, they tend to raise self-efficacy or, conversely, if these activities produce failure then it leads to low self-efficacy.

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The Effect of Using Flipped Classroom Strategy on the Academic Achievement of Fourth Grade Students in Jordan

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Abstract—This study aimed at investigating the effect of flipped classroom strategy on the academic achievement in the subject of science among fourth grade students in Jordan. The study population consists of all fourth grade students in the Directorate of Private Education in Amman area, totaling 2134 students during the second semester of the academic year 2015-2016. The study sample consists of 44 male and female students who were chosen purposely from the study population. The study sample was distributed into two groups: the experimental group that consisted of 22 students, who has studied according to flipped classroom strategy, and the control group that consisted of 22 students, who has studied in the ordinary method. To achieve the objectives of the study, an achievement test was prepared and its validity and reliability were checked. ANCOVA, Means, and Standard Deviations were used to analyze the collected research data. The study deduced the following results: 1) There are statistically significant differences in the Means on the educational achievement test attributed to the teaching strategy, in favor of the members of the experimental group, and 2) there are no statistically significant differences in the Means on the academic achievement test attributed to gender. In light of the findings, the study recommended encouraging science teachers to teach students using teaching strategies emanated from the use of modern technologies, particularly the flipped classroom strategy. In addition, the study suggested that colleges of education should train prospective teachers on the use of teaching strategies stemming from modern educational theories and strategies such as the flipped classroom strategy during the period of preparing them to teach. Furthermore, the study recommended re-applying this experience and identifying its effectiveness at other schools stages and other subjects in other content areas.

Keywords—Flipped Classroom Strategy, Academic Achievement, Science Subject, Jordan.

1 Introduction and Background

In recent years, the international educational system has witnessed rapid and sequential changes. Effects of such changes are reflected on to what extent the developed and developing countries are interested in reforming and using new strategies in learning and teaching processes. Consequently, many countries attempted to make structural modifications on teaching methods in order to face the acceleration resulted from the huge changes in knowledge and informational fields. Such challenges require doing a comprehensive review of the educational system in most countries in the world. This leads to find out new approaches to develop and update teaching processes. These approaches focus on the role of learner and make him/her the center of learning process. They assert that each student can learn and reach the proficiency level, if teaching and learning environments and teaching methods are suitable to his/her abilities and needs. One of such modern methods and strategies is the flipped classroom model. Tully [21] pointed out that flipped classroom is one of the teaching and learning patterns and strategies that facilitates student-teacher interaction by using technology tools. Flipped classroom method has the potential to create fundamental changes in the educational context and institutions.

According to Bergmann and Sams [9] the concept of flipped classroom means what is done at home as a traditional learning is done during the classroom period, and what is done during the classroom period as a traditional learning, is done at home. Furthermore, the information of content is presented to the student outside the classroom period through technology tools such as video, which created by teacher to explain a certain lesson or information related to the lesson. Alzwekh [7] mentioned that flipped classroom is a form of modern teaching methods that uses the advanced techniques smartly and funnily in order to meet the needs of students at the present time. In addition, the idea of flipped classroom is based upon flipping learning assignments between classroom and home by increasing the role of effectiveness of modern technological tools in teaching and learning processes. DeLozier and Rhodes [11] defined the flipped classroom as the teaching practice of teachers occurs by assigning lectures outside of class and devoting class time to a variety of learning activities. In this practice, students are responsible for reviewing all prepared materials. In this model teachers prepare lessons through videos or any multimedia that the students can view at homes or in any other places by using their tablets or smart phones before attending the class, while the time of lecture is advocated for exercises, activities, practices and helping solve home assignments.

The previous definitions point out that the concept of flipped classroom means flipping the processes of teaching and learning in the classroom and home by activating the role of modern technological tools in preparing and presenting lessons. That is, the teacher prepares the material in which he/she explains the new information by using modern audio and visual multimedia, and reactive evaluation in order to be available for the student before starting the lesson. The role of teacher in this strategy is a mediator and a motivator of students to learn through the prepared materials before class time.

1.1 Implementing flipped classroom strategy

Shorman [17] indicated that the flipped classroom method focused on flipping or inversing the teaching and learning processes. That is, in a traditional teaching environment learning of new knowledge occurs in classroom. Then, the student returns to his or her home and completes home assignments. However, implementing flipped classroom method enables students to learn new information ahead of time at home through several technology tools and educational websites prepared and shared by teachers. For example, teachers prepare and share a video ranging from 5- 10 minutes. In addition, he or she can use other technological tools to promote flipped classroom such as multimedia, social media websites, educational games, YouTube for Educational purposes, TED Talk, Khan Academy, iTunes University or other educational websites.

Asiksoy and Ozdamli [8] demonstrated that flipped classroom approach is a type of student-centered approach. That is, students could actively learn information of new lessons at any time at home by using smart phones or computer devices such as IPads. Those technology tools enable students to play back educational videos several times in order to understand the new information. In addition, it is possible to accelerate the educational videos to skip the parts that they are mastered in. In addition, it is possible to take notes. By implementing flipped classroom strategy, the individual differences of students can be considered, performance can be improved, boredom will disappear, and excitement and learning enjoyment will increase.

After reviewing learning materials, students attend the physical environment of classroom readily to apply what they have learned before at home. The teacher starts with evaluating levels of students' understanding and revising what has been learned at home; then he/she presents the activities, and group problem-based projects to be performed in the classroom instead of prioritizing classroom time in passive listening to the teacher's explanation. Home assignments do not exist in the flipped classroom as students administer activities that are home assignments in the classroom.

Alzain [5] showed that blending such technologies in its nature does not achieve strategy of flipped classroom. Therefore, it is necessary to know the fundamentals or criteria on which the effective flipped classroom is built. Such criteria include: 1) Culture of learning is centered on the student who becomes the center of teaching and learning processes. 2) The teacher identifies the content that students will learn outside of the classroom in order to invest the time in classroom in applying what is prepared by students. 3) The role of teacher in the flipped classroom is greater than his/her role in the traditional learning. In classroom, the teacher provides immediate feedback for students, facilitates further activities and evaluates their works.

1.2 Positives of flipped classroom

According to Strohmyer [18] applying flipped classroom strategy achieves many benefits. These benefits include that flipped classroom: 1) guarantees for teacher making good use of classroom period; so, he/she makes use of time in guiding and helping, 2) enhances the critical thinking, self- learning, building experiences, communi-

cation skills, and cooperation among students, 3) provides a technique to evaluate the students' understanding because tests and short tasks that students perform are indicators of weaknesses and strengths in their understanding of content. Alshahry [4] added some other positives of flipped classroom that include: 1) developing the role of teacher as a lecturer to become a guide and supervisor, and developing the role of student to become a researcher participating in the teaching and learning processes, 2) helping students' self- learning according to their abilities and individual differences, 3) providing students with excited educational environment, and enhancing high thinking skills such as critical thinking skills.

Alzain [5] asserted that the flipped classroom is a modern technological solution for treating academic weaknesses of students and developing levels of their skills of thinking. Al-Zain added that the flipped classroom strategy provides teacher with enough time to converse and discuss with students in classroom instead of memorization. Furthermore, through applying the model of flipped classroom the intellectual abilities of learners can grow up. By utilizing this method learners can develop their knowledge in scientific, practical and behavioral sides. Dickenson [12] addressed that the flipped classroom is considered as one of the active practices that enable the learner to link between what is learned and his/her personal life and experiences. In such process, learner will be able to link what he/she learns with his/her intellectual behaviors, until it becomes a part of his/her personality.

1.3 Obstacles of flipped learning: installment

Although flipped classroom model has many advantages, Tully [21] mentioned some issues related to applying flipped classroom strategy. These issues include that this teaching strategy depends on using internet and technological devices at students' homes. Therefore, it is difficult for students who have not such devices to benefit from this strategy. Further, it requires a motivated teacher who has the will to follow-up students' progress. This requires providing additional working hours and effort from teachers. Furthermore, teachers should be professional in integrating modern technological in education. Therefore, implementing this strategy could be difficult for educators who are not qualified in using technology or communication skills.

Some obstacles may face the educational and learning process while applying technology tools in the classroom. These obstacles include: 1) the lack of devices and software used in recording and preparing lessons, 2) the lack of teachers' skills in using the technology tools skillfully to develop teaching methods, motivation and communicating with students, 3) the insistence of teachers to follow the traditional method in their teaching process. However, those teachers can be convinced through presenting successful practices of applying technology inn the classroom comparing with the traditional method [16].

Due to the importance of this educational and learning strategy, the Ministry of Education in Jordan takes into account keeping up with educational developments in various fields. It provides adequate training for teachers to use new and modern teaching methods. The training aims at helping and participating in raising the level of information delivery to students and developing their motivation to convey this in-

formation easily. Through the Education Reform for Knowledge Economy Program Project (ERFKE) that the Ministry of Education in Jordan adopts [20], there is a focus on the necessity of using communication and information technology into teaching and learning processes. This focus can enable students to build required skills such as scientific thinking and critical thinking skills that allow them to be long life learners by using various teaching methods such as flipped classroom [20]. Therefore, this research study attempts to shed the light on the effect of using the flipped classroom model on the academic achievement among fourth grade students in science subject in private schools in Jordan.

2 Previous Studies

Reviewing previous literature shows that flipped classroom strategy was studied in different contexts. For example, Alzwekh [7] study aimed at studying the effect of flipped classroom concept in teaching the computer curriculum on self-learning skill in a school in the eastern area in Saudi Arabia. He used the experimental scientific method through conducting an experiment on a sample of 26 female students. They learned through applying flipped classroom to learn skills of new computer courses at home. The results showed growing and increasing skills of self-learning among female students in the experimental group. In addition, they showed that flipped classroom strategy contributed to take into account individual differences, learning according to their abilities, and encouraging bearing responsibility. The study recommended applying flipped classroom strategy in teaching some courses, and training teachers to implement flipped classroom into the teaching and learning processes.

Both Almuaither and Alqahtani [2] conducted a study that aimed to identify the effectiveness of the flipped classroom strategy in developing information security concepts among the female students of the College of Education at Princess Nora Abdul Rahman University in Saudi Arabia. The sample consisted of (100) female students who study special education. To achieve the goal of the study, the researchers developed a test to determine the level of students in the experimental group before and after applying the flipped classroom strategy. The results showed the effectiveness of the flipped classroom strategy in developing information security concepts among the female students of the College of Education at Princess Nora Abdul Rahman University. The study pointed out many of the recommendations, including: the need to encourage university instructors to use the flipped classroom strategy and holding seminars, courses, and training workshops on applying the flipped classroom strategy.

Almusawi [3] conducted a study aimed to investigate the effect of the flipped classroom strategy in the acquisition of geographical concepts and the development of creative thinking among the fourth-grade students. The researcher followed the experimental scientific method. He chose the sample of this study from schools of Rusafa Directorate in Baghdad. The results indicated that students who learned by the flipped classroom strategy were able to acquire geographical concepts and develop creative thinking skills more than the students learned by the traditional method.

Chipp's [10] study aimed at investigating the impact of using Flipped Classroom in teaching mathematics. The study was conducted at the New Jersey University in the United States on mathematics students, as the study sample consisted of 80 students. Empirical research was used, where a group of students has been taught mathematics course through using flipped classroom strategy, as the students received information at home through videos on the internet, and they were working in small groups at classroom to solve problems. Teaching of second group has used traditional teaching strategy. Although both classrooms have studied the same basic concepts of mathematics at the beginning, but the classroom that used flipped classroom strategy has achieved higher results in tests than the other classroom where students have been taught by using traditional teaching strategy. The study has recommended encouraging instructors to use modern technologies in teaching mathematics subject, given its positive effect on developing mental skills of the students during studying this subject.

Herreid and Schiller [13] have conducted another study in USA, where they used a poll opinion of the members of the national center for studying cases at teaching science to verify the use of flipped learning within teaching by teachers who supervise them. 200 teachers emphasized that they used flipped learning strategy. They mentioned reasons for using flipped learning that include: 1) providing sufficient time for students to work on the devices and equipment available at the classroom, 2) participating in activities and watching the lectures they have missed, 3) flipped learning provides reinforcement to the students' thinking inside and outside classroom time and it also increases their interaction within the educational process.

After reviewing the previous studies, the researchers did not find any national study that investigates the effect of flipped classroom strategy on the scientific achievement in the subject of science among fourth grade students, which necessitated conducting this research study. In addition, the focus of previous studies on the importance of applying flipped classroom strategy on the students' learning empowered the researchers to conduct a study to investigate the importance and the effect of employing new technologies and teaching and learning strategies on students' learning process, and their academic achievement. Therefore, this study attempts to identify the impact of using flipped classroom strategy on scientific achievement among fourth grade students in science subject.

3 The study problem and questions

As researchers, who are interested in the educational filed, we have noticed that many new technology tools surround students and teachers. For example, the social networks applications are used regularly as one of the most important communication ways among the daily life of students and teachers. However, the teaching and learning processes are still depend exclusively on traditional methods. According to Murad [15] and Aldohoon [1] teachers use different applications and software for the personal purposes, but using these technologies for educational purposes was very low.

Given previous experience indicated that there is a big gap between modern teaching methods that followed by teachers, and learning methods that their students need based on their abilities and interests. According to Alzedanin [6] the advanced technology leads to create new challenges in face of the school administration to make use of advantages of the new technology in learning settings. She added that by emerging educational technologies, the teaching and learning processes are no longer limited only to transform knowledge from the teacher to the learner, but the teacher needs to search for modern teaching methods and strategies to keep up with the accelerated changes that arise in the educational system, as the student becomes its centre. Al-Zedanin pointed out that new strategies and methods should be based on cooperation, direct and positive interaction between learner and educational technologies through the teacher's guidance and supervision.

In view of what the academic curricula witness of rapid developments during the recent years, the curricula of primary school in Jordan have gained plenty of reform developments. This situation encouraged the researchers to conduct this study to investigate the effect of using the flipped classroom on the academic achievement among fourth grade students studying the science subject in Amman. The reviewers of the educational system in Jordan realize the need of developing teaching process and strategies. The reform in this field will meet students' needs and individual differences. The use of technology tools can play a vital role in the educational reform. Some of these tools become available to the students and teachers. In addition, there is a rarity of Arabic studies, – according to the researchers' best knowledge - that addressed the effect of using strategy of flipped classroom in the teaching process. As a result, this study is conducted as an attempt to detect the effect of using the strategy of flipped classroom on the academic achievement among fourth grade students in science subject in private schools in Amman, Jordan.

The study problem can be identified through answering the following main question: "What is the effect of using the strategy of flipped classroom on academic achievement among fourth grade students in science subject in private schools in Amman"? The following sub-questions are branched from this main question: The first question is: Are there statistically significant differences at the significance level of ($\alpha = 0.05$) between means of achievement scores among fourth-grade students in science subject attributed to teaching method variable? The second question is: Are there statistically significant differences at the significance level of ($\alpha = 0.05$) at academic achievement level between male and female students attributed to gender variable?

4 The study objectives and importance

This study aimed at identifying the effect of using the flipped classroom strategy on academic achievement among fourth-grade students in the science subject in private schools in Amman, Jordan. Specifically, it identifies the impact of the teaching strategies (traditional and flipped classroom) on the academic achievement among fourth-grade students in science subject in private schools in Amman, Jordan. Fur-

thermore, the study points out the impact of students' gender (male and female) on the academic achievement among fourth-grade students in science subject.

The importance of this study stems from many important points. First, the possibility to benefit from results and recommendations in developing and applying the flipped classroom strategy in the classroom environment at Jordanian public and private schools. Second, this study contributes to guide teachers and educational decision-makers to develop curricula that meet modern directions in field of information and communication technology, and in field of education to employ modern teaching methods such as flipped classroom. In addition, this study will contribute to the Arabic educational literature related to flipped classroom topics, as the reviewed previous literature suffered from the shortage of researches in this field.

5 The study terms and procedural definitions

Flipped classroom: According to DeLozier and Rhodes [11] flipped classroom is a modern strategy in which the teacher provides the content of subject for students in several forms such as recorded lectures, videos, and electronic readings, so that students can review such materials and understand information before attending the classroom. In classroom, the teacher starts providing opportunities to discuss, review, and analyze such information. Then, students start working in groups or individually to complete several activities or projects inside the classroom. These procedures lead to acquiring knowledge and move from the memorization and understanding stages to the analyzing, applying, and producing stages by supervision and guidance of teacher.

The researchers defined it procedurally as designing an interactive teaching method that depends on integrating technology tools in the selected academic subject. This teaching method was implemented in the delivery of a selected unit in science subject for fourth grade students. The researchers chose a specific unit entitled seed plants unit from science subject textbook from the fourth grade. They developed the educational content resources related to the selected unit in advance by using various technology tools, applications, and techniques such as: preparing videos, brochures, handouts and educational learning materials before the time of implementing the unit. The teacher who taught the selected class was trained how to deliver the designed materials. Then, the teacher engaged in providing an interactive, collaborative, and active environment to build on what the learners have been guided to in advance and applied what have been learned inside the classroom.

Academic achievement: According to Khatib and Tarawneh [14], it is mastering a set of skills and knowledge that can be owned by the student after presenting educational experiences in a specific subject or a group of subjects. Khatib and Tarawneh added that the academic achievement represents measuring the ability of student to understand the subject matters and his/her ability to apply them through measurement methods used by school such as oral and written exams conducted in different times in addition to the daily and seasonal exams.

The researchers defined it procedurally as being a total of achievement scores of student that were gained after using a group of teaching methods (flipped classroom

method and traditional methods), it is measured by scores that the student gets in the achievement test which was prepared by researchers.

6 Study Limitations

This study is limited to fourth-grade students, who studied a unit that is entitled seed plants from fourth grade science textbook, part II issued in 2015 from the publications of the Ministry of Education in Jordan. The study was conducted in one of private schools in Shafa Badran area in Amman, Jordan. In addition, this study conducted in the second term/ academic year of 2015-2016. Moreover, the study results determined based on the responses of the study participants to study instrument and the scores of investigated validity and reliability of this instrument.

7 Study Methodology

To answer the research question, a pretest/posttest Quasi-Experimental Design were used in order to analyze data and interpret results that the study revealed.

7.1 Study Population and Sample

The study population consisted of all students (2134) in fourth-grade in the private schools in Amman, Jordan, in the second term of the academic year of 2015-2016. The researchers chose a purposive sample consisting of 44 female and male students of the fourth-grade (22 experimental, 22 control). To achieve the principle of equalization in the two groups, the study participants were randomly assigned into two groups based on their academic achievement in the academic year of 2014-2015. The experimental group, that was taught according to flipped classroom strategy, included 22 students (11 male, 11 female), and the control group included 22 students (12 male, 10 female) who was taught according to traditional teaching method.

7.2 Study Instruments and Implementation Procedures

To respond to the study questions and main aims, the researchers selected the unit entitled seed plants, in the science book part II for fourth-grade. Then, the unit was analyzed and various learning objectives were identified. After that, the researchers developed the content of the unit by designing flipped classroom model that consisted of a variety of activities, handouts, brochures, PowerPoint presentations, and selected educational videos. The developed content of the unit was reviewed by science subject supervisors from the Ministry of Education in Jordan and senior science teachers. The content was checked to make sure that the designed flipped classroom strategy is developmentally appropriate to the fourth grade students. The adequate amendments were made based on the experts' feedback. The researchers trained the teacher who will present this strategy for the experimental group before the beginning of the se-

mester. The developed unit was implemented during the second semester of the academic year 2015-2016. In addition to the developed unit, the researchers developed an achievement test to measure the academic achievement level among fourth-grade students according to the identified learning objectives. The test included 20 questions consisted of multiple choices and open-ended questions. The pre-test was implemented at the beginning of the second semester of the academic year of 2015-2016 to both the experimental group and the control group. After that, the developed unit based on flipped classroom strategy was presented by the trained teacher to the experimental group. The teacher presented each lesson of the unit based on the training that she took before the beginning of the semester. The teacher met with the students 3 times a week. Each lesson lasted for 45 minutes. Some designed materials were distributed to the students ahead of time based on the coming lesson. The students were informed to review the materials and activities at home. When they meet with the teacher, the lesson began with the reflection from the students of the materials observed. Then, the teacher presented related activities to deepen the students' knowledge of the topic. The control group was taught by the traditional teaching method. Teaching through the traditional method focused on presenting the lessons of the unit by utilizing the textbook as the main and only resource. The teacher presented each lesson in the classroom and asked the students to complete the assignments of the lesson at home. After three weeks of the implementation of the unit, both of the groups responded to the post-test.

7.3 Achievement test validity

To check the validity of the research instrument, the researchers presented the achievement test to a panel of 13 experts experiencing and specializing in measurement and evaluation, science curricula and teaching methods, supervisors of science subject, and some teachers who teach science subject for fourth-grade students in schools in Amman. The notes and comments of the experts were considered and the test was modified based on them. Thus, the achievement test consisted of 20 items.

7.4 Applying the achievement test to exploratory sample

After completing preparation of the achievement test in its final form, the test was applied to an exploratory sample consisting of 20 fourth-grade students outside the study sample. The coefficients of discrimination (DisCo) and coefficients of difficulty (DifCo) for all items of the achievement test were calculated. Table (1) shows this.

It is shown from the above table that coefficients of difficulty for achievement test items range between (0.31-0.90), while coefficients of discrimination for achievement test items range between (0.20-0.80).

Table 1. Coefficients of difficulty and coefficients of discrimination of achievement test questions (exploratory sample)

Item no.	DifCo	DisCo	Item no.	DifCo	DisCo
1	0.31	0.42	11	0.90	0.40
2	0.64	0.30	12	0.53	0.20
3	0.63	0.45	13	0.65	0.30
4	0.74	0.59	14	0.34	0.70
5	0.38	0.60	15	0.63	0.40
6	0.44	0.50	16	0.44	0.50
7	0.81	0.45	17	0.70	0.60
8	0.68	0.25	18	0.54	0.40
9	0.71	0.80	19	0.70	0.60
10	0.60	0.20	20	0.69	0.40

7.5 Instrument Reliability

After applying the achievement test to the exploratory sample consisting of 20 students, the Internal Consistency Reliability was calculated by Cronbach's Alpha Coefficient which was (0.79), and this value is accepted for the purposes of this study.

7.6 Equalization of study groups

To check the equalization of the study groups (control, experimental), a t-test was applied to students' scores in the two groups in the achievement pretest. The result is shown in Table (2).

Table 2. Results of t-test on scores of achievement pretest of experimental and control groups

Instrument	Group	Num.	Mean	S.D.	df	F	Sig.
Achievement test	Experimental	22	4.63	2.12	42	0.140	0.890
	Control	22	4.72	2.18			

** Statistically significant at the level of significance (α=0.05)

Table (2) indicates that the value of F was (.14), which is not statistically significant at the level of significance (α = 0.05). The result reveals that there is no statistically significance between average scores of students of experimental and control groups in the achievement pretest. That is, the experimental and control groups are equivalent.

7.7 Study variables

The independent variables in this study are: 1) teaching strategies (flipped classroom, traditional), and 2) gender (female, male). The dependent variable of the study is the academic achievement (means of study sample scores on items of academic achievement test.

7.8 Statistical Treatments

The researchers used the following statistical analyses: 1) Means and standard deviations to calculate academic achievement according to the group variable and gender variable, 2) ANCOVA to check the effect of group on academic achievement, 3) T- test to check the equalization of the study groups, and to calculate the significance of difference in academic achievement according to gender variable.

8 Study Results and discussion

The first question is: Are there statistically significant differences at the significance level of ($\alpha = 0.05$) between means of academic achievement scores among fourth-grade students in science subject attributed to teaching method variable? To answer this question, means, standard deviations, and modified means of academic achievement scores are calculated according to the group variable (experimental, control) as shown in table (3).

Table 3. Means, standard deviations, and modified means of academic achievement scores according to the group variable

Group	Pretest		Posttest		Modified mean	No.
	Mean	*S.D.*	*Mean*	*S.D.*		
Control	4.72	2.18	16.27	2.47	15.88	22
Experimental	4.63	2.12	19.09	1.01	19.03	22
Total	4.68	2.13	17.68	2.35	17.31	44

Table (3) demonstrates that the mean of pretest for the control group students is (4.72) and standard deviation is (2.18). In addition, the mean of pretest for the experimental group students is (4.63), and standard deviation is (2.12). Further, the mean of posttest in the control group students is (16.27) and standard deviation is (2.47). Furthermore, the mean of posttest for the experimental group students is (19.09), and standard deviation is (1.01).

Table (3) also reveals that there are clear differences in means and modified means of academic achievement scores attributed to the group variable (experimental, control). The modified mean for the control group is (15.88), while the modified mean for the experimental group is (19.03). To show the statistically significant difference between means, ANOVA test was used as shown in table (4).

Table 4. Results of ANCOVA test for the effect of group variable on academic achievement

Source	Sum of squares	df	Mean squares	F	Sig
Pretest (accompanied)	62.126	1	8.875	4.344	0.00
Group	33.800	1	33.800	16.545	0.00**
Error	57.200	51	2.043		
Total		53			

** Statistically significant at the level of significance (α=0.05)

Table (4) shows that the value of F is (16.545), which means that there are statistically significant differences at the significance level of (α=0.05) between means of academic achievement scores among fourth-grade students in science subject attributed to teaching method variable. Table (4) demonstrates that statistically significant differences attribute toward experimental group. This result indicates that teaching by using flipped classroom strategy increases the motivation to learn as being internal source of excitement, on contrary to the traditional method in which excitement is depending on teacher's notes, comments, questions, answers and forms of enhancement that student receives, thus the source of excitement is external. By using flipped classroom strategy, enhancement is raised from the practical activity itself, from the excitement that the learner feels during presenting information and the practical application he does. Such activities present the content attractively leading to develop the scientific thinking in students through observation, understanding, classifying, analyzing and assessment. The activities are close to the level of students and take into account the individual differences. Thus, such differences appeared for the experimental group on academic achievement test.

This study result agreed with Strohmyer [18] insights that students who experienced flipped classroom method pointed out positive perceptions of increased engagement and interactions, as well as more in-depth learning in flipped environments. This method supports how students learn, provides more opportunities to interact with their peers and the teacher in a productive and active learning by utilizing critical thinking skills. The study of Chipp [10] indicated that the classroom in which strategy of flipped learning are used, achieve higher results in tests than the classroom in which strategy of traditional method is used.

The second research question is: Are there statistically significant differences at the significance level of (α=0.05) at academic achievement level between male and female students attributed to gender variable? To answer this question, means and standard deviations of the academic achievement test scores were calculated according to gender variable. Table 5 shows the results.

Table 5. Means and standard deviations of academic achievement test scores according to gender variable

Gender	No.	Academic achievement test scores	
		Mean	***S.D.***
Males	23	17.56	2.44
Females	21	17.80	2.29

Table (5) shows mean of males' scores in academic achievement is (17.56), and standard deviation is (2.44). In addition, mean of females' scores in academic achievement is (17.80), and standard deviation is (2.29). That is, there is a clear difference in means of academic achievement scores between males and females. However, to check is there a statistically significant difference at the significance level of (α = 0.05) at academic achievement level between male and female students attributed to gender variable, t-test was used to identify the significant difference between the means. Table 6 shows this.

Table 6. Results of t-test at academic achievement level between male and female students attributed to gender variable

Group	No.	Mean	df	F	Sig.
Males	23	17.56	42	- 0.341	0.73
Females	21	17.80			

** Statistically significant at the level of significance (α=0.05)

Table (6) shows that the value of F is (-0.341), which means that there are not statistically significant differences at the significance level of (α=0.05) at academic achievement level between male and female students attributed to gender variable. This result can be interpreted that students whether males or females are similar in using modern technological methods because of the availability of modern technological devices as a result of the huge scientific and technological development and the easiness to access such modern technologies. Such technologies become at the hand of such students as they are at the primary stages. Such stages are considered the stages of learning, researching and exploring. Female and male students have positive attitudes towards this strategy which help them to learn by involving learners in the process of learning in an effective way that respects their individual abilities.

9 Conclusion and further recommendations

This study aimed at investigating the effect of flipped classroom strategy on the academic achievement in the subject of science among fourth grade students. The results showed that students who were taught by using the strategy of flipped classroom as a teaching strategy got higher scores in the academic achievement test than students who were taught by using the traditional strategy as a teaching strategy. In addition, there were no statistically significant differences between male and female students in the academic achievement test. The study findings encourage teachers of science to teach students by using modern teaching strategies, in particular, flipped classroom strategy as it improved the academic achievement of students. In addition, the findings urge preparing pre-service teachers at faculties of education to have adequate training to use new teaching strategies raised from the modern educational theories such as flipped classroom strategy. Further, the findings recommended providing schools with adequate technology tools, modern laboratory devices, and high speed internet to help teacher to prepare the needed materials according to the flipped classroom strategy. Furthermore, the study suggested re-applying this research study by investigating the effect of flipped classroom strategy on other variables such as other content subjects or areas and other grades from different academic stages.

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Construction of Interactive Teaching System for Course of Mechanical Drawing Based on Mobile Augmented Reality Technology

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Abstract—The teaching aim of mechanical drawing is to cultivate the students' graphic interpreting ability, plotting ability, inter-space imagination and innovation ability. For engineering students in Chinese universities, a mechanical drawing course focused on 3D and 2D inter-space transformation is often difficult to master. The ordinary dull teaching method is insufficient to stimulate students' spatial imagination capability and interest in learning and cannot meet teachers' need to explain complicated graphical relationships. In this paper, we design an interactive teaching system that uses mobile augmented reality to improve the learning efficiency of a mechanical drawing course. To check the effect of the proposed system, we carried out a case study of two classes in mechanical drawing. The results demonstrate that the class for which an interactive teaching system based on mobile augmented reality technology was adopted is significantly superior to the class for which the ordinary dull teaching approach was adopted with regard to the degree of students' proficiency in the course's key, difficult content areas, their spatial imagination capability, and their interest in learning and study after class.

Keywords—Augmented Reality, Mechanical Drawing, Interactive teaching system, multimedia teaching application

1 Introduction

Mechanical drawing or mechanical engineering drawing is one of the fundamental courses for engineering students in Chinese universities. Mechanical drawing teaches

drawing and recognition rules and methods of producing mechanical drafts, which consist of graphics, symbols, words and figures to express design intentions. Mechanical drawing, which requires experience with making and communicating technical documents, is considered a language in engineering circles. [1] The teaching aim of mechanical drawing is to cultivate the students' graphical interpretation ability, plotting ability, inter-space imagination and innovation ability [2].

However, it is often due to a lack of spatial imagination capability and an insufficient opportunity to touch real machine parts that the students cannot imagine the real machine parts. It is also hard to map 3D objects with their 2D projections. As a result, students feel that it is difficult and boring to learn mechanical drawing. It is also a challenge to teachers because they need to explain complicated graphical relationships using ordinary teaching equipment in a limited period of time in the classroom.

Advanced computer and information technologies have promoted the effectiveness of education. AR (Augmented Reality) technology was proposed early in the 1960s, as an important branch of VR (Virtual Reality) that addresses the combination of real-world and computer-generated data [3]. It provides supplementary information to reality by superposing virtual objects that are made by computers or other information on to real scenes. Augmented reality systems have been restricted by hardware for a long time, and users have to use a heavy HMD or sit in front of a PC on a desk. In recent years, with the development and promotion of smartphone technology and functions, smartphones are now equipped with some functions, such as calculators, videos, image displays, GPS, mobile networks, touch screens, and pitch detection, and prices continue to drop. Meanwhile, a survey about the mobile phone usage of college students in China shows that mobile phones have become a dominant information media among college students [4]. Thus, an augmented reality system based on a smartphone platform offers technologies for university education. Teachers should make the best use of this kind of emerging technology in mechanical drawing courses to promote a more natural study atmosphere, stimulate students' interests and improve learning efficiency.

2 State of the art

Kay, Papert and Weiser all believe that pervasive computing offers opportunities for completely changing the mode of teaching and learning. [5] [6] [7] Considerable effort has exerted to use augmented reality (AR) technology for distributing educational content. The first AR book (Magic book) was developed in 2001 by Billinghurst et al. [8] Kirner et al. presented an interactive book with AR for the teaching and learning of geometric shapes on a PC, and they discussed the use of GeoAR by children in real situations [9]. Ángela Di Serio et al. showed that AR technology had a positive impact on the motivation of middle-school students [10]. Santoso M et al. developed digital edutainment content that combines AR technology with tangram toys and proved that users become more engaged and interested when using it than when just using conventional methods [11]. It can be seen that AR has great potential in the educational domain.

Here are some major aspects of educational applications of augmented reality:

- **Combining AR technology with a book:** Billinghurst et al. developed an AR book, which is an early attempt to explore how we can use a physical object to smoothly transport users between reality and virtual reality [8]. Later, the authors added virtual visual and auditory enhancements to an already published story book. Since then, many other AR books have been developed [12].
- **Combining AR technology with practical classroom teaching behaviours:** Shelton and Hedley use AR technology to teach experiments on the nine planets, [13] which provides evidence that this form of AR has cognitive advantages. Kaufmann and Schmalstieg applied Construct3D using AR technology to teach spatial geometry [14]. A great deal of evidence supports the idea that Construct3D is easy to learn, encourages experimentation with geometric constructions and improves spatial skills.
- **Combining AR technology with entertainment:** Markus Santoso combined a tangram toy and its manual book with AR technology [11]. Hye Sun Lee and Jong Weon Lee used augmented reality technology to design an educational game to help students from kindergarten or primary school master knowledge about addition [15].

The works most relevant to our own are presented in [16] and [17]. They all developed instructional systems for drawing courses based on augmented reality. In [16], an augmented book called AR-Dehaes was designed to provide 3D virtual models that help students perform visualization tasks and promote the development of students' spatial ability during a short remedial course. In [17], an instructional system for an engineering drawing course was developed based on augmented reality.

However, these applications have common problems: Because they assist education by matching the content of the virtual environment with the real environment by scanning special marks supported by PC system hardware, they have to design markers while developing the software. The markers need to be published in books, which means the textbooks should be typeset and printed again. To meet the demand of university education, this paper presents a way to apply mobile augmented reality technology more naturally and without special markers to support teaching and learning in mechanical drawing courses.

3 Theoretical basis

3.1 Augmented reality technology

Augmented reality technology superimposes computer-generated data on top of a user's perception of the real world in real-time. An augmented reality system supplements the real world with virtual computer-generated objects that appear to coexist in the same space as the real world. An augmented reality system has three main characteristics: (1) combining real and virtual objects in a real environment, (2) real-time interactivity, and (3) registering in 3D or, put another way, aligning real and virtual

objects. Mobile augmented reality systems provide a similar experience "without constraining the individual's whereabouts to a specially equipped area". [3] Mobile augmented reality technology has three features: augmentation, interaction, and personality.

The primary work process of an augmented reality system is demonstrated in Fig. 1. [18] On the one hand, the real scene video streams captured by camera and other image capture devices are entered into the system and analysed by tracking technology, and registration information is obtained. On the other hand, the virtual information displayed by real-time rendering techniques, with the help of registration information, are combined efficiently with real scenes. In the end, they are protracted together by augmented reality display devices.

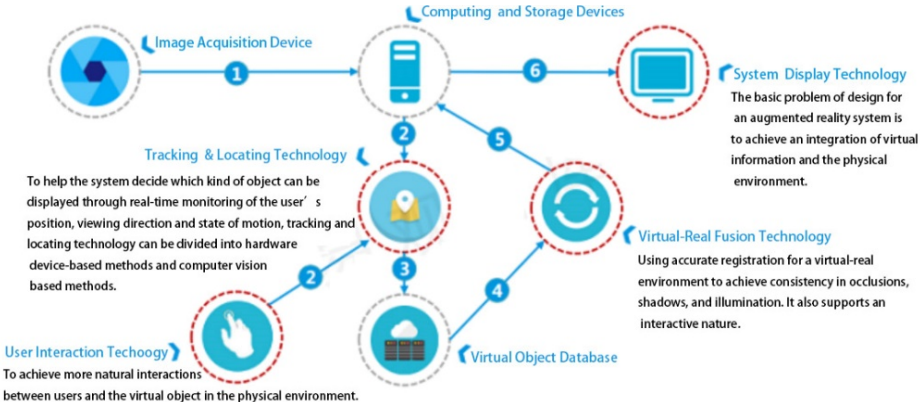

Fig. 1. The primary work process of an augmented reality system

3.2 Mark-based method and nature-feature-based method

In a mobile augmented reality system, target recognition methods can be divided into mark-based methods and nature-feature-based methods. The mark-based recognition technology needs us to add special artificial definition marks in advance, and then analyse marks obtained, to recognize graphics in the place and pose of a computational camera. These marks are usually simple graphics with strongly contrasting colours, as shown in Fig. 2. The nature-feature-based recognition technology adopts the natural features of graphics to recognize them directly by analysing the graphics and calculating and testing geometrical features to substitute for marks so that it can recognize the graphics, as shown in Fig. 3. Compared to the mark-based method, the nature-feature-based method has the following advantages. First, no special marks need to be designed; second, the original textbook is used, whereas the mark-based method needs to add marks to the textbook and re-print it; and third, it is easier to use, is more natural for communication and can improve the users' experience.

Fig. 2. Markers

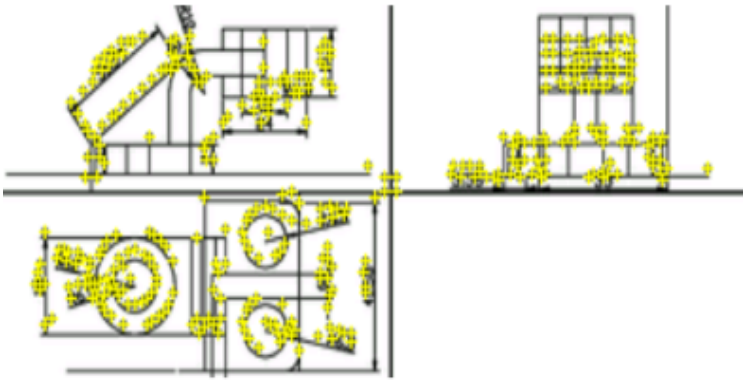

Fig. 3. Nature-feature points in a mechanical 2D drawing

Tracking registration technology

After recognition, mobile an augmented reality system begins tracking registration with the adoption of the computer vision method. The procedure accomplishes the following steps: (1) track the spatial position and shape of a mobile phone's camera on a target object, (2) calculate the coordinates of the virtual information in the camera according to this information, and 3) match the position-related information with the graphic by projecting their coordinate systems: computing a world coordinate system W(X_W, Y_W, Z_W), a camera coordinate system C(X_C, Y_C, Z_C), an imaging plane coordinate system o(x, y), and a pixel coordinate system o_1(u, v). The mapping algorithm can be deduced as below:

The transformation between the world coordinate system W and the camera coordinate system C is shown in Equation 1, where R_{WC} (rotation information) and T_{WC} (displacement information) represent a relative position and shape between W and C, respectively.

$$C\ (X_C, Y_C, Z_C,1)^T = R_{WC}T_{WC}\,W\ (X_w, Y_w, Z_w,1)^T \quad (1)$$

The transformation between the camera coordinate system C and the imaging plane coordinate system o is shown in Equation 2, where *f* represents the distance between the camera imaging plane and the focus plane.

$$x = fX_c/Z_c\ , y = fY_c/Z_c \quad (2)$$

The transformation between the imaging plane coordinate system o and the pixel coordinate system o1 is shown in Equation 3, where λ is the scaling factor between the systems of o and W and K is the camera's internal parameters, as seen in Equation 4.

$$\lambda\, o_1\ (u, v, 1)^T = KR_{WC}T_{WC}\,W\ (X_w, Y_w, Z_w, 1)^T \quad (3)$$

$$K=\begin{bmatrix} f/d_x & 0 & u_0 \\ 0 & f/d_y & v_0 \\ 0 & 0 & 1 \end{bmatrix} \quad (4)$$

4 Development of a mobile AR technology Interactive teaching system for a Course of Mechanical Drawing

An interactive teaching system for mechanical drawing courses aims to help students understand the relation between three-dimensional mechanical parts and two-dimensional projection drawings and solve problems when they study in class or after class. It is also useful in helping teachers to teach efficiently in a limited time during classes. We choose the existing textbook *Mechanical Drawing* [2] as the resource, and we take advantage of mobile AR technology to develop the interactive teaching system.

4.1 Requirement analysis

There are several requirements for an interactive teaching system based on mobile augmented reality technology being used in the teaching and learning of mechanical drawing, as follows:

1. Improve students' familiarity with mechanical parts. The system should be designed to offer a great number of digital models of mechanical parts kept in the database of virtual objects to demonstrate the great variety of mechanical parts models to the utmost degree and improve students' familiarity with mechanical parts.
2. Improve the capability of students' reading of drawings. The system should be designed so that it can virtually overlay three-dimensional mechanical parts models in real two-dimensional projection drawings. This will help students understand the mapping relationship between plane figures and 3-dimension models and improve the capability of students' reading of drawings.

3. Help students understand sophisticated structures. The system should be designed to offer interactive functions so students can directly control the digital models of mechanical parts in real time, such as zoom in, zoom out and rotation. This will help students understand the sophisticated structures or assembly relationships of mechanical parts.
4. Help students draw the view from a particular perspective. The system should be designed to offer screenshot functions, so students can directly and clearly observe different photos of virtual three-dimensional mechanical parts models from different shooting scales.
5. Help students better understand the content being taught. The teaching system should be designed to offer instructional functions by using embedded animation or video to teach difficult areas of the current mechanical parts models to students.
6. The teaching system should be designed to assist the teacher in class with the aim of surmounting the shortcomings of traditional teaching modes. It could also help students solve problems when they study after class, inspire students' enthusiasm for learning and improve their subjective initiative.

4.2 Architecture design

Based on the requirement analysis of the system, a mechanical drawing interactive teaching system needs to gather video images of target objects in realistic environments when paper drawings or textbooks are by the camera on the smart terminal. It determines the location and posture of the camera in the real scene by identifying concrete illustrations in the real scene so it can superimpose the corresponding digitized content on the target object. In this process, the software system needs to undertake a series of related actions to promote the completion of the above tasks. The teaching system is mainly composed of real scene video digital acquisitions, realistic scene target object tracking locations, actual registration, digital content objects and real scene video image overlays, interactive operations, virtual fusion displaying the output and other modules. The architectural design diagram is shown in Fig. 4.

The application design of the teaching system involves the integrated development of a variety of technologies. On the one hand, it involves image recognition, three-dimensional tracking registration and other key technologies, which are focused on augmented reality technology, to realize the virtual fusion of the system. On the other hand, the teaching system also involves the digital image technology of the mechanical drawings' digital transformation. In addition, the whole system operates in an intelligent terminal platform, and it also involves high-speed transmission and storage of all kinds of data. Therefore, the main technologies of this teaching system are divided into key technologies, enabling technologies and supporting technologies, and the technical contents of specific levels are shown in Fig. 5

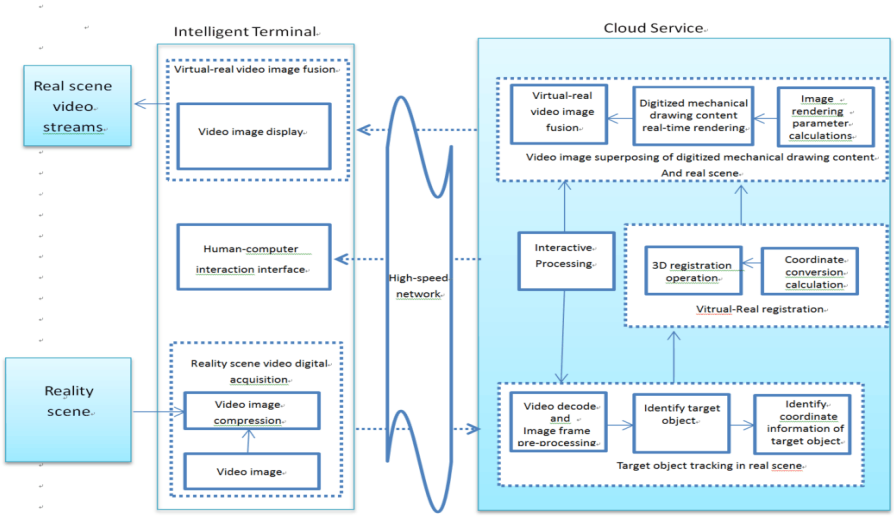

Fig. 4. Architectural design diagram

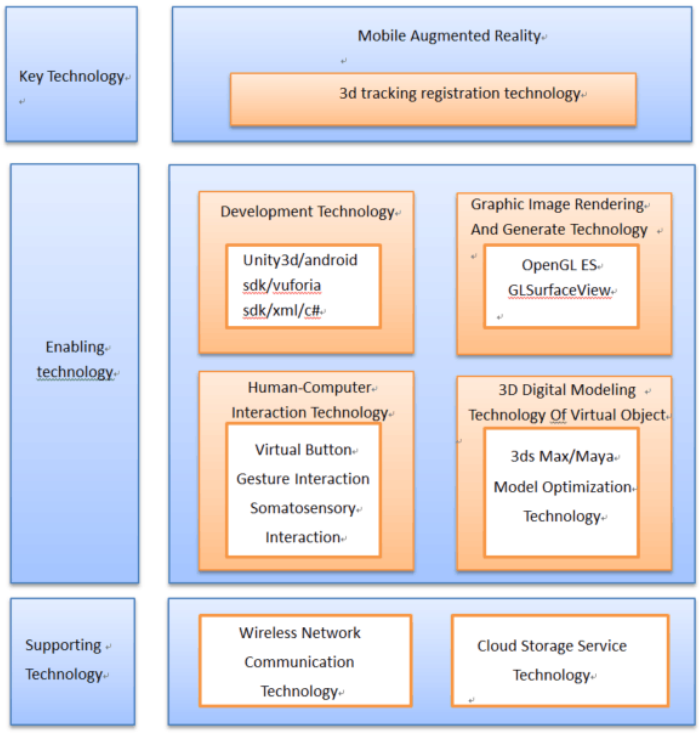

Fig. 5. Primary technology hierarchical structure diagram

4.3 Function display

This teaching system is based on the Unity3D game engine [19], Qualcomm vuforia, and uses 3ds max for 3D digital models. The functional diagram of the mechanical drawing interactive teaching system is based on the augmented reality approach designed in this paper, as shown in Fig. 6.

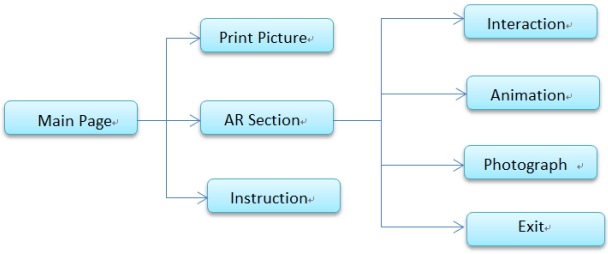

Fig. 6. Functional diagram of Mechanical Drawing interactive teaching system

Starting with the main page shown in Fig. 7, it includes 3 components: the print picture, the instruction page and the augmented reality page.

- Print picture: This page can print or store some classical 2D design drawings
- The instruction page teaches users how to operate this app.
- The main part of this digital instruction system is the augmented reality page. When a user chooses the augmented reality page, the mobile camera will be activated automatically. Next, the user needs to place the mobile camera above the 2D patterns or a monitor. The characteristic of our system is the absence of a marker, so users directly target 2D patterns or a monitor. Then, the interactive teaching system will track the picture and visualize the registered digital virtual content of each picture, as is seen in Fig. 8.

Fig. 7. Main page

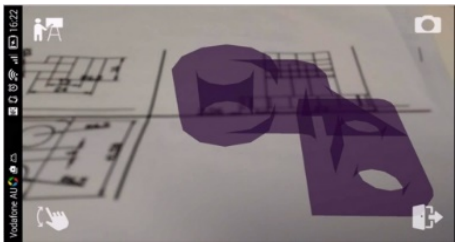

Fig. 8. AR page

In the AR section, there are also 4 function buttons to meet a user's personalized learning requirements, namely, the animation demonstration button in the top left corner in Fig. 5(b), the photograph button in the top right corner in Fig. 5(b), the tangible interaction button in the bottom left corner in Fig. 5(b), and the exit button in the bottom left corner in Fig. 5(b). When the "animation demonstration" button is chosen, a clip of animation will be played to show how the 3D model is integrated or divided;

when the "photograph" button is chosen, the current view can be restored. When the "tangible interaction" button is chosen, the user can freely transform, rotate, and scale the 3D model. Tapping on the "exit" button will allow the user to exit the whole system.

When a difficulty is faced in the teaching and learning of mechanical graphics using a textbook, one can use the applications by aim it the graphics, and then, the corresponding digital content will overlap the graphics. We selected 3 typical cases as examples, which involve the basic mechanical drawing skills required of students.

Fig. 9 is a position example, helping students understand points in space on a curved surface. Fig. 10 and 11 are decomposed graphics to help students understand assemblies, such as the differences between intersections and tangents. Fig. 12 helps students understand complex graphics.

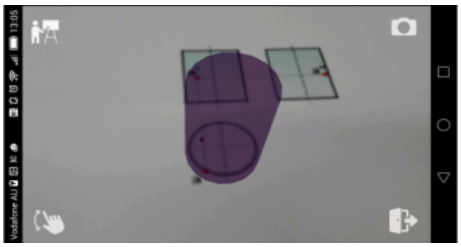

Fig. 9.

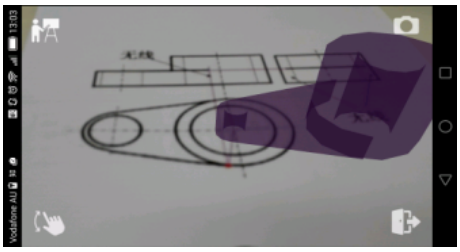

Fig. 10.

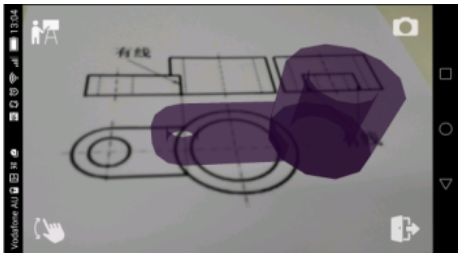

Fig. 11.

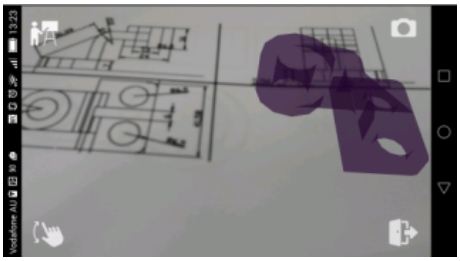

Fig. 12.

4.4 Effect check

To evaluate the effect of the teaching method designed in this paper, a case study of a mechanical drawing course was carried out. Two 35-student classes (Class 1 and Class 2) of undergraduate students were surveyed.

For Class 1, based on the ordinary teaching method, an interactive teaching system using mobile AR technology was adopted so that students could understand the content being taught more easily in class. This approach could also help students solve problems when they study after class. However, for Class 2, only the ordinary teaching method was adopted, which mainly includes an electronic teaching plan, teaching wall chart, a presentation of real materials and interpretation and drafting practice after class. After 18 weeks (72 class hours), a questionnaire survey was completed by

the students of the two classes to analyses and evaluate the teaching effects. Table 1 shows the evaluation results of the questionnaire survey.

Under the same circumstances, class 1, for which the mobile augmented reality interactive teaching system was adopted, is significantly superior to class 2, for which only the ordinary teaching method was adopted, with regard to the students' degree of proficiency in the key, difficult content areas of the course, their spatial imagination capability, and their interest in learning and study after class.

Table 1. Survey of effect of the virtual reality teaching technology on course learning

Class	Help mastering key, difficult content areas of the class	Help comprehension and establishment of inter-space imagination	Help stimulate students' study interest	Help students' learning and study after class
Experimental Class 1	77.1%	85.7%	88.6%	82.8%
Control Class 2	45.7%	51.4%	42.8%	37.1%

The students' exam scores each month also indicate that there were differences between class 1 and class 2 during the semester. For the purpose of evaluation, the average scores were calculated. As Table 2 shows, the two classes appeared to be equal in the first month's exam, but the scores of the experimental Class 1 became superior to those of the control class 2 starting in the second month. This is mainly because that the students needed time to adapt to the new teaching method. When the students from the experimental group became used to the new interactive teaching system in the first month, then they were able to surpass the control group. This indicates that the new teaching method can help students improve their academic record.

Table 2. Evaluation on students' course knowledge and skills (Score=100)

	1st month	2nd month	3rd month	Final exam
Experimental Class 1	78.65	81.31	83.11	84.23
Control Class 2	79.53	80.25	80.01	81.03

5 Conclusions

In this paper, a new type of interactive teaching system based on mobile AR technology is designed and implemented. The teaching system has been applied to the experimental teaching and learning of mechanical drawing. The questionnaire survey of the students at the end of a semester and the evaluation of students' performance show that the students are satisfied with the new of type interactive teaching system designed in this paper because it is helpful in arousing students' learning interest, enhancing their inter-space imagination capability and improving their academic record. The new mobile AR teaching system can not only transcend the limitation of time and space in the classroom for students but also help teachers focus on teaching instead of on preparing teaching aids. This intuitive visual experience, which allows

for quick and convenient operations by users, can solve the abstract problems of mechanical drawing courses.

The limitations of the study are as follows. Currently, mobile AR technology is in the developmental phase, and relatively few enterprises have mature technology in product development. Great developmental difficulties and higher costs are the main bottlenecks to the popularity of mobile AR teaching system for mechanical drawing courses. The stage of evaluating the teaching effect of this approach was limited by time, manpower, material resources and money, so the study had a shorter demonstration application period and smaller sample size, which led to the lack of a comprehensive detailed data analysis. Therefore, the next stage will be for our team to take further steps to study this by building a relatively stable AR teaching system development group, exploring industrialized models, demonstrations and applications, and improving the teaching effect evaluation mechanism.

To sum up, the practice of utilizing advanced digital information technologies for teaching and learning has been gradually accepted and adopted by the public in the new digital age; information technology is developing rapidly and various emerging teaching systems are increasingly attracting attention and have been adopted by educators of different subjects. Based on the attempt to apply an interactive teaching system based on mobile AR technology in the teaching and learning of mechanical drawing, we realize that mobile augmented reality technology can largely promote the effectiveness of education and provides a new idea and direction for educational reform.

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Smart Makerspace

A Web Platform Implementation

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Abstract—Makerspaces are creative and learning environments, home to activities such as fabrication processes and Do-It-Yourself (DIY) tasks. However, containing equipment that are not commonly seen or handled, these spaces can look rather challenging to novice users. This paper is based on the Smart Makerspace research from Autodesk, which uses a smart workbench for an immersive instructional space for DIY tasks. Having its functionalities in mind and trying to overcome some of its limitations, we approach the concept building an immersive instructional space as a web platform. The platform, introduced to users in a makerspace, had a feedback that reflects its potential between novice and intermediate users, for creating facilitators and encouraging these users.

Keywords—makerspaces, immersive instructional spaces, web platforms

1 Introduction

Nowadays, Makerspaces, along with terms such as Hackerspaces and FabLabs, are a growing phenomenon which academia has already grappled with it from multiple lens and fields [1]. They can be home to a range of activities and be used for fabrication processes and accomplishing Do-It-Yourself (DIY) tasks, also acting as creative spaces and learning environments. Ref. [2] practically defines them as a community workshop where "hackers" share knowledge, expertise and access to tools in order to produce something tangible.

However, these environments can look rather challenging to novice users, since they make available equipment that are not commonly seen or handled, that have not been introduced or made accessible to people yet. These spaces mainly include machinery such as 3D printers, laser cutters, soldering irons, drilling machines, electronics and various raw materials used for making.

Additionally, these spaces are not that commonly available to the public, though the maker movement is a tendency, especially in emerging countries. For that, it is

necessary to think of ways to provide this experience and disseminate these activities, who contribute to develop the creative, collaborative, experiential and participatory sense through the maker experience. In this paper it is describe the process of development of a web platform, trying to fulfill the maker experience previously mentioned, directed to act as an immersive instructional space, willing to encourage new users to maker activities, being an auxiliary agent to provide context and necessary information for the development of maker tasks.

1.1 Motivation and inspiration

For such reasons, researchers from Autodesk have presented an immersive instructional workspace for novice and intermediate makers [3]. Called the Smart Makerspace, the goal is to guide makers through the completion of a DIY task, while providing detailed contextually-relevant assistance, domain knowledge, tool location, usage cues, and safety advice [3].

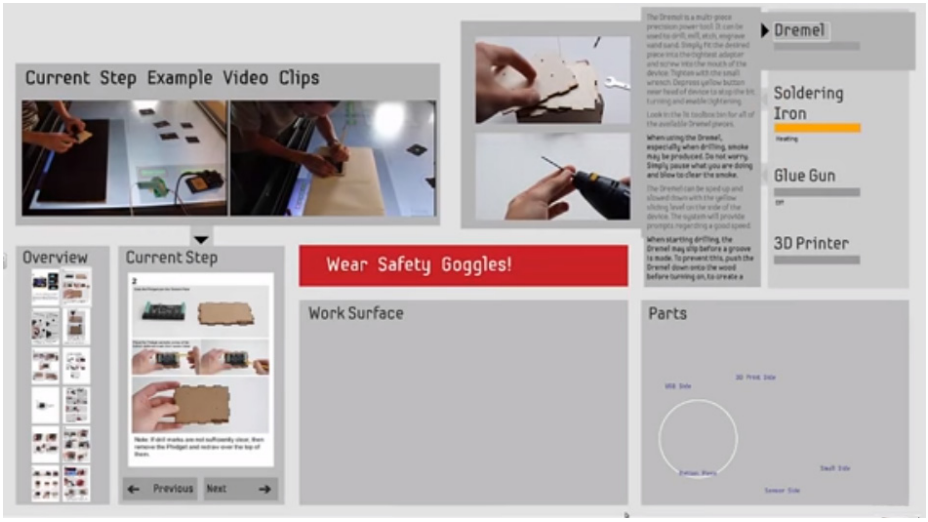

Fig. 1. Underneath screen view of the smart workbench

Technically, the making environment proposed by Ref. [3] is focused around a smart workbench, a toolbox and power-tools such as glue gun, soldering iron, drilling machine and a 3D printer. With all the equipment connected to the augmented workbench, the translucent surface has a screen below that shows information necessary for handling equipment and keeping track of a DIY task, which includes the DIY task manual, an overview of the task, videos of the current step and alerts. At the same workbench, it is also given the space for working, piece tracking and placing power-tools.

Another related work is done at Harvard University, where it was created the Guerrilla Makerspace, an initiative that experiments with a space-less makerspace. The

method experimented was to bring making to people instead of bringing people to a space. "We show up at unexpected places with a plastic bucket full of things to make with, two laptops, and a handful of MaKey MaKeys, and we go from there" [4]. In this case, it relates and encourages the creation of a web platform immersive instructional space as the users use their laptops for the whole making process, which could be used and adapted to instruct according to the components and tasks provided in the experiment, for example.

1.2 Our approach

The work presented here is inspired and based on the same concept, but bringing a different implementation. In this case, the idea has been approached by using, instead of a workbench, a web platform that runs in the user's laptop for accompanying the maker tasks. It also goes around some issues identified in the previous implementation, related to having the need of separate power-tools and a workbench for each user, which does not correspond to reality on makerspaces.

In this model implementation of a Smart Makerspace, the challenge is to create a web platform that can correspond to an immersive instructional space, inspired and based on the features presented by Autodesk [3]. Also, it is aimed to build a system that has a lower cost for implementing in makerspaces, easy to access, and enabling equipment to be shared with multiple users at the makerspace, due to some equipment are not feasible to be dedicated to only one user.

Furthermore, it is designed after demands presented by the instutional makerspace, willing to diminish staff intervention in the making tasks, which gets overloaded hence its users are frequently in need of help and assessment, but also willing to provide higher autonomy for its users. In the next chapter, these concerns will be discussed in more detail as well as this work's approach for it.

2 Conceptual solutions

The solution is based and inspired on the Smart Makerspace concept proposed by Ref. [3], but with a different implementation. Facing similar difficulties for novice and intermediate users, as well as thinking of its own demands previously mentioned for the instutional makerspace, the Smart Makerspace concept is approached by the development of a web platform.

One of the reasons of building a web platform comes justified by most of the makerspace users work using their laptops, even though some simple maker tasks can be done without the use of a computer. Indeed, approaching maker activities with a workbench can also work for some tasks, but considering that plenty of tasks make use of electronics and some require heavy processing, it could limit the possibility of performing activities such as programming using IDEs or using specific computer tools such as 3D modeling along the steps.

Building the Smart Makerspace as a web platform also allows that the tools and equipment do not have to be specially linked to one workbench, which is very limit-

ing and does not correspond to reality of what is experienced on makerspaces. Normally, this equipment would have to be shared with numerous users during a day and with simultaneous requests, needless to say the physical space and available budget to allocate such individual workbenches and equipment.

2.1 Web application basis

In a nutshell, the web platform works as the user, at first, fills in a small form page for then then being redirected right away to a page for choosing a maker task of desire. After choosing a task to work on, the tutorial page (Instructable, for example) comes along with a sidebar where the user can find information needed whenever necessary, such as guidance information and instructions for 3D printing or other equipment.

More specifically, it is implemented as a sidebar helper alongside the tutorial steps, making it possible for the user to show it or hide it with a toggle button whenever necessary. This way, it can be shown when help or assistance is needed, but at the same time it does not get in the way of the user if the same has enough confidence to follow up the work. In addition, the sidebar buttons trigger modal boxes that appear in the page for further information and actions.

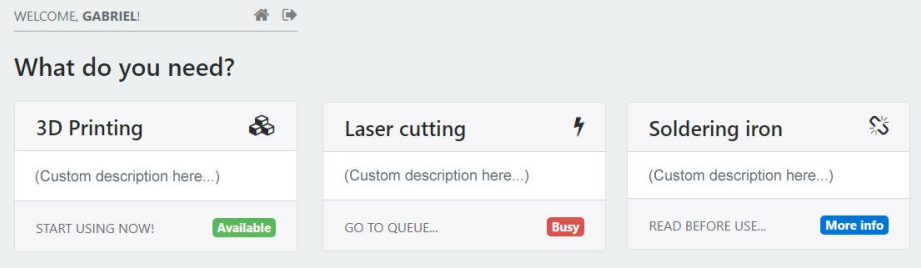

Fig. 2. Toggleable sidebar helper (items horizontally listed in this figure for space matters)

Regarding the matter of having specially connected equipment to only one workbench, it will work out through a queueing system implemented in the platform, making it possible for the equipment to be shared with other users. The users will be able to join the queues through the sidebar helper, where they can select the equipment they need to use and can also upload files (a 3D model, for example) to it. At the same location, it is possible access further information regarding how to use, security and warnings.

Additionally, for every equipment that has a dedicated computer for running the control software, the same will have access to a page with all the information regarding that equipment. In this page, it is possible to visualise the queue, finish the current user allowing space for the next on queue as well as download the files uploaded from the users' laptops.

3 Overall web application

You In this chapter we will focus on the overall web application, the pages it is composed of, how the implemented features appear and how the user interacts with it. First, we will introduce the workflow of the application and how pages interact with each other. Later, we will explain in detail the features that each page contains.

3.1 Welcome page

For every user that enters the web application, it is mandatory to start a session before working, since every action that is taken by the user is identified and related to its session. Therefore, the first page is the Start Session page, where the user fills in some personal and student data. It requires a first and last name, a student number and the institution of studies.

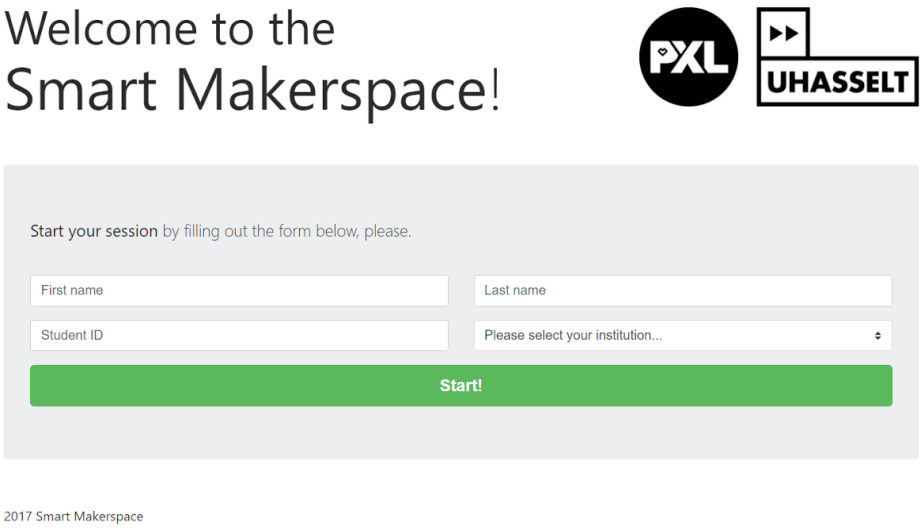

Fig. 3. Start Session page

3.2 DIY websites and FabMoments page

After filling in the data and starting the session, the user is redirected to the second page, where it is possible to choose a DIY website to choose a project and start working. The second page has mainly two sections, the first one is where the user has DIY websites available to choose from and, secondly, the FabMoments section, where users' previously projects can be published so that others can see its results and get inspired by.

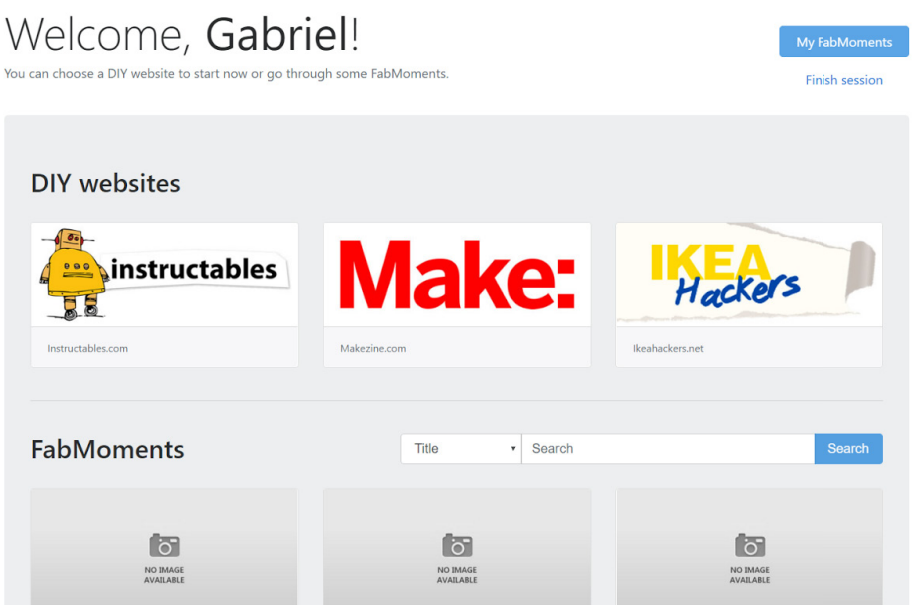

Fig. 4. DIY websites and FabMoments page

The FabMoments is link to a parallel project that is included to the platform. It figures as a section in this page where it is possible to view projects recently done by makers, who after finishing a project at the makerspace have the option to post it on the platform. By clicking on the button at the upper right corner, they are able to view their own FabMoments, edit and create. It supports search for other users' projects and has a pagination for browsing.

3.3 Tutorial page and helper

By choosing any of the DIY websites given in the application, the user is then redirected to the respective website where it is possible to freely navigate the website and choose any task to work on. The Smart Makerspace comes in with a sidebar helper that has a toggle (hide/show) button, so the user can continue the steps without it getting on the way.

The sidebar helper shows a list of the most commonly used equipment in DIY tasks, which in this case are 3D printer, laser cutter, soldering iron, drilling machine and glue gun. Moreover, by using a queuing system, it also shows its status whether it is available for use or busy at the moment, when another user is currently using it.

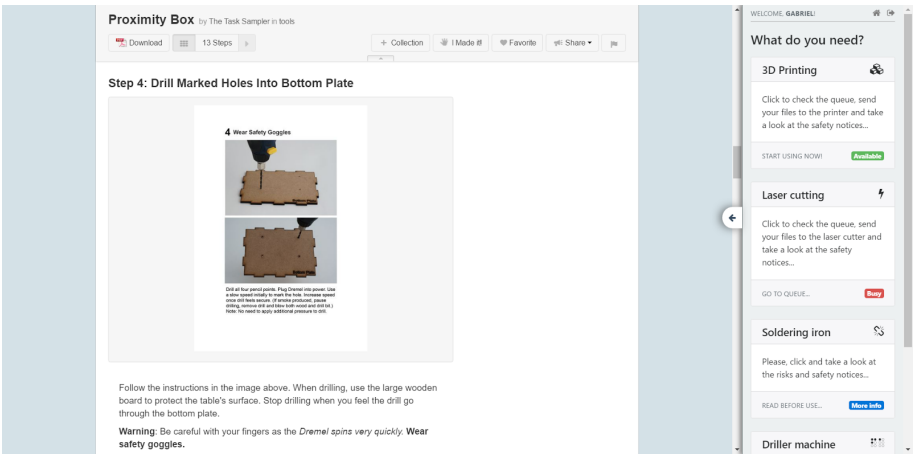

Fig. 5. "Proximity Box" Instructable and sidebar helper

3.4 Equipment modal windows

For every equipment listed in the sidebar helper, clicking on it will result on opening a specialised modal[1] for the equipment which contains its specific information. This information regards to the queueing system, file uploading system and technical information for the equipment, concerning as well security notices and usage instructions.

For using some of the equipment, it is necessary to enter a queue. By opening the modal, it is possible to find all the users in the queue who are willing to use an equipment, where you can as well enter the queue or leave it, in case. Another feature is the file uploading system, where you can send files from the laptop to the respective equipment computer, when applicable, such as 3D models or vector files that are input to the equipment software.

However, it is not pertinent that for every equipment there is queueing and file uploading system implemented. In fact, some machinery need a dedicated computer in order to work, such as a 3D printer or laser cutter, for example, which both need a computer in for running the software that controls it. Therefore, this equipment will get a queuing and file uploading system, once both of them work with specialised software, both need input files and are highly requested.

[1] A modal is a floating window that appears in focus, centered in the foreground, always on top. Example in Figure 4.

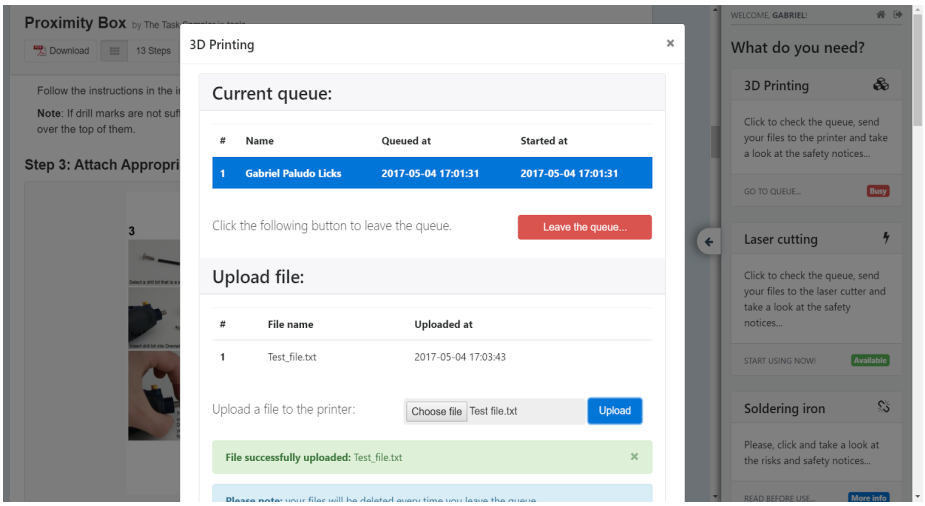

Fig. 6. 3D printer modal opened with queueing and file uploading

3.5 Equipment pages

For the equipment that uses a dedicated computer to work, those will have a dedicated page that will be open in the computer. This page works as a complement to the modals, giving extra functionality to the queueing and file uploading system. Nevertheless, it also shows all the proper information regarding how to use the equipment and security measures for a smooth operation.

Concerning the queue, it will show the current queue for that specific equipment, where it will allow users when finished working on the equipment to allocate the next user on the queue to start. For the file uploading system, it will list all of the files that different users have sent, where each of them has a button to download it to the computer and then work on it with the equipment software.

In the next chapter, we will describe in detail all the features presented here, regarding its implementation and a more technical point of view. The different tools used during the project will also be pointed out next.

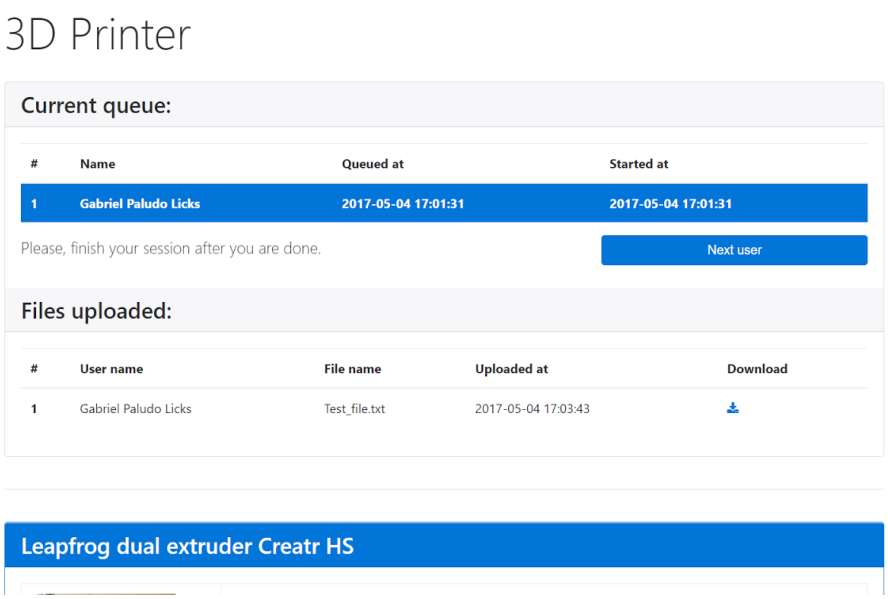

Fig. 7. Specialised page for the 3D printer with queue and file list

4 Features and implementation

In this chapter we will detail the tools used for implementing the web application, which covers the frameworks used, programming languages, softwares and IDEs necessary to build and run the application. Furthermore, we will introduce the specific features of the application, which consists on the logics used for implementing each of them along with the role they have in the application.

4.1 Implementing tools used

The implementation of the web platform consisted of two development stages. The first one is the front-end development, which relates to the user interface, the pages' flow and the triggers for user interaction. The second part was responsible for the back-end of the application, which consisted on the programming and logics of the application features, database and server interactions.

After describing the two development stages, we will cover other fundamental aspects for the application to be ran, such as the database and server as well as other tools used along the project.

Front-end development. In this first stage of the development, the main goal was to build a consistent user interface aiming ease of use and a proper look and feel. For that, basic languages used for constructing a web page such as HTML (HyperText Markup Language), CSS (Cascading Style Sheet) and JS (JavaScript) were used.

Initially, the languages used were pure HTML and CSS for structuring and styling the page. However, the Bootstrap[2] 4 framework has been used for further styling and element positioning, which comes with built-in alignment classes and elements that are automatically styled when using the respective classes.

Back-end development. The second stage of the development was responsible for the back-end of the application, which was developed following the Model-View-Controller[3] (MVC) architecture. The main language used for this stage was PHP[4] (Hypertext Preprocessor), a general-purpose scripting language that is especially suited for web development and can be embedded into HTML.

However, nowadays there is a range of frameworks with built-in features that help developers to save time and reuse code. Therefore, this application has been developed over the CodeIgniter[5] PHP framework, which is lightweight and has good support for implementing some of the basic features of the application. In addition, the jQuery library has also been used mainly for making AJAX[6] calls in some pages for dynamically refresh the content.

Database, server and other tools. For database, this project has used the MariaDB 10.1, which is open source and uses MySQL commands. Even though, some operations were made using phpMyAdmin[7], a free tool intended to handle the administration of MySQL over the web.

The web server used is Apache 2.4 HTTP Server, free and open source as well. And finally, tools such as the NetBeans IDE 8.2 and Sublime Text 3 were used for coding and handling files during the project.

4.2 Specific functionalities

In this section we will describe some of the particular functionalities that figure the platform. They represent some of the conceptual ideas behind the challenge of implementing the workbench functionalities to a web platform, adding a queueing system for equipment that enables sharing and organising equipment information regarding how to use, instructions and warnings.

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[2] Bootstrap is an HTML, CSS, and JS front-end framework for building responsive projects on the web. Official webpage at http://getbootstrap.com/.

[3] Model view controller (MVC) is a design pattern for writing software three fundamental parts: the model represents the data; the view displays the model data and sends user actions; and the controller provides model data to the view, and interprets user actions such as button clicks. Source: http://www.tomdalling.com/blog/software-design/model-view-controller-explained/.

[4] Official webpage at http://php.net/.

[5] CodeIgniter is a PHP framework with MVC design pattern built for developers who need a simple and elegant toolkit to create full-featured web applications. Official webpage at https://www.codeigniter.com/.

[6] jQuery is a feature-rich JavaScript library that makes HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. Official website at https://jquery.com/.

[7] Frequently used operations (managing databases, tables, columns, relations, indexes, users, permissions, etc) can be performed via the user interface, while you still have the ability to directly execute any SQL statement. Official webpage at https://www.phpmyadmin.net/.

Toggle hide/show button and sidebar. The sidebar helper is where the maker can find the listing of commonly used equipment and access further information for each of them. By clicking over any equipment, the respective modal will open for further features and information.

Also, the sidebar can be shown or hidden by a toggle button on the right side of the page. This is meant to allow the user to choose whether he wants to follow up the task with it or not, giving freedom if one is confident enough to follow up without any assistance. platform.

Queueing system. By opening a modal, it is possible to view the current queue for some equipment, where all users who are willing to use it are listed. Or, there could be none as well, meaning that the queue is empty and ready for the first user (available status).

For entering the queue, it is just necessary to click a button and wait until you get your turn. At the same place, if the user is already in the queue, the button becomes an option to leave the queue, in case no longer necessary.

In every equipment page, the queue will be shown as it appears in the modals, which comes with a button that allows the current user to finish its session and leave space for the next on the queue.

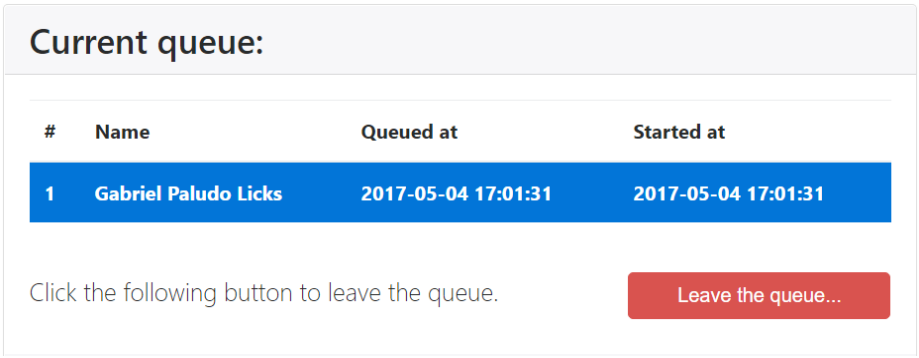

Fig. 8. Example of queue in a modal

File uploading system. The file uploading feature has been implemented for making the user's life easier while reducing while reducing the traffic of flash disks running around the makerspace. When the user gets its turn for using an equipment, he can go directly to the computer and easily access the previously sent files. The files can be uploaded directly from the equipment modal, and then accessed in the equipment page.

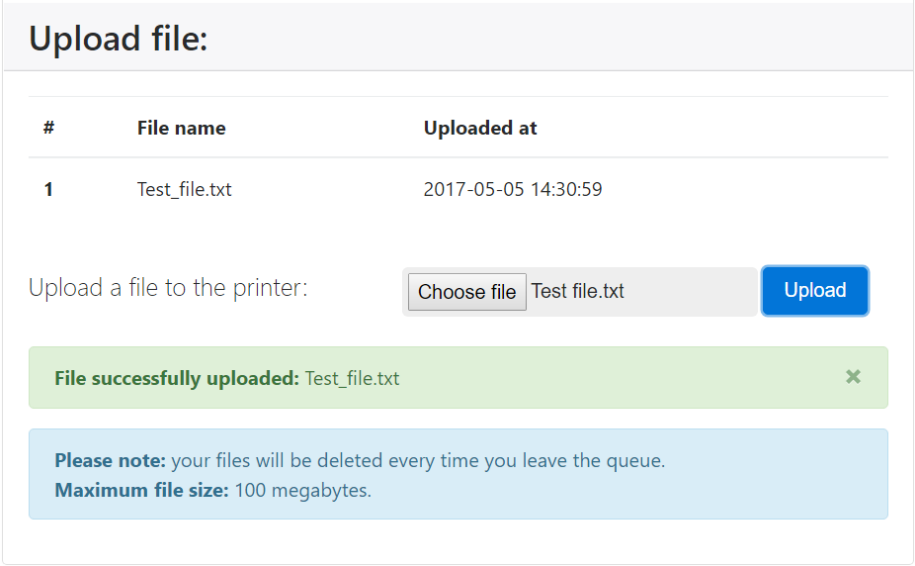

Fig. 9. Example of a file uploading form in a modal

This system also works along with the queue, since every time a user leaves the queue, either by itself before even using the printer or by having finished his session at the equipment, all the files uploaded from the user will be deleted from the server. Mainly for two reasons: first, for not overloading the list of files at the equipment page and creating a visual pollution for the user with a huge number of files; and second, not to maintain old and unused files in the server, as well as freeing up disk space.

Instructions and usage warnings. For every equipment listed in the sidebar, it is provided the respective instructions necessary on how to use the equipment, along with usage and security warnings for dealing with the equipment. The instutional makerspace provides the user with individual protection equipment, which are instructed as well.

Special equipment pages. Every equipment with a dedicated computer, in this case the 3D printer and the laser cutter, will have access to a page that contains the queue and the files sent by the user from the laptop. In these pages, the queue is shown as well as a button for releasing space to the next user and also a list of files sent by every user where every file has a button to download it. An example of this pages is shown in Chapter 3, Figure 5.

5 Feedback and discussion

For an evaluation of the platform, it was elaborated a feedback form to be answered by random users at the instutional makerspace, in the period of May/2017. They have been given an introduction to the project, and then the chance to use the

platform as they would, free to explore. Then, we will be discussing some characteristics between this model of Smart Makerspace and the one presented by Autodesk.

5.1 Feedback results

The web application has been uploaded in a local server at the instutional makerspace, and therefore was introduced to the users who had the interest on the potential of the idea and to collaborate by giving feedback. This is intended for having a primary quantitative evaluation of the work and analyse the acceptance of the features provided, as well as getting suggestions for improvements and new features, nevertheless. For this matter, after being given an introduction and experimenting the features of the platform, the users were asked to answer a feedback form.
The questions that the form contains, that later will be shown in detail, are based on the parameters evaluated by the Autodesk study. Initially, the first questions are to verify the expertise that the user already has, how familiarised and experienced the user already is on DIY tasks and fabrication equipment. Next, the second objective of the form aims to verify how useful each of the platform main features are, rating on a 5-point Likert scale (1 = strongly disagree until 5 = strongly agree). Lastly, also answering in a Likert scale, the overall helpfulness of the platform, look and feel, ease of use and other questions concerning the platform as a whole.

Quantitative results. The students whom the platform was presented had an average age of 22, whom area of studies is Informatics and also Architecture, in a total of 10 students. In level of experience, 30% of them considered themselves Beginners, 60% Intermediate and 10% Experienced; 80% said that enjoy working on DIY tasks; and 90% do use online tutorials for making; having 60% of them already used websites such as Instructables[8], Makezine[9] or IKEA Hackers[10].

Later, in the questionnaire, the users were asked on how experienced they were with some specific equipment, commonly used on makerspaces (results are an average of the answers in a 5-point Likert scale):

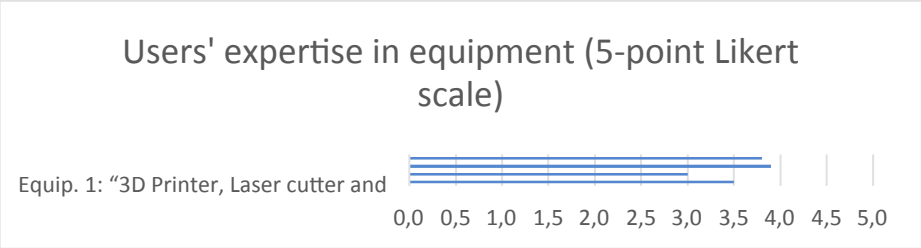

Fig. 10. Chart of users' expertise in equipment

[8] Access at: http://www.instructables.com/.
[9] Access at: http://makezine.com/.
[10] Access at: http://www.ikeahackers.net/.

It is possible to see in Fig. 10 chart that most of the interviewed users declare not being that experienced with more complex equipment such as 3D printer and laser cutter, in comparison to other more common hand tools. In a reality which these spaces and equipment are not that common, it is reinforced the need of new methods for appropriating this kind of tool and technology, creating ways for making it more feasible to the public. This is related to the platform's goal, to encourage and make it easier to approach this kind of equipment, providing the information needed to move forward in tasks, contributing for the users to have the "maker experience".

Furthermore, the tool they claimed being less experienced was the soldering iron. This tool is mostly related to electronics and robotics tasks, which today is a very specific type of activity between the public, but likely encouraged when making use of the platform's immersive space.

Regarding the platform's specific features, the users also answered the following questions (5-point Likert scale):

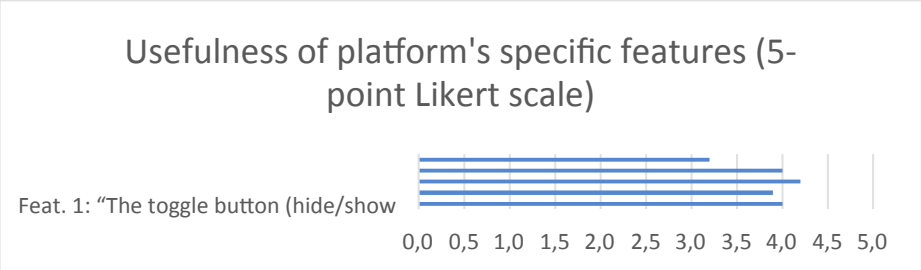

Fig. 11. Chart of usefulness of platform's specific features

The highest rated feature of the platform was the queueing system, implemented to distribute the access for some equipment between the users. The Smart Makerspace model from Ref. [3] has a limitation of one user only per workbench, limiting the access to the 3D printer only for the current workbench user. The queueing system and the web platform model will allow the users to share the equipment, which goes according some fundamental concepts of the maker movement: sharing and collaborating resources.

And finally, concerning the web platform as a whole, the following questions were made (5-point Likert scale):

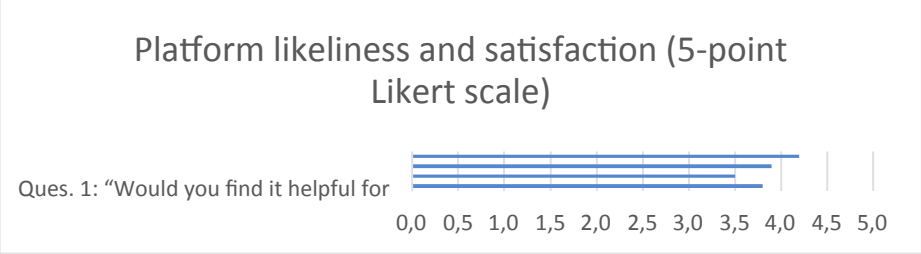

Fig. 12. Chart of platform's likeliness and satisfaction

With the initial ideas of creating an immersive instructional space, it was mandatory to have a platform with ease of use and a good interaction with the user. Based on the feedback numbers in Fig. 12 chart, we verified

that we could attend this goal and make a friendly environment.

5.2 Discussion

Approaching the idea of Smart Makerspace as a web application has its benefits, since it allows higher flexibility for incrementing features and adding equipment as needed. On the other hand, the workbench has a rather more immersive experience, since the whole environment is focused to one user. Therefore, both models come out with their own pros and cons.

A characteristic of the Autodesk [3] model is that it has a much higher accuracy on information such as the equipment actual state, where sensors were physically installed on each of the equipment kept track by the workbench. Installing these sensors, such as temperature, light and movement, for example, allows a broader range of possibilities to keep track of each of the equipment in a detailed fashion.

However, this demands special modifications on each of the equipment at the makerspace, plus the communication between microcontrollers and the web application. This is not feasible for expanding the idea between makerspaces and implementing as a web application allows countless equipment to be added - not the case for this initial work - but something to take in consideration when thinking of scalability.

As mentioned in the early chapters, a web application is as well more likely to users as their tasks are normally accompanied using a laptop, being more correspondent to the habitual routine in makerspaces and users' habits. Other features such as the file uploading are to attend demands by the makerspace itself, aiming to avoid running flash disks all around, as well as giving information in advance for users on how to use equipment, making it less likely the need of asking for personal assistance from the staff.

6 Final considerations

This work has, initially, started as a challenge to create a tool that corresponded to the objectives of the Smart Makerspace concept proposed by Autodesk, but aiming to come up with alternatives that could work around some of the issues identified at it, as discussed in the introduction. Our feedback results at the makerspace reflect the potential of this tool between novice and intermediate users, which is satisfying for the objective of creating facilitators and tools that encourage these users to become more familiar with maker activities and equipment.

Having built a web platform is also a facilitator for future implementations in a wide fashion that the web provides. The decision for not using sensors neither receiving direct signals from the equipment was taken in order to reinforce the scalability of the system, both for adding more equipment to keep track and also for simplifying the establishing the idea on other makerspaces.

An interesting future possibility is that, as a web application, makes possible for growing in the meaning of expanding on other makerspaces and creating a network for communication between makerspaces. This could result in benefits such as, for example, being aware of equipment available in others could be useful when one needs the other, as well as visualising different projects that are made, both for inspiring and growing community with all the information shared between these spaces.

As a result of this expansions, an administration dashboard for controlling the content of the application is also a very likely improvement, allowing an administrator to insert new equipment to the Smart Makerspace and managing content according to its needs. Some of the possibilities would be creating multiple queues, inserting more alerts (dynamic or not) regarding security notices, editing any kind of information and adding specialised content that fits better to each makerspace.

The Smart Makerspace as a web application allows much higher flexibility and scalability, as well as being a solution intended for sharing equipment between the user and not having specialised equipment for each session. In contrast, the workbench model does provide more accuracy on its information and delivers more integrated information focusing on the user. However, this is possible to be attained as a web application as well, which remains as a situation for future implementation ideas. Nevertheless, this is a solution that can also be applied in other makerspaces due to its scalability and, with future implementations, has a growing potential for connecting these spaces.

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Construction of SPOC-based Learning Model and Its Application in Linguistics Teaching

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Abtract—The design of a reasonable learning model must take the new internet age into consideration. The purpose of this paper is to construct a SPOC-based learning model and demonstrate its effectiveness in the teaching of the linguistics course. Following a contrastive study between MOOCs and SPOCs, a SPOC-based learning model is proposed which consists of four components, 1) the preliminary component composed of anterior analysis and course construction, 2) the restrictive admission component for student number control, 3) the learning procedure component which is subdivided into pre-class session, class session and post-class session, and 4) the evaluation component which includes both online assessment and classroom assessment. Employing a combined qualitative and quantitative method, this paper shows that this model has advantages over previous ones and the application of this model in teaching linguistics to college students shows clearly its effectiveness in increasing participation and learning time, and in improving learning attitude.

Keywords—MOOC, SPOC, Learning model, linguistic teaching

1 Introduction

The 21st century is what people usually call the "internet+"age, which means that every person can have access to the world through internet connection anytime anywhere. The new feature of internet surroundings is reinforced by the rapid spreading of mobile laptops, smart phones and communicative phone apps, like Twitter and Wechat. Nowadays, it is possible that the new generations can never live their lives without mobile electronic devices, which may pose a serious challenge to traditional modes of classroom teaching and learning. Teachers and students can either stick to the old-fashioned way of teaching, controlling the use of information technology in class, or find ways to utilize the new age feature and facilitate teaching and learning. It can be easily judged that the second alternative is a wiser choice.

In 1982, the first distance learning program was initiated in the University of Chicago [1], and the online programs grow exponentially thereafter. The first known MOOC (massive open online course) was offered by MIT to provide web access of course materials to students [2]. Currently, there are abundant MOOC platforms in many esteemed universities, which make use of clouding computing systems to offer

learning opportunities to people all over the world. The term SPOC (small private online course) is coined by Fox [3], a professor at University of California at Berkeley, and the first SPOC was offered at Harvard Law School in 2013, where approximately 500 students are selected from a total of more than 4,000 applicants to participate in the SPOC course. The transformation from MOOCs to SPOCs reflects the popularity of online courses and people's thorough reflection of online learning. In the setting of university education, this change seems to be logical and inevitable. Though there are many studies on the advantages and disadvantages of these two course models, a proper and exact learning model utilizing SPOCs has yet to be established, and this is one major concern of this paper.

Linguistics is the scientific study of language which can be divided into subbranches concerning sound, structure and meaning [4]. This discipline is a compulsory course for language majors which usually lasts for one or two semesters. One important feature of linguistics is its systematicity and abstractness, which makes it difficult to learn for initial learners. Another purpose of this paper is to apply the SPOC-based learning model to present a specific learning agenda of linguistics teaching, so that the efficiency of teaching and learning of this course can be improved.

2 From MOOCs to SPOCs: A Changing Model of Online Platforms

In this section, the MOOCs and SPOCs are discussed in detail, with a focus on their practices and features. After that, a comparative observation is presented to show the necessity of changing from MOOCs to SPOCs against the background of university education.

2.1 The emergence of MOOCs

Since its appearance in 2012, MOOCs are now a common theme in the educational system. Currently, there are about 100 platforms that offer MOOCs, with the cooperation of leading institutions of higher education and top scholars as well as industry experts in different areas of learning. There were originally three major American MOOC providers, i.e. Coursera, edX and Udacity. Now more MOOC platforms are created in other countries, e.g. FutureLearn in the UK, Open2Study in Australia, Iversity in Germany and France Université Numerique in France [5].

MOOCs are online courses which offer educational chances to potential applicants all over the world, usually free of charge. A typical MOOC usually consists of a series of video lectures, assignments, computer-based tests and online discussion forums [6]. Students are accepted usually in a large number without limit. These MOOCs give open access to originally controlled learning materials and chances of education in an asynchronous and interactive manner. The students can even receive a certificate when finishing a course. The essential feature of MOOCs can be generalized as accessibility, which gives the general public a channel to learn any subject they choose, regardless of previous learning experiences. While in the past, these opportunities

were only available to only a limited number of elite university students. The idea of creating MOOCs opens up the possibility of creating a genuine pathway for life-long learning processes, which is of critical importance in the current fast-paced, highly competitive society.

2.2 The emergence of SPOCs

MOOCs are divided into xMOOCs and the cMOOCs [7]. The previous type follows the traditional classroom learning model with video lectures chosen by instructors, while the latter usually resorts to pedagogies based on learner networks and connectivism (a theory of learning in a digital age that emphasizes the role of social and cultural context in how and where learning occurs) to help learners acquire new knowledge. In recent years, there is also a tendency to combine the two types to create derivative types of MOOCs. SPOCs are just one of the course types emerged following the rise of the grand-scale online MOOC wave.

SPOC is pioneered through the edX platform and it can be defined as a curriculum education model which employs MOOC resources to the physical environment of learning on campus. A SPOC is modeled on XMOOC which includes instructor videos, interactive assignments, and discussion groups [8]. Some scholars generalize the feature of SPOCs as the combination of MOOCs plus classroom [9]. When a new SPOC is opened, the applicants need to write admission essays and the instructor can choose a specific number of students, usually under 500, based on essay-writing adequacy of the applicants. This elicitation procedure offers instructors a chance to obtain more insights concerning their students and adjust the supervision methods to satisfy learners' idiosyncratic learning needs. The accepted learners are mentored by on-campus students and receive the same requirements of the course expected of a regular student. They become drop-outs if they cannot keep up with the learning process, which maintains the quality of teaching. Seen from this way, a SPOC resembles the flipped classroom pattern [10] of learning more than a MOOC.

SPOCs change the status of traditional way of classroom teaching in the physical environment. It is a hybrid model integrating online learning and traditional classroom learning offered to a small group of learners. A SPOC can employ the resources of MOOCs through instructor design, and promote learner-teacher interaction and the improvement of academic performance. SPOCs give full play to the merits of MOOCs while remedy some of their disadvantages. As a result, SPOC platforms with a school-learning basis receive more popularity over the recent years.

2.3 Comparing MOOCs and SPOCs

MOOCs are usually created and promoted by prestigious top universities which provide free access to learning opportunities to people all across the globe, and they are precious resources for learners with strong learning motivation and less financial support. Accompanying this advantage, there are also some disadvantages.

Firstly, since MOOCs are completely open to the public without a selection procedure for a short period of learning span, all people can participate in MOOCs, which

brings a huge number of online learners and high rate of dropout. The completion rate is usually less than 15% [11].

Secondly, the learning method of MOOCs is unitary with an emphasis on self-learning. There is no information sharing, multi-modal curriculum templates, or class management. Furthermore, operation demonstration, case analysis, and group discussion are rarely employed.

Thirdly, the evaluation strategies to access students' learning outcomes are limited, with a focus on self-assessment and peer-assessment [12], while some other more efficient evaluation methods are neglected.

Fourthly, the ideology of teaching is not completely changed in MOOC platforms from traditional teaching. MOOCs are the electronic representation of traditional class structure and teaching content. Investigative learning and individual learning requirements are not met.

Fifthly and finally, the equipment of learning of MOOCs is usually limited to PCs. The confrontation of machines can bring exhaustion and boredom to students, which dampens students' motivation of learning.

On the contrary, the SPOC model can compensate the shortcomings of the MOOC model. Firstly, a SPOC is controlled in the sense that a fixed number of students are chosen with potential abilities of finishing the courses. The control of candidates brings a high rate of class attendance and course completion, which can reach 90% [13]. A SPOC usually lasts for a whole semester, the time span for regularly-enrolled students. Secondly, since SPOCs combine MOOC resources with classroom instruction, all the procedures lacking in MOOCs can be remedied through teacher-student interaction. Thirdly, with teachers' participation and classroom involvement, other efficient and diversified assessment strategies can be added. Fourthly, with a combination of MOOCs and traditional classroom teaching, SPOCs create a blended learning environment, which is truly a drastic change in terms of teaching pedagogy and teaching ideology. Finally, the learning equipment in SPOCs can be increased to include the Blackboard Learning Management System (a virtual learning environment and course management system developed by Blackboard Inc.), physical learning materials, white-board, smart phones, etc., which brings diversity to the learning process. The major points of the two models are summarized in Table 1.

Due to the advantages of SPOCs over MOOCs, this paper argues that the SPOC model should be employed as the basis for learning model construction. Against the background of higher education, the SPOC-based model can provide an important channel for teachers and students to maximize learning resources to make progress in study. The following problem would be the exact learning model that can be constructed with the employment of SPOCs, and this will be the topic of the following section.

Table 1. Differences between MOOCs and SPOCs

No.	Perspective	MOOCs	SPOCs
1	openness	completely open	controlled
2	student selection	all permissive	competitive selection
3	candidate number	large-scale	small-scale
4	time span	short	regular
5	attendance rate	low	high
6	finishing rate	low	high
7	teaching materials	self-made	self-made or adopted
8	learning method	online	online + classroom
9	evaluation strategies	monotonous	diversified
10	education cost	low	relatively high

3 Construction of SPOC-based Learning Model

In this section, the principles of building a learning construction are presented first. After that, taking these principles as guidance, this paper proposes the SPOC-based learning model.

3.1 Principles of learning model construction

There are three principles that must be taken into consideration when a learning model is constructed, i.e. the principle of systematicity, the principle of interaction, and the principle of initiative.

A teaching system is the intentional arrangement of resources and process. Any ingredient, which is intended to explore people's potential of learning, should be included into the system [14]. In the same way, in the design of a teaching model, any activity or component which may bring positive effect upon the learning outcome should be considered in the model, for example, learners, the instructors, the teaching aids, technology, resource design and selection, evaluation procedure, feedback mechanism. People should appraise and integrate them into the model if possible. Furthermore, these ingredients should receive systematic and orderly organization. This is why the principle of systematicity is important in the design of a teaching model.

In learning, learners inevitably encounter problems, and the solution to problems usually comes from group work. The communication between co-learners facilitates learners in terms of meaning construction of the knowledge they are aiming for [15]. This is why the principle of interaction is important. In the design of a teaching model, online and offline communication between students are both of critical importance. They can work together to make full use of learning materials and resources, and solve specific problems through the way of teamwork and group cooperation. If the principle of interaction is fully implemented, students will become active agents en-

gaging in learning, rather than receptive entities, which may bring drastic change to the learning result.

According to constructivist learning theories, learning is not the passive acceptance of stimulus information, but the active construction of knowledge by the learners themselves [16]. The students, when they are in the process of learning, should be encouraged to raise questions, air views, and participate in the process of learning. The result is that the learners should take an active role in the learning process. A learning model should take the inspiration of students' learning initiative as one key issue, so that students can enhance their learning consciousness and improve learning efficiency.

3.2 SPOC-based learning model

Based on the previously mentioned principles, this paper proposes a SPOC-based learning model which is organized in a liner and systematic way. This model is represented in figure 1.

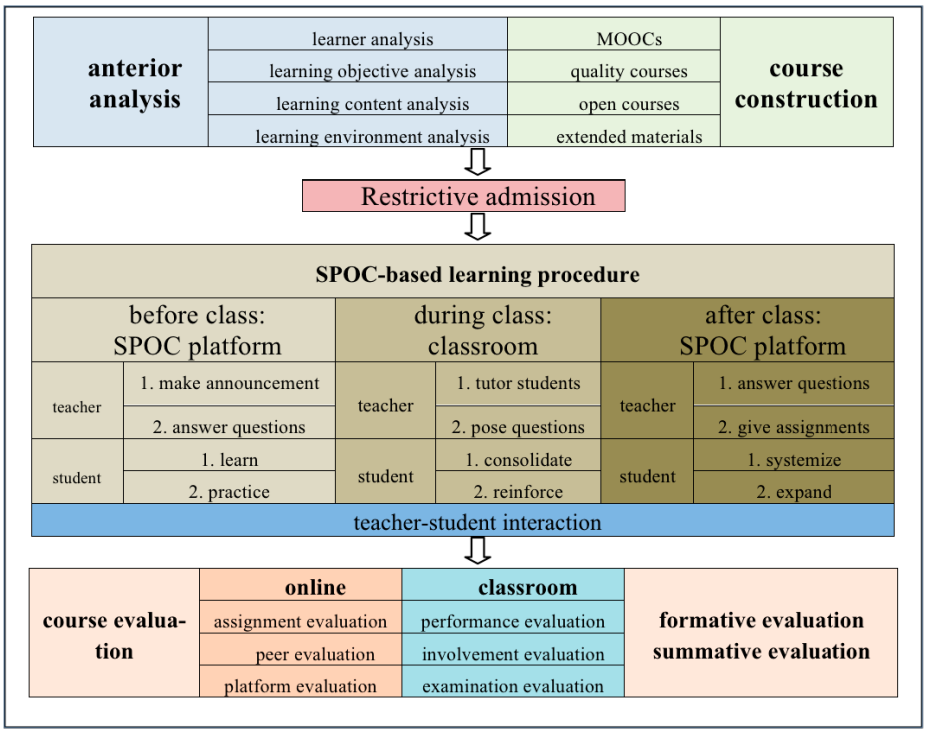

Fig. 1. SPOC-based learning model

The SPOC-based learning model consists of four components, and they are the preliminary component, the restrictive admission component, the learning procedure component, and the evaluation component. The purpose of restrictive admission is to

control the number of applicants to avoid the negative effect of large-scale and diversified learner pool, which is an often discussed demerit of MOOCs. The remaining three parts are analyzed in detail in the following part.

The preliminary component has two subparts, i.e. anterior analysis and course construction. Anterior analysis mainly focuses on the assessment of the background of learning which includes the assessment of learners, learning objective, learning content, and settings for learning. Course construction is of critical importance in the SPOC-based learning model, and the courses may be MOOCs or high-quality courses created by different teaching groups that are open to one specific university or to the general public. Furthermore, some extended materials can also be included in this model.

The learning procedure is divided into three subparts, i.e. the pre-class part, the class part, and the post-class part. The pre-class part sets the stage for learning where teachers give students specific directions while students make use of the online SPOCs to achieve basic learning goals. They also need to do a specific amount of exercise to check the effect of learning. In classroom learning, teachers do not have to focus on every detail of the course. They should rather focus on critical points or raise questions to ensure the quality of learning. Students can consolidate what they have learned and reinforce their understanding towards the objective and content of learning. In the post-class part, students have to do more exercises and read more advanced materials to establish a systematic view of what they have learned; some top students can even start investigative learning or start their projects to achieve even more results. Throughout the three subparts, teachers and students can always interact with each other so that feedback can be transmitted and both parties can adjust themselves to achieve maximum learning effect.

The evaluation component is carried out through formative evaluation methods and summative evaluation methods. The online performance and classroom performance are both taken into consideration to offer students holistic and objective assessment.

3.3 Advantages of SPOC-based learning model

The SPOC-based learning model has some advantages over previous learning models. The aim of this section is to present and discuss in detail five advantages of this model.

Firstly, this model preserves students' learning attentiveness. The SPOC-based learning model has modular mini-lectures and highly pertinent exercises. The students, before the classroom session, self-study the mini-lectures through a series of videos followed by specific and targeted exercises to guarantee understanding. The short span of video playing and the shift between watching videos and doing exercises help maintain high attentiveness of the learners to achieve optimal study effect.

Secondly, this model satisfies individualistic learning needs. Students can replay the videos online, freely arrange their time, place and pace of learning, and pose insightful personal questions towards the course. This freedom realizes individualism in learning to accommodate the needs of a verified circle of learners.

Thirdly, this model promotes the flipped classroom pattern of teaching and learning. The mini-lectures through videos are given to the students to learn before class. In the class, students and teachers are mainly involved in the activities of analyzing key points, doing exercises, researching on projects, and taking part in group discussion, etc. This flipped pattern avoids the traditional pattern of on-length teaching in the class, and brings promising integration of online learning, offline learning, self-learning, group learning and investigative learning.

Fourthly, this model frees teachers into doing more significant work. A teacher does not need to give a full lecture all through the class, and he or she can be the initiator of learning tasks, the organizer of group discussion, and the coordinator of class activities. These changed roles bring forth new benefits to both teachers and students.

Finally, this model provides meaningful big data for teaching research. The online interaction and evaluation procedure leaves precious raw materials for teachers and researchers to engage in the study of learning path, teaching modes, error patterns, and interactive channels. Consequently, the results achieved through these studies can provide educators with valuable reference information on issues of problem diagnosis, learning intervention and learning policy determination.

4 SPOC-based Learning Model in Teaching Linguistics

The author has employed the SPOC-based learning model to teach the course of linguistics to English majors in a Chinese university. Taking the chapter of generative syntax as an example, this section focuses on the specific practice of applying this model to the learning process.

4.1 The preliminary component

The students are a group of 90 juniors of 3 classes in the School of Foreign Studies who all have the basic required internet and computer skills. They have received the previous English language professional training for two years, and their English proficiency is approximately medium level to advanced level. They all have great interest and confidence in the SPOC-based learning model. The learning objective of this chapter is to understand the basic theories and different schools of generative syntax, while the learning content is syntactic theorizing and analysis of specific languages, especially English and Chinese.

The online learning platform is provided by the academic office of the university. On that platform there is one module dedicated to the course of linguistics. The platform is composed of four parts, the SPOC section, the test section, the forum, and the learning surveillance system, which provides systematic assurance of the learning effect. The SPOC section consists of the following five components as summarized in table 2.

Table 2. SPOC section composition for the linguistics course

No.	materials
1	learning videos produced by the teaching group
2	courses from the National Quality Course Network
3	materials from digital libraries, eg. Cnki and Wanfang
4	PPT files for the course
5	extended reading materials

4.2 The Learning procedure component

The chapter of generative syntax takes 2 class hours to finish, which lasts for one week's time. The time allotment is shown in figure 2.

Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday
Online learning			Classroom learning	Online learning		
Teacher-student interaction through platform or Wechat & QQ groups						

Fig. 2. Time allotment for the chapter of generative syntax

As can be seen in fig. 2, the class meeting takes place on Friday, and the remaining days are separated into two parts for online learning. The previous part is for before-class activities and the latter part after-class activities.

On Tuesday, the students are asked to log onto the online learning platform to check the learning syllabus for the week, and they are required to watch the videos and read the extended materials on the platform. The 30 students in one class are divided into 6 learning groups that work together to do exercises independently and find out the right answers collectively. Furthermore, they have to prepare a list of 6 questions for discussion with the group's joint effort. The students are required to finish all the work in three days before Friday. When they have their questions during the process of learning, they can go to the forum system to start a discussion or ask for help from the teacher who will answer the question online or offline.

During the classroom section on Friday, the teacher lists the major schools and theories of generative syntax and asks representatives from the six groups to report their findings, and they are ready to be questioned by either the teacher or their fellow students. After that, a different group of student representatives report their questions and initiate discussions concerning the topics raised. Through these steps, the students deepen their understanding of the originally abstract syntactic theories and are capable of doing practical language analysis.

After Friday, the students have three more days to finish the exercises provided by the teacher on the platform. This time, the students have to do the work all on their own. After that, the students are required to upload their answers to the platform system to be graded. One academic paper on the topic of "modern syntactic analysis" is provided to the students to read. The top students can chat with the instructor through Wechat or QQ (Chinese instant communicative apps) for personal comments and

further materials. Through this way, the students systemize what they have learned and are ready to go further into the frontier areas of syntactic study. All the students must finish the work before Tuesday when the mission of the following chapter is announced on the learning platform. All through the three stages, when the students have questions, they can always go to the forum or use Wechat and QQ to consult their fellow students or the teacher, so the interaction between learners and instructor occurs all the time.

4.3 The Evaluation Component

The evaluation of the linguistics course is divided into two portions, the online portion and the classroom portion. The scores are given according to the assignments and topics posed on the learning platform. Furthermore, the performance of the students in the classroom is also taken into consideration, focusing on the quality of their reports and involvement in classroom activities. The ratio is 60% online performance plus 40% classroom performance. At the end of the semester, the students have to take a test which occupies 30% of the total score, which means that the semester-long performance online and in the classroom occupies 70%. This method of evaluation covers both formative evaluation and summative evaluation, and is a fair procedure generally accepted by the instructor and the students.

5 Surveys of Students' Reaction to the Learning Model

After the learning of the chapter on generative syntax, the author conducted a simple investigation concerning students' reaction to the SPOC-based model. The subjects are the 90 students taking the linguistics course. There are three factors under consideration, i.e. learners' participation rate in the learning process, time spent in learning and learners' attitude to the model.

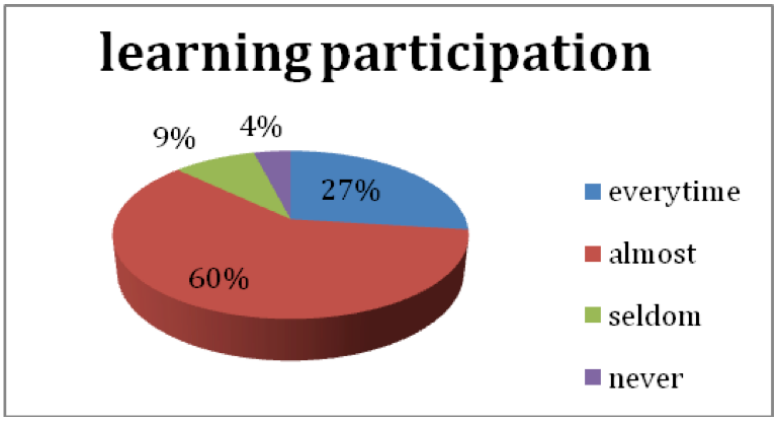

Fig. 3. Survey result of learning participation

Figure 3 shows that with the online part added to the learning process, a majority of students have participated in the learning process. 27% of the learners dedicate themselves completely to learning while only 4% do not participate. These 4% students have offered their reasons of not participating, and none of the reasons are related to the course design itself. 60% of the students almost always take part in the process, and 9% do not contribute enough to learning. For an abstract course like this, this rate is good enough to make a difference.

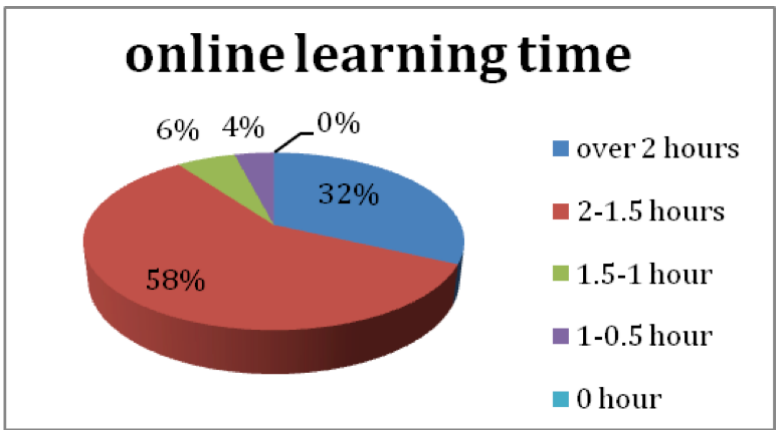

Fig. 4. Survey result of online learning time

In figure 4, it is shown that besides the classroom meeting time, every student logged on the internet to access online materials. The majority of students take 1.5 to 2 hours of online study, 32% of them study over 2 hours. Students who study less than 1.5 hours occupy only 10%. This shows that students all have interest and willingness in SPOC-based learning. This amount of time spent is one of the important reasons guaranteeing the effect of study.

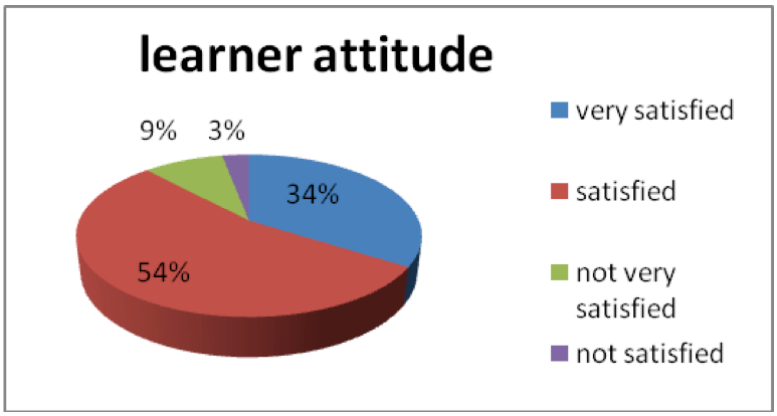

Fig. 5. Survey result of learner attitude

Figure 5 shows that the students who are satisfied or very satisfied with the model occupy 88%, which means that most of the students have positive feelings on this blended way of learning. The students who are not satisfied provided reasons which mainly cover load of work and difficulty of catching-up, which is not closely related to the model itself. In a different research carried out with the traditional model of teaching, it is shown that students who are very satisfied with this course occupy 0%, students satisfied with the course 13.3%, students not very satisfied 80%, and students not satisfied 6.7% [17]. When the two sets of data are compared, the advantages of the SPOC-based model can be easily recognized.

These three survey results show that almost all students hold positive response to the SPOC-based learning model and this model can make a significant difference for the students who are taking this challenging course. When the students take part in the learning process actively, and when their interest of learning is motivated, the improved learning effect can be duly expected.

6 Conclusion

The traditional learning model overlooks students' individual learning needs and cannot catch up with the fast development of technology and society. On the other hand, the Internet-based courses, when they are properly used, can bring significant change to the ways of teaching and learning, and revolutionize people's conception of education [18]. The SPOC-based learning model as proposed in this paper is just one of the models that can bring positive effect upon learning. This model brings important implications for teachers and students regarding their roles and patterns in the learning process, and reflections upon these changes can help educators rethink and reconstruct more efficient ways of learning. After all, the learning model is an instrument facilitating learning. If learners want to make substantial improvement, they must make an effort in their own learning motivation and course involvement, understandably, with the help of more and more rational and optimal learning models.

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Factors Influencing Academic Performance of Students in Blended and Traditional Domains

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Abstract—This paper aims to identify the most important and significant factors in two different areas of learning: combined and traditional learning. Several critical issues have not yet been resolved to achieve the full potential of the learning outcomes in the two domains. The objective of this paper is to review the critical factors that have a great influence on academic performance. The document focuses specifically on a set of factors such as the use of technology, the interaction processes, the characteristics of the students and the class. These identified factors were classified and discussed. The document also determines the technical and pedagogical limitations of the two declared domains. The technical and pedagogical challenges were proposed and future works were recommended.

Keywords—Technology Use, Interaction Process, Student Characteristics, Class Characteristics, Blended Learning, Traditional Learning.

1 Introduction

The best learning environment has emerged with the combination of the strongest aspects of blended learning (BL) and traditional learning (TL). BL is adopted in the learning process to eliminate TL deficiencies and web-based learning (WB). TL is ineffective in terms of student participation and interaction process, that is full of a limited period of time and that distance learning limits the interaction between students has caused the emergence of this new learning environment [1].This new learning approach is BL, in the international literature BL is referred to as hybrid learning and mixed learning and is also used very differently by many researchers, academics, and scientists. Online learning is deprived of many advantages that TL incorporates. The greatest shortcoming of online approaches is that they cannot provide students

with opportunities for social interaction and face-to-face with other students and instructors [1].

There are some factors that prevent the future growth of online learning. These factors are represented in the management of online courses that require a lot of time. In addition, students are often frustrated. In addition, the problems cited with the use of technology, as well as the lack of communication between students and remote instructors. furthermore, some programs experience high dropout rates as a result[2]. Student academic performance (SAP) includes academic achievement, achievement of learning objectives, acquisition of desired skills and competencies, satisfaction, persistence, and post-university performance[3]. The term academic achievement refers to some method of declaring or expressing the academic rank of a student. In general, it is a grade for a course, an average for a group of courses in a particular subject, or an average for all courses expressed in a 0 to 100 or other quantitative scales[4]. In this paper, SAP was defined as a total grade of a student in a specific course that is distributed in the midterm marks and final exam scores and was expressed in a 0 to 50 scale for each midterm exam and the final exam. The objective of this work is to identify the factors that influence SAP in BL compared to TL.

There are many studies in the literature that discussed the influence of the use of TL and BL technologies on SAP as established in the Refs [5-9]. In addition, some studies focused on the influence of interaction processes in SAP in two different domains of TL and BL as established by Refs [10-14]. Furthermore, other studies presented the influence of the characteristics of students and classes in SAP as established in Refs [15-18]. However, none of these studies addressed the influence of all the factors established in SAP. Therefore, this study has classified the factors that influence SAP in four main factors. These factors are the use of technology (TU), the interaction process (IP), the characteristics of the student (SC) and the characteristics of the class (CC). Each main factor is further divided into subfactors. Figure 1 showed the factors that have a great influence on SAP in deliveries BL and TL.

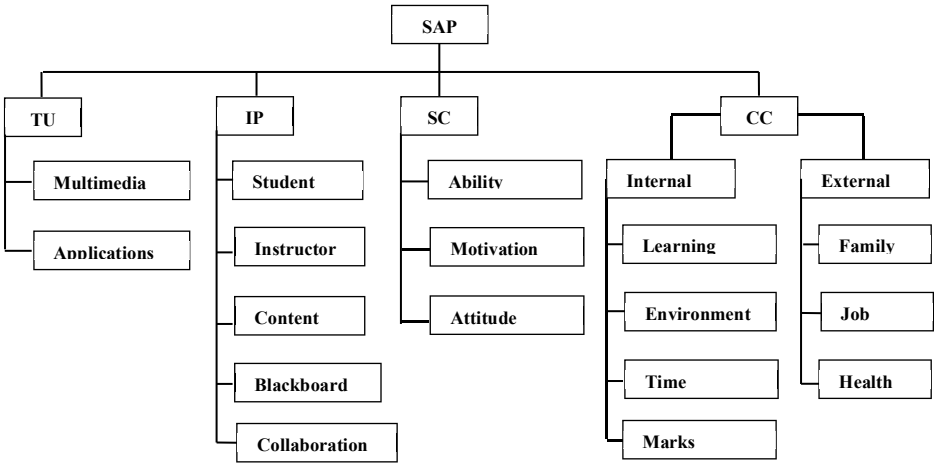

Fig. 1. Classification of Factors Influencing SAP in BL and TL

2 Factors influencing SAP in BL and TL deliveries

The objective of this section is to identify the most important factors that have a great influence on academic performance in BL and TL deliveries.

2.1 The influence of the use of technology on SAP

The use of technologies in TL and BL includes multimedia technologies and applications that are used in teaching and learning processes. It involves skill and competence in the use of technology to carry out specific activities in BL and TL. Ref. [19] stated that the use of technology is not intended to replace the traditional classroom setting but to provide new opportunities and a new virtual environment for interaction and communication between students and their instructors. Ref. [20] explained that traditional lectures could be an effective way to help students acquire new knowledge, while the pace of instructors' lectures in the classroom sometimes causes problems. These problems are reported in some students who do not have new information or content and other students may feel that the same material is quite difficult to understand because they do not have sufficient prior knowledge about the subject.

The effect of the use of TL Technology on SAP - Ref [21] said the digital learning environment such as the Internet and the Web-based now defines the highly interactive learning environment redefinition as well as the concept of teaching. Classrooms are not the only place in a learning process. The whole world is the classroom. Millions of students from around the world belong to the network generation. Students can travel around the world with the click of a mouse or even at the command of their voice. Ref [5] noted that one of the internal class factors that have a great influence on academic performance is the technology used in classroom and exam systems. Ref [6] stated that students use computers and other digital media to entertain, learn and communicate. These students prefer interactive learning. This type of learning emphasizes the innovative approach such as learning discovery, student-oriented, manipulated materials, videotapes, slides, computer-assisted instruction. All of this interactive learning has become part of the innovative approach to classroom support.

The advance of technological support emphasized that combined learning rapidly evolves as an alternative to teaching and learning in higher education, which in turn contributes to distance education. In addition, TS offers a just-in-time approach to your new learning challenges. Ref [22] stated that the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchange and collaboration will result in the improvement of learners academic performance. The collaborative technologies such as discussion forums, peer-tutoring and video conferencing have an effect on student learning as well as assist in achieving higher order thinking skills. Video conference technology is a system that supports transferring of information in the form of text, audio, and video, from one user to other users in different locations. Other technologies such as multi-user virtual environments (MUVE) capable of synchronous communication and are considered social networking applications.

The effects of the use of BL Technology on SAP - Five studies in TS were used. The first study was carried out by Refs[23, 24] that studied the effects of LMS on student performance in relation to a web-based forum. Their results revealed that online questionnaires, assignments and the electronic content of the BLS had a significant effect on SAP, but the feeling of isolation in an online environment represents an obstacle factor that affects the attitude of students to use LMS. They also confirmed that there is a lack of interaction between students when using pure online.

The second study conducted by Ref [7], which states that students can interact with each other by using features of LMS in order to bridge the gap of lack of close interaction among students. This, in turn, is reflected in the SAP. Although online activities are used to foster two forms of interaction, however, this study attempts to use LMS activities as discussion forums in order to raise the level of student interaction processes. The third and fourth studies are carried by Refs[8, 9], who studied the effect of e-learning tools in SAP. Their findings revealed that the ease of use of learning tools will lead to improved academic performance. This study assumed that student interaction with the ease of use of LMS will increase students' motivation to participate effectively through well-designed BL courses.

The fifth study indicated that software is an important element of technology for enhancing the quality of technological resources. The software must provide a new experience to the students, leading them to a more active and collective engagement during the class. Ref [25] confirmed that Web 2.0 technologies are generally associated with a variety of meanings that include an emphasis on user-generated content, information sharing, collaborative efforts, new ways of interacting with Web-based applications as well as the use of the Web as a social platform for creating, repositioning and consuming content. Web 2.0 technologies include social networks, blogs, micro-blogs, wikis, discussion boards, bookmarking and media sharing.

One of the main objectives of using the combination of TL and BL domains is to examine the two different types of methods of these domains. In addition, it identifies which domains are positively associated with SAP. This article explores the effect of the interaction process when students use LMS activities in BL and the level of student interaction in SAP.

2.2 The influence of interaction processes on SAP

Interactions occur when objects and events mutually influence one another. An instructional interaction is an event that takes place between the student and the student's environment. Its purpose is to respond to the student in a way that aims to change their behavior towards an educational goal. Educational interactions have two purposes. The first is to change the students and the second is to move them towards the achievement of their goals. In this article, interaction refers to the response of students to students, students to instructors, and students to content.

Interaction can be divided into three types: (a) student-student interaction (S2SI), (b) student-instructor interaction (S2II) which refers to both forms of communication and c) interaction between students and content (S2CI). All these interactions occur synchronously or asynchronously through collaborative learning (CL). This study

focuses on the fourth interaction between student and the blackboard interface (S2BI) that has been neglected and there are few studies challenging this type of interaction. Ref [26] classify online interactions into four types of interaction models: purpose/task, activity based, tool-based, and communication models. Purpose/task models categorize interactions in terms of their functionalities. Activity-based models classify interactions in terms of their instructional purposes. Tool based models group technology tools in terms of their capabilities in supporting educational interaction. Communication models that categorize interaction in terms of relationships or exchanges between learning parties. Ref [27] indicated that the interaction is related to the activity which has to be performed in a physical/virtual environment, for example, the interaction of instructor with students is taking place mainly in classroom, office or/and virtual classes. Also, students' interaction with course content can take place in the library or/and digital content.

The effect of student-to-student interaction on SAP - The objective of S2SI is to study the interaction between students in order to examine the effect of this interaction over SAP. The interaction between students can occur between one student to another, between one student to several other students or between two groups of students. S2SI is intended to stimulate and motivate students to learn the course content by exchanging dialogue between them. Ref [10] (p. 85) stated that students in an online learning environment lack opportunities to experience the benefits of both structured dialogue and the sense of community that can be created in the more traditional classroom environment. The lack of interaction in online educational environments is supposed to be avoided in order to make online educational environments similar to traditional classrooms environments that are filled with the vital learning interactivity. Ref [11] (p. 104) explained that S2SI is the exchange of information and ideas that occurs among students about the course in the presence or absence of the instructor. This type of interaction can take the form of group projects, or group discussion, etc. The S2SI can foster learning through student collaboration and knowledge sharing.

Ref [28] to study the relationship between online participation and student ratings. Their study showed that there is a lack of close interaction between students. This lack may have adverse consequences, possibly because students experience feelings of isolation. It makes sense that the more active a student is, the better he or she will perform. Ref [7, 24] suggested that students can interact with each other through discussion forums and course messages in order to bridge the gap of this lack of close interaction between students and feelings of isolation in an online environment. Neither the feeling of isolation nor the interaction in an online environment can bridge the gap between a problem of close interaction. However, the two forms of interaction between students and instructors can minimize this gap. Ref [7] stated that students can interact with each other by using features of learning management systems (LMS) in order to bridge the gap in the lack of close interaction between students. This, in turn, is reflected in the SAP as they have no other choice than to sustain with learning activities. This study attempts to examine the effect of the two forms of interaction in SAP. The objective of S2SI is to study the effect of these interactions on SAP. In BL delivery, the interaction between students helps them to exchange ideas and to share

information between students as well as allow them to discuss their subjects matter through online discussion forums, chat rooms, and e-mail or course messages. On the other hand, in TL delivery students may interact in person and through electronic means (e.g. e-mail, telephone and facsimile machine). In other words, students can interact during class or schedule meetings outside the normal class hours. Ref [12] posed several challenges to implement the designed interaction that reflects a high level of student-student interaction in the online environment, including the size of the class, the time involved in evaluating student learning, motivation and the experience of collaborating using the technology.

The effect of student-to-instructor interaction on SAP - The objective of S2II is to study the two forms of interaction between students and instructors in order to examine the effect of these interactions over SAP. Also, S2II is intended to help reinforce student understanding of the material or explain meanings. Moreover, S2II can help students clarify nebulous points and reinforce proper interpretation of course information. Furthermore, in TL delivery oftentimes of S2II can occur in a face-to-face or physical meeting, while in BL delivery S2II must be transmitted by electronic means, such as chat discussions, course messages, and e-mail communications. Ref [11] (p. 104) stated that S2II refers to the interaction between the learner and the instructor. This can take the form of instructor delivering information, encouraging the learner, or providing feedback. In addition, this can include the learner interacting with the instructor by asking questions, or communicating with the instructor regarding course activities. Ref [28] (P. 657), said there is a lack of close interaction between students. But the study did not manage the relationship between students and instructors in online participation. This study attempts to explain the importance of the two forms of interaction. The first interaction allows students to communicate with their instructors through SMS services or course messages in order to obtain timely information from their instructors as well as to help them exchange ideas and share information in the particular subject area. In addition, interactions allow students to discuss their topics through discussion forums or course messages.

Ref [29] indicates that students and instructors can benefit from the additional channel of communication such as SMS in the classroom, which implicitly points out individual learning experiences. The open channel turned out to be especially useful, efficient and preferred method of communication, in comparison to the traditional raising hands method of asking questions. The second interaction allows instructors to solve students' learning problems and respond immediately to their questions. Finally, this study attempts to investigate the effect of S2II when collaborative learning is added as a moderating variable between these interactions and SAP. Ref [13] identified five types of student-instructor interactions that are most predictive of students' sense of community. These interactions include: instructor modeling, support and encouragement, facilitating discussions, multiple communication modes and required participation. All these types of communications are important to students and will reflect on their academic performance. In the Journal of Computer Assisted Learning, Ref [30] found that factors related to instructional interaction had more predictive power on learners' perceived learning achievement than factors related to social interaction. He added that factors related to instructional interaction and presence of in-

structor had more predictive power on learners' perceived satisfaction than factors related to social interaction.

The effect of student-to-content interaction on SAP - The objective of the S2CI is to study the interaction between students and course content found in BLP in order to examine to what extent the S2CI contributes to SAP. S2CI includes recorded videos, audio lectures, PowerPoint slides, written documents and group discussion. Ref [11] (p. 104) stated that S2CI is the method by which students obtain information from the course materials. The content can either be in the form of text, audio or videotape, CD-ROM, computer program, or online communication. Ref [14] stated that S2CI was found to be a significant predictor of student satisfaction and had a larger effect on the achievement of learning outcomes when compared to the effects of S2SI and S2II. The lack and weakness of interaction with course content was a commitment to promoting only one type of interaction. To make S2CI have positive impacts on SAP one need to integrate the three types of interactions in distance education.

Ref [31] carried out a study on the use of modern technology from student to student and across various groups in examining the relationship of BL in SAP. The findings suggested that students in multiple cohorts performed significantly better on multiple-choice questions that were accompanied by online resources. In addition, the use of online resources by students indicated that the high level of students to participate in online resources after the live teaching event. Ref [32] carried out research on the evaluation of BL in higher education at the Arab Open University of Kuwait. Their research indicated that the university is even more inclined towards TL than the e-learning education system. The author suggested that increasing e-content in college can help to have a balance between TL and BL in college. This study attempts to investigate the effect of student interaction with BL content compared to TL environments and how this interaction affects their academic performance (AP). Ref [23] stated that online examinations and electronic testing of LMS had a significant effect on SAP. This study uses both resources and online tutorials on LMS and traditional resource activities. These activities help students review and review the course content. Therefore, content availability will improve student interaction and will be reflected in your AP. This study concluded that student interaction with content will provide instructors with the ability to document students' performance levels on subjects. It also allows the instructor to review and update the topic on time.

Ref [33] conducted its study on the impact of multiple e-learning resources on SAP. Their findings showed that student interaction with the use of electronic resources and tools provided by instructors have a positive correlation with student ratings. In addition, they added that using the task management system and LMS, they contain resources and activities that encourage students to devote their time to tasks. It also solves problems of interaction with course content and interaction with each other. These systems have the most significant positive effects on grade performance. This study seeks to find the correlation between student interaction with content and SAP. Ref [28] stated that greater activities on the use of BLS will result in a better AP in terms of module degree. This means that students who completed all of their online activities using BLS will get high marks on their final exam. Therefore, this is reflected in your AP. Major BLS activities or assignments make the interaction of the stu-

dent definitely difficult. However, the diversity of online activities will reduce student boredom. Therefore, this study attempts to use LMS activities such as assignments and electronic tests to improve practical aspects. The improvement of practical aspects will result in higher scores in student scores that will be reflected more in their AP.

Ref [34] indicated that interaction with content has statistically significant relationships between the amount of time the learner spent with the content and weekly quiz grades. She added in her conclusion, that the learners who spent more time interacting with course content achieve higher grades than those who spent less time with the content. This study attempts to find the correlation between student - content interaction and SAP.

The effect of student-to-blackboard interaction on SAP - The objective of S2BI is to investigate the interaction between students and blackboard learning platform (BLP) and its significances on SAP. S2BI is intended to enable students to master their interaction with BLP platform in which course content is used. In BL, the interaction concerns the technological media that allows students to interact with course content, instructor and other learners. In TL, students interact with various technologies such as audio, video conferencing, internet and e-mail.

Ref [35] (P. 213) and Ref [9], studied the effect of e-learning tools on SAP. Their findings revealed that the ease of use of learning tools will lead to improvement in academic performance. This study assumed that the interaction of students with ease of use of BLP will increase students' motivation to participate effectively through well-designed courses. Also, the interaction with BLP allows the instructor to design and prepare e-activities in a way that helps the students to understand their subject. Ref [36] stated that there is a lack of coordination of group involvement and the time management in some practical aspects which represent a key factor for student's success. Whenever student's time is saved, student's involvement as teamwork will appear. This means when the rate of student's acquisition of knowledge increased, SAP will improve. This study attempts to study the effect of student's interaction with the BLP and how this interaction affects their academic performance. In addition to that, this study also attempts to find the correlation between S2BI and SAP.

The effect of collaborative learning on SAP - The objective of using collaborative learning as a mediator variable is to find the effect of the predictor variables of interactions on SAP when CL mediates the indirect effects of predictors and SAP.

Ref [37] confirmed that CL is described as working together toward a common goal. This means that students are responsible for each other's learning as well as their own race. Reaching the goal implies that students have helped each other to understand and learn their subject in a collaborative way. Ref [9] indicated that synchronous communications, such as chat and conference require the presence of "physical" or "virtual" participants at the same time. This has the benefit of collaboration in real-time and delays in communication. Asynchronous communications, such as e-mail, blogs, and threads, have the advantage of allowing students to access learning resources at any time. Asynchronous communication mode is useful when learning parties have to communicate and share information between interaction sessions.

Asynchronous is also beneficial when students are geographically dispersed and difficult to assemble at the same time.

2.3 The influence of student characteristics on SAP

The objective of this section is to review the characteristics of students that have a major effect on both TL and BL domains. Ref [18] listed the student characteristics factors in ability, motivation, attitude, and effort.

The effect of student ability on SAP - Refs [15, 18, 38, 39] using the information from variable proxies such as Skill including, Average High School Average, University GPA, Scholastic Aptitude Test (SAT) and Variable test tips. Their results showed that the proxy variables have a positive and significant effect on the test results. Therefore, it is reflected in SAP. The reported results supported by Ref [18], which confirmed that student ability accounts for large amounts of unique variance in college grades due to their relative independence from SAT and GPA scores for the high school. In addition, the results indicate that, after controlling the unobservable characteristics of students, teaching has an important independent effect on learning. Therefore, the student's ability is directly associated with SAP.

The effect of student motivation on SAP - Ref [39] stated that the motivation and attention problems most likely to occur in the larger classes. The attention problem affects student characteristics and leads to the low motivation. Ref [17] explained that absenteeism has proven to be an indicator of the low level of motivation for learning. In addition, a university culture that promotes discipline and integrity, especially among medical and older students, discourages social drug use likely to improve motivation. In addition to that, motivation is important for better academic performance.

The effect of student attitude on SAP - Ref [40] carried out research on students' attitudes in terms of examining the class attendance factor. The result showed that student attitudes toward lectures vary widely, from "never miss" to "are not worth anything", with most of the answers falling somewhere in between. Most students reported that they try to attend conferences, and often do so, occasionally losing them as a result of academic, extracurricular, or personal conflicts. Student responses showed that they are more willing to attend classes when instructors clearly teach with the help of appropriate examples and demonstrations. In addition, their interest in attending classes increases as teachers make an effort to align the content of the conference with the assessment requirements. The Refs [16, 18] emphasized that student performance is associated with the profile of students as their attitude towards the class. The student's attitude was found a critical factor that has a great contribution to SAP. Ref [23] in their results indicated that activities such as online tutorials had a significant effect on SAP, but feelings of isolation in the online environment represent an obstacle affecting the students' attitude to online activities.

2.4 The influence of class characteristics on SAP

According to the literature, researchers of the same domain are emphasizing the effect of the characteristic factors of the class in SAP. Ref [41] states that the characteristic factors of the classes include learning activities, preferences and learning styles, course content and course evaluations. These factors have an impact on SAP measurement. Ref [42] found out that the impact of traditional learning on SAP is influenced by many internal and external variables. These variables have a positive or negative relationship with SAP.

Internal class factors (ICF) - Ref [5] groups the ICF in the student's English proficiency, class schedules, class size, English textbooks, test results of class, learning and style facilities, homework, classroom environment, the complexity of course material, the technology used in class systems and exams. These ICFs are very important to be considered when measuring SAP in mixed and traditional deliveries.

The effect of student learning on SAP - Ref [43] emphasized that teaching has a positive impact on student learning. In addition, an early study led by Ref [38] suggested that compulsory attendance could have a negative effect on student learning. On the other hand, another study conducted by Ref [44] stated that the strongest predictor of student learning was a previous academic success as measured by the current GPA of students. Therefore, all these factors dominate students to attend classrooms and laboratories and are reflected in their academic performance.

The effect of learning environment on SAP - Ref [16] stated that the disagreeable classroom environment makes it uncomfortable and the annoying teacher is associated with SAP. Uncomfortable environment not only impedes academic achievement but also promotes a poorly educated society and therefore leads to many negative social issues. This result was defended by Ref [15], which indicated that students from the SIMAD University (SU) were heavily affected by the SU environment. Also, Ref [17] in their conclusions showed that there is an extensive literature indicating the link between SAP and unfavorable learning environment.

The effect of time and marks allocation on SAP - Ref [16] stated that student performance is associated with the profile of students as the time allocation of studies. Ref [15] confirmed that students at the SIMAD University were greatly affected by the Marks assignment.

External class factors (ECF) – Ref [5] stated that there are ECFs that contribute in affecting SAP which is grouped by S N. K. Mushtaq in extracurricular activities, family problems, work, financial, social problems. Therefore, this study focuses on mainly family, work and health variables.

The effect of family variables on SAP - Ref [45] stated that parental involvement and family education affects student achievement. This finding supported by Ref [16] noted that student performance on the annual examination is associated with family income, education of mothers and fathers. They added that the factor such as mother's education has a positive impact on SAP. Ref [5] confirmed that family variables such as stress, social economic status, qualification, and responsibility are associated with SAP.

The effect of job variables in SAP - Ref [17] indicated that 20% cited part-time work as the reason they lost many classes. Also, they are arguing that part-time and full-time construction is one of the main reasons for the lack of conferences. Therefore, a missed conference can be reflected in SAP.

The effect of health variables on SAP - Ref [45] indicated that student behavioral disorders are a key risk factor for substance use and psychiatric disorders. In addition, Ref [17] confirmed that, the association of socio-demographic student behavior. Therefore, the variables indicated affects the learning outcomes and are reflected in SAP.

3 Discussions

After a critical review of this study, the identified factors that have great influence on SAP have been discussed in term of proposed solutions and challenges.

3.1 Technology use

Refs [6, 31, 46] proposed solutions of the use of technology in term of multimedia by posting an array of multimedia materials to support learners during their studies. This proposed solution has proved that multimedia sources have a major effect on SAP. The challenge of their solution will lead learners to use other digital media for entertaining instead of focusing on their learning materials. Also, Refs [7-9, 23, 47] suggested a solution of the use of technology in term of applications by using a web-based forum, features of LMS and e-learning tools. These proposed solutions have indicated that the use of these applications have major effects on SAP. The challenge encountered by learners in the proposed solutions will provide learners with a feeling of isolation during their interaction on the use of the stated applications. This challenge may lead to ineffective use of the stated technology which will reflect negatively on SAP.

3.2 Interaction process

Refs [7, 28] suggested that interaction through discussion forums and course messages can close the gap of the feeling of isolation during student interaction about the use of application technology. The challenge of this solution is that students lack close interaction with their instructors. References [47, 48] suggest that the instructor can provide a variety of activities within the lessons. This suggestion has its consequence on expectations of student performance. The challenge of this suggestion may result in the lack of feedback from the instructors. Refs [21, 23, 28, 33, 41, 49] proposed the solution to increase the e-content in the university that can help to provide a balance between the interaction of traditional learning and e-learning. They added that the number of activities will lead to a better academic performance in terms of module level. This solution represents the main challenges for students to prepare and control their activities. These challenges reported in a large number of activities will

hinder student interaction, student attendance; will promote boredom and frustration. Ref [17] suggests that the use of resources that are available at LMS encourages students to devote their time to homework. This suggestion will result in a positive effect on the grade performance and will affect the final grade that will be reflected in SAP. The refs [8, 9, 36] suggest that the interaction of students with the ease of use of the Blackboard learning platform (BLP) will increase students' motivation to participate effectively through well-designed courses. The ease of use of BLP will improve SAP. The challenge of this suggestion can lead to a lack of coordination of group participation and lack of time management. Ref [9] confirms that asynchronous communication allows students to access learning resources at any time without location restrictions.

3.3 Student characteristics

Refs [15, 38, 39] suggested that the ability of student to have high university GPA or pass scholastic aptitude test (SAT) and test tips scores have a positive and significant effect on the test results. The result of this suggestion is confirmed by Ref [18] which stated that student ability accounts for large amounts of unique variance in college grades due to their relative independence from SAT and GPA scores for the high school. The challenge of this suggestion will provide students inability to pass their final grades in BL since students experience lack of coordination of group involvement. Moreover, Ref [17] stated that a university culture that promotes discipline and integrity especially among students will likely improve their motivation in the online community. The Low level of motivation from staff members to students will result in a negative effect on SAP. Furthermore, Refs [16, 18] suggested that students attitude towards academic, extracurricular, or personal conflicts will reflect a negative effect on SAP. This challenge will result in students' performance and be reflected in their participation.

3.4 Class characteristics

There are many challenges of class characteristics that influence SAP. These challenges are classified into internal and external challenges that prevent students to enhance their academic performance. The authors of Refs [15-17, 41] classified the internal challenges into unpleasant classroom environment of TL and uncomfortable learning environment of BL, Timetable schedule, and clashes and marks distribution. Other authors of Refs [5, 17, 50] listed the external challenges as family stress, socio-economic status, level of education, parental involvement, missing classes and class absenteeism. All the internal and external challenges reflect negatively on the improvement of students' performance in both TL and BL deliveries.

4 Limitations

The identified factors that influence on SAP have limitations which are classified into technical and pedagogical limitations. All factors and limitations are discussed briefly.

4.1 Technical Limitations of BL and TL Domains

Ref [51] stated that the limitations of the online environment are represented in the communication channels between the learner and the instructor. These channels do not have readily predictable responses because of the variability of the traffic load. In addition, the actual delay of these channels will depend on the configuration of the network, the bandwidth, the routing and the traffic at that moment. On the other hand, Ref [52] explained that, poor internet connection in traditional classrooms that made participants quickly frustrated and stop using online activities. In addition, Refs[53, 54] emphasized that the accessibility limitations of online activities are listed in communication with other online students and the trainers were not standardized resulting in some dissatisfaction as illustrated by students in the sessions. In addition, there is an absence of delay in feedback from remote tutors and citing problems with the use of technology. In addition, Ref [55] stated that there is a lack of communication with remote instructors to solve demanding learning problems. All of these problems are represented by critical technical constraints that influence SAP. Ref [56] summarized the barriers of instructors in using technology into lack of confidence, anxiety regarding the computer, resistance to and negative attitudes towards changes are considered internal barriers. The external barriers are listed as lack of access to the resources, lack of time, lack of instructors' competence and technical problems. There are other barriers to be considered, such as the educational system itself, which often limits innovative strategies regarding ICTs, due to its rigid and uncompromising structure. There is a shortage of physical adequacy for the incorporation of ICTs in the classrooms; there is a lack of software that contemplates the educational curriculum. In addition to obtaining the technology itself, instructors need to be trained to learn how to use all their resources appropriately.

4.2 Pedagogical Limitations of BL and TL Domains

Some pedagogical limitations that are preventing students from improving their academic performance are illustrated by many researchers such as Refs [52, 57-60], these limitations are reported in the student's lack of participation in the online environment, as well as, virtual classrooms. On the other hand, some online environments lack proper integration in a common framework. In addition, some students require more training and background in using the online environment. In addition to that, there is a lack of learning environment when using combined courses that are based on LMS. Finally, the lack of interaction process between the students in discussion and with their fellow students and tutors.

Some researchers, such as Refs [23, 40] listed several limitations of online conferences in (a) decreasing student attendance in terms of face-to-face conferences that reduce student participation and performance. (b) Students will be reluctant to attend as online conferences are available twenty-four hours. Ref. [61] enumerated some limitations of BL in the tentative results of the students. In addition, for some students, it is the first time they experience BL. On the other hand, students were not mentally or cognitively prepared to adapt to the new mode of learning, which affects students' motivation and learning achievements. Ref. [1] established other limitations represented in the deficiencies of traditional and web-based learning. The inefficiency of the processes of student participation and interaction, a limited period of interaction between students and other students and instructors. There are some limitations of TL that affect the learning process. These limitations are represented for the management of online courses, the frustration of the students and the high drop-out rates of some experience. In addition, the limitations of TL, such as class time, the theme of the conference, the commitment of the staff and the interesting session, represent the main challenges of the learning process.

5 Conclusion

This work has shown the most important factors influencing SAP in two different domains of BL and TL. These factors are classified into four main categories. The first category represents the use of technologies in BL and TL that include multimedia and applications technologies. The second category is interaction processes that include student interaction, instructor interaction, content interaction, blackboard interaction and collaborative learning. The third category is student characteristics that include ability, motivation, and attitude.

The final category is class characteristics that consist of internal and external class factors. Internal class factors are represented in student learning, learning environment, time allocation, and markings. External class factors are represented by family variables, labor variables, and health variables. The technical limitations are represented into three challenges: the challenge of communication channels and poor internet connection. Future studies require enhancing infrastructure environment, the challenge of accessibility of online activities, to solve this challenge the authors suggest the diversity of online activities by giving learners one activity per week and the challenge of delays in feedback from remote instructors can be resolved by two forms of interaction between learner and instructor. The pedagogical limitations are represented into two challenges: challenges in day class time, conference theme, staff engagement level and interesting session, the challenge of proper integration in a common framework and standard integration framework requires integrating all online environments.

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A Systematic Review of Second Language Learning with Mobile Technologies

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Abstract—This study provides a systematic literature review of the research done in mobile assisted second language learning (MASLL) published since 2010. Starting from 1424 sources, 54 articles were selected using predefined selection criteria. The documents were analyzed and coded using the categories: educational form and level, study design, location, context, role of technology, pedagogical practice and learning impact. That information allowed an identification of major educational outcomes related to the integration of mobile devices into second language learning. In addition, the study contributes with a set of identified research gaps and recommendations for future research.

Keywords—second language learning; mobile learning; mobile technologies; MASLL

1 Introduction

Mobile technologies have been incorporated in almost every aspect of our daily live offering mobility, portability, and usability. Users began to prefer smaller mobile devices with touch screen interfaces over traditional PC, having implications for many sectors of the society [1]. Mobile devices nowadays can be considered as all-purpose computing devices that can help to perform everyday tasks providing services in different fields such as banking, e-commerce, and education [2]. The use of mobile devices has not been limited by age, and therefore the number of young users have also increased. Thus, mobile devices have a significant role in daily life, yet both as a distraction and as an educational tool [3][4].

In the educational field, the use of mobile technologies has become a hot trend as tablets and smartphones can offer several learning opportunities [3][5]. Compared with Pcs and laptops, mobile devices such as smartphones and tablet PCs have several advantages. They are lighter, smaller and it is easy to interact with them on the move [6]. The touch screen also permits the student to interact directly with the interface thus creating new pedagogical approaches that allow the teacher to act as a facilitator and enhances student participation [7].

Several investigations have tried to identify the advantages that the use of mobile technologies brings to education, such as increased opportunities for communication, collaborative interaction, independent learning, and production of digital material

[7][8]. Other studies have tried to identify the impact of mobile technologies on the acquisition of a second language. According to [9], mobile devices offers attractive alternatives to learning by the use of different kind of applications, for instance, game-based learning applications. Learners can use different applications in informal contexts that can help to increase vocabulary, improve reading and listening comprehension, as well as helping with translations, spelling and grammar revisions.

It is against such a background mobile-assisted language learning (MALL) has become a relevant area within the field of mobile learning [10] [11]. However, there is an absence of systematic reviews that shed light on studies investigating the use of mobile technology for learning a second language. Therefore, the aim of this paper is to report on a systematic review of different projects that investigate mobile technologies as a tool to support the learning of a second language, examining the various trends of the research done during the last years.

1.1 Research questions

The present review is based on the following general research question with associated sub-questions: Which are the major trends in studies about the use of mobile technologies as a tool for second language learning (SLL)?

- Which are the major methodologies and learning outcomes identified?
- What role do mobile technologies play in research on second language learning?
- What kind of pedagogical second-language learning practices are supported with mobile technologies?
- In what context are mobile technologies utilized for second-language learning?
- Which are the major similarities and contradictions of conducted studies?
- Which are the gaps not addressed in these studies?

2 Background

2.1 Mobile technologies

Mobile technologies have been incorporated in almost every aspect of our daily live offering mobility, portability and lower prices than PCs. The first commercial device available in the market was the Apple Newton message pad in 1993 followed by the Palm Pilot in 1996 The Palm Pilot offered the users several advantages compared with the Newton, such as word processing, database, and spreadsheet programs, gaining popularity among business professionals and educators. However, it was until the release the iPhone in 2007 when the popularity of mobile devices increased not only among adults but also between a younger population.

Apple continued releasing mobile devices such as the iPod touch, the first non-phone PDA in 2007, which marked the beginning of the handheld devices in the education market. It is until 2010 that the first iPad is launched in the marked. The iPad

included the functionality for video and audio recorder of the iPod but adding the eBook reader functionality. The evolution of mobile devices is summarized in Table1.

Table 1. Mobile devices timeline [12]

Year	Device
1993	Newton Message Pad – First PDA on the market
1996	Palm Computing - First commercially successful PDA
2001	Microsoft tablet PC - First tablet on the market
2001	Apple iPod - First commercially successful MP3player
2007	Apple iPhone - First smartphone from Apple – iOS released
2007	Apple iPod touch - First non-phone PDA from Apple
2007	Amazon Kindle - First commercially successful eBook reader
2008	Google Android OS - First serious competitor to Apple iOS
2010	Apple iPad – First commercially successful tablet computer
2012	Apple iPad Mini – First small tablet computer from Apple

[13] pointed out that the technological advances have allowed mobile technologies to perform sophisticated operations, while manufacturers are constantly developing new devices that can handle new technical demands. Therefore, mobile technologies, particularly tablets and smartphones, have become powerful enough to compete and override PCs and laptops, offering portability and a lower cost. Mobile devices nowadays can be considered all-purpose computing devices with internet connectivity that allows performing different tasks such as mobile banking, e-shopping, web surfing, and mobile learning.

A mobile device can be defined as a small handheld computer with a touch display or small keyboard. As [6] explains, the key features of mobile devices are the versatility and mobility, as they can be used in different situations and settings, being easily carried around, supporting activities such as exploring outdoors. The adoption of mobile technologies is mainly influenced by three main factors: the age of the potential adopter, the technology self-efficacy, and the cultural origin, as this last one can define the role of usage [14]. Another relevant characteristic is the usability, that refers to the ease of use of mobiles technologies.

[15] estimated that by the end of 2016 82% of the mobile phones used worldwide would be smartphones, which represents 12% more than during 2015. The change is particularly in emerging markets such as China or India. In those countries, people is changing from mobile phones to basic smartphones that can fulfill their needs at a lower cost (Atwal, 2017).

[16] identified five different kinds of mobile devices:

iPod – A portable media player that allow users to download various types of material such as podcast, audio,e and video, also enabling file sharing between users. However, it does not provide interactivity. The screen size is also a negative aspect as it can difficult to read big amounts of data [16] .

Personal Digital Assistant (PDA) - It combines the internet connectivity with the capabilities of a computer, having a significant processor power, and internet connec-

tivity that allows web access [16]. The PDA could include word processing tools, dictionaries and allows the user to play both audio and video, supporting interactive group learning. Its main advantage is the possibility to introduce text via a screen keyboard having as a disadvantage the small screen and limited storage capacities [16].

Smartphone – This mobile device can be considered a hybrid device that combines the characteristics of a PDA with the abilities provided by a cell phone. It supports internet access at the time that integrates several features such as telephone, camera, and mp3 player. The smartphones allow storing data, supporting interactive learning and global collaboration. The main advantage of this device is its portability. However, the small screen can difficult to read a large amount of text. Another disadvantage is the price of advanced equipment [16].

Tablet PC – [16] consider that this device is the most functional of all mobile technologies. It integrates the features of a PC and network support, allowing functions like web surfing, word processing, and VoIP connections. Tablet PCs offer learning advantages such as multi-functionality and mobility, motivating independent learning and developing creativity [1].

Others - such as mp3 player, pen drive, and handphone. These devices have a principal advantage that they are light and compact, having a long battery life. However, they do not allow any interactivity options [16].

2.2 Mobile learning

The concept of mobile learning, or m-learning, has been tried to be defined by several authors. Some authors consider m-learning as a form of e-learning that is supported by the use of mobile devices such as tablets and smartphones [17]. Others regards research into mobile learning as '*the study of how the mobility of learners, augmented by personal and public technology, can contribute to the process of gaining knowledge, skills and experience*' [18]. From the perspective of [19] and [20] m-learning has five principal characteristics:

1. portability: it allows to transfer the learning to any possible environment, facilitating the access to information and motivating the student to investigate and learn from experience
2. accessibility: information can be access anywhere and anytime
3. personalized: it can be adapted and customized to different learning needs and styles
4. social connectivity that increases communication and collaboration between several learners
5. increases learning motivation both in the formal and informal context

Mobile learning differs from traditional education not only because of the integration of mobile technologies. Mobile enhanced learning can work in both formal and informal environments, as well as promote both individualized and collaborative network learning. Therefore, it is possible to transform the traditional teacher-centered instruction into one focused on the learner [20]. The use of mobile technolo-

gies also promotes an informal learning process outside the classroom environment, allowing to learn without teacher support.

M-learning is a broad area that is still being explored. Hence, it is possible to research the impact of mobile learning in different areas.

2.3 Research on the use of technology to support second language learning

Use of computers for second language learning. Computer-assisted language learning (CALL) have been available for second language learners since the second half of the 21 century. The evolution of CALL is divided, according to [21], in three different stages known as behavioristic phase, communicative phase, and integrative stage.

In the behavioristic phase, CALL focused on repetitive material that was attentive to vocabulary, grammar and translation tests [21]. During this phase, CALL offered students of a second language the advantage of having material prepared on an individualized basis, which was available whenever it was needed and which allowing repetition. During the 70's and 80's, CALL evolved into its communicative phase. During this phase, the computer is seen as a tutor that allows learners the possibility to practice their second language skills through the use of language programs and games. CALL focused on training language proficiency such as conversation, written task, and critical thinking [21].

CALL current state is known as the integrative phase. It is based on the use of multimedia and internet for digitally supporting learning, shifting from a teacher-centered to a learner-center classroom. This learning environment can integrate different activities that support the development of language skills, increasing the motivation of the learner and decreasing the learning stress and anxiety. The access to many resources also proportionates a high degree of control over the learning process, improving the quality of education [21] [22].

Mobile assisted second language learning. Mobile assisted language learning can be seen as a subset of both m-learning and CALL [23], becoming a relevant research area as support to second language learning. Mobile-assisted second language learning (MASLL) offers the learners the advantages of mobile technology such as flexibility, small size, user friendliness, and a wide offer set of mobile applications [10] [23]. MASLL also provides learning opportunities that are not available in CALL, such as language learning through real life situations, mobility, learning over time and self-regulated learning. Other advantages are increased motivation, autonomy, and social interaction as well as decreased time for formal learning [23].

[24] pointed out that MASLL allows students to interact with different language learning software as well as with real persons such as peers and teachers. The increased collaboration allows the learners to get feedback from peers and learn to critically analyze their current skills and progress. The use of m-technology and access to apps can also contribute to the development of creative and interactive learning material that is designed for learners based on their needs. As a result, the learner will be empowered to control his/her own learning process [25]. Research has shown that

mobile technologies facilitate the acquisition of L2 skills and linguistic knowledge, with a particular focus on vocabulary acquisition, listening comprehension, grammatical accuracy and speaking proficiency [10] [25].

3 Method

3.1 Data collection

Databases searched. The electronic databases and journals selected for this review are: ACM (Association for Computing Machinery), IEEE (Institute of Electrical and Electronics Engineers), ERIC (Education Resources Information Center), JSTOR, ScienceDirect, SAGE Journal Online, Inderscience Online and Wiley online library.

Searched terms. The search terms used for this paper can be divided into two groups. The first group includes terms that relate to mobile technologies or mobile learning. The search words in this set include "mobile technologies", "mobile learning", "mobile assisted learning", "m-learning", "mobile assisted language learning", "MALL", "mobile devices". The second group clusters terms related to second language learning: "second language", "second language acquisition", "second language learning". The search was performed by using the next query:

("mobile learning" OR "m-learning" OR "mobile assisted" OR "mobile assisted language learning" OR "MALL" OR "mobile technologies" OR "mobile devices") AND ("second language" OR "second language learning" OR "second language acquisition")

The previous query would allow the database to look for any kind of combination between any term of group one and any search phrase of the second set, such as "mobile learning AND second language acquisition" or "mobile devices AND second language".

Selection of articles for inclusion in the review. To be considered appropriate for this review, the research articles have to fulfill the following inclusion criteria:

- The article must be an empirical study.
- The investigation has explicitly address second language learning or second language acquisition, as well as the use of mobile technologies here defined as smartphones and tablets.
- The article has to be published in journals or conference proceedings published between 2010 and 2017. The time frame was defined considering the introduction of the iPad in the market during 2010 as the first commercial tablet computer, which is a central mobile technology to be considered in this review.
- The articles must be written in English.
- The articles must have an abstract. The abstract will be used to select relevant papers during the systematic review process.

The review focus only on mobile technologies, therefore, any article that addresses the use of laptops or computer-assisted language learning (CALL) will be excluded as they are not considered a mobile device.

Papers identified and selected. The total number of research articles that were identified were 1424. The number reduced considerably after applying the inclusion and exclusion criteria to 52 selected articles. Table 2 presents the number of articles per database after applying the inclusion and exclusion criteria. Most of the articles were found in the database ERIC (48.1%) followed by ScienceDirect (17,3%) and JSTOR (15.4%).

Table 2. Total number of articles identified in databases before and after applying inclusion and exclusion criteria

Database	Frequency	
	Initial Search	***After inclusion and exclusion criteria***
ACM	13	3
IEEE	21	5
ERIC	311	25
JSTOR	48	8
ScienceDirect	50	9
SAGE Journal Online	225	0
Wiley Online Library	732	0
Inderscience	24	2
Total	1 424	52

SAGE Journal Online, the International Review and Wiley Online presented a high number of incidences after the first initial search. The exclusion criteria eliminated from the selection most of the documents as they were related to CALL. Other articles did not fulfill the selection criteria as they considered laptops as mobile devices or focused on the use of mp3 players.

3.2 Data analysis

Coding. The papers that fulfill the inclusion criteria will be coded as following:

- *Education form and level*: primary school, secondary school, informal learning. The aim of those codes is to have an overview of the educational level and form (formal and informal) that have been subject of research. It also helps to determine potential research areas and research gaps.
- *Research design*: how was the research questions studied. The codes allow determining the main research methodologies used within the studies.
- *Location*: which country the study was conducted. The location of the studies gives an overview of the countries that have been more active in mobile second language learning. It also helps to determine if the particularities of the country influence the outcomes of the investigations performed.
- *Context*: Classroom, Indoors (non-classroom), Outdoors, Across indoors and outdoors. The codes explain in which context technology is mainly used and how it is used.

- *Role of technology*: utilized functionality and affordance. The codes help to detect how and what technology (hardware and software) is used for second language learning purpose. At the same time, they contribute to detecting which technologies are more accessible to students.
- *Pedagogical practice*: how was language learning pedagogically enacted. The codes help to identify pedagogical scenarios/activities in which mobile technologies are used for supporting second language learning.
- *Learning outcomes*. The category provides an overview of the impact of the use of mobile devices in the process of second language learning.

To assess inter-rater reliability with respect to the coding of the papers, a subsample of 27 of the 54 papers (50%) was coded independently by one of the coders. The inter-rater reliability (r) was .93, showing good agreement between the two coders.

4 Results

4.1 Education form and level

Table 3 indicates the educational form and the educational level reported on in the selected research articles. Formal education is the most researched educational form, being studied in 41 (78,8%) papers, indicating the incorporation of mobile learning practices into the L2 curricula. Informal education is addressed only in 8 (15,4%) research articles. The last three documents (5.8%) have a blended focus on both formal and informal learning as the purpose of two of them was to explore the attitudes of students and/or teachers towards MASLL in general terms whereas the last document explored the use of both formal and informal MASLL between fifth graders.

Table 3. Education form by educational level studied in the selected articles

	Education form			**Total**
Education Level	***Formal***	***Informal***	***Blended***	
Kindergarten/Preschool	1			1
Primary School	11	2	1	14
Secondary School	6			6
Higher Education	20	3	2	25
Blended (2 education levels)	1	2		3
Non specified	2	1		3
Total	41	8	3	52

The data indicates that a large portion of the studies, 20 papers (38%), have focused mainly on L2 learners within formal higher education. The second most addressed educational level is primary school (14 studies, 27% of the total selected papers), particularly in a formal context (22%). Other educational levels identified were kindergarten/preschool (2%), secondary school (12%) or mixed groups (6%)

formed by primary and secondary school L2 learners or secondary school and higher education students. The last group is based on three research articles which participants were L2 students in language schools with an age range from 16 years old and up.

4.2 Employed study design

Table 4 shows the different research methodologies used in MASLL projects. The most popular design was quasi-experiments (39% of the papers). The approach is characterized by the utilization of a pre-test and a post-test for measuring the L2 proficiency of the participants, who were part of non-randomized control and experimental groups. Survey was identified as the second most used research design, used in 21% of the documents, followed by the mixed methods approach (15%) case studies (8%) and experimental design (8%). A minority of papers reported Design-Based Research (2%) and pure qualitative methodologies (4%).

Table 4. Research design used

Research Design	Frequency	%
Quasi-experimental	20	38,5%
Survey	11	21,2%
Mixed Methods	8	15,4%
Case study	4	7,7%
Experimental	4	7,7%
Correlational	2	3,8%
Qualitative	2	3,8%
Design Based Research	1	1,9%
Total	52	100,0%

4.3 Location

presents an overview of the countries where MASLL research is taking place. The data shows that Asia is the most active region representing the 65% of the papers included in this study. Taiwan has shown itself as an active country with a clear interest in MASLL research, producing 14 studies (27%), followed by Saudi Arabia, Malaysia, and Singapore with three papers each (6%).

The table also indicates that Europe's involvement in MASLL research is represented by 27% of papers. The UK has taken the leadership of the region by producing four research projects (one of them in collaboration with Italy and Norway), followed by Netherlands and Turkey with two documents each. America was the less active geographic area with only four research projects, representing 8% of the conducted studies.

Table 5. Countries where the selected studies have been performed

Asia		**Europe**		**America**	
Country	***Frequency***	***Country***	***Frequency***	***Country***	***Frequency***
Taiwan	14	UK	3	USA	2
Saudi Arabia	3	Netherlands	2	Brazil	1
Malaysia	3	Turkey	2	Canada	1
Singapore	3	Belgium	1		
China	2	China/Sweden	1		
India	2	Germany	1		
Iran	2	Hungary	1		
Kuwait	2	Russia	1		
Japan	1	Spain	1		
Kazakhstan	1	Italy / Norway /UK	1		
Thailand	1				
Total	34		14		4

4.4 MASLL context

Data in Table 6 shows that mobile devices for second language learning are mainly used indoors (70%) in three different contexts: classroom (25%), non-classroom (17%), and across both of them (27%). The use of MASLL across indoors and outdoors represents 27% of the conducted studies. These studies are characterized for mixing both learning activities indoors with task-based activities in a real world context, supporting the idea of situated and ubiquitous learning. However, the use of MASLL only in outdoors contexts has not been explored extensively as it only represents the 4% of the total.

Table 6. Context of learning activities

Context	**Frequency**	**%**
Classroom	13	25,0%
Indoors (non classroom)	9	17,3%
Indoors (classroom and non classroom)	14	26,9%
Total Indoors	36	69,2%
Outdoors	2	3,8%
Across indoors and outdoors	14	26,9%
Total	52	100,0%

4.5 Role of Technology

Mobile devices and MASLL. Mobile phones are the most popular devices used for MASLL purposes (67%). The most representative mobile phone is the smartphone (44%), while PDAs are represented by only 4%. Few studies used tablets (14%).

However, there is a higher incidence of studies that used both mobile phones and tablets for MASLL purposes (19%).

Regarding the utilization of a particular operating system, Android showed the higher representation with 19%, followed by iOS (10%) and Windows Mobile (4%). Three studies that used more than one type of mobile device indicated the use of both Android and iOS (6%). There is, however, a high occurrence of research papers that did not specify the type of operating system used during the research (62%).

Table 7. Devices identified in the selected articles by operating system

	Operating System					**Total by type of device**
Device	***Android***	***iOS***	***Android/iOs***	***Windows***	***Not Specified***	
Mobile phone						
Smartphone	9	2		1	11	23
PDA phone				1	1	2
Non specified					10	10
Subtotal mobile phones	*9*	*2*	*0*	*2*	*22*	*35*
Tablet PC		3			4	7
Blended						
Smartphone/Tablet PC	1	1	2		6	10
Total by OS	10	6	2	2	32	52

Software and mobile applications used for MASLL purposes. Mobile applications employed in the researched documents were grouped into four categories: educational applications, mobile messenger/SMS applications, audio/video applications, and web browsers. 75% of the reviewed documents included only applications in one category while the remaining 25% used more than one category during their research (detailed information in Table 8). Educational applications presented the highest incidence with 22 papers (43%), 17 of them specifically developed for the research (33%). The rest of the applications identified were not developed specifically for learning purposes but were used to support MASLL. Mobile Messengers/SMS applications represented 12% of the sample, while audio/video player apps and web browser were 6% each. 10% of the papers did not specify the mobile applications used for MASLL.

Table 9 shows in detail the mobile applications used in the 13 studies that have been coded in more than one category. 46% of the studies included the use of web browsers as part of the learning practices, followed by the use of educational applications (39%). The next most used applications are Mobile messengers/SMS (31%), Audio/Video recorders (31%), Audio/Video players (23%) and Online storage/Collaboration platforms (23%). Some research papers also included Blogs apps (15%), QR scanner apps (15%), free multimedia apps (8%), E-book readers (8%), Facebook app (8%), E-mail apps (8%), and text to speech apps (8%).

Table 8. Mobile applications used

Software type	Frequency	%
Educational applications		
Developed for the study	17	32,7%
Others	5	9,6%
Total Educational applications	22	42,3%
Mobile Msg /SMS	6	11,5%
Audio/Video player	3	5,8%
Web browser	3	5,8%
Non specified	5	9,6%
Subtotal studies using a single type of application	39	75,0%
Studies using more than one type of application	13	25,0%
Total	52	100,0%

Table 9. Studies using more than one type of application

Software type	Frequency	%
Educational applications		
Developed for the study	4	30,8%
Others	1	7,7%
Total educational applications	5	38,5%
Web browser	6	46,2%
Mobile Msg /SMS	4	30,8%
Audio/Video recorder	4	30,8%
Audio/Video player	3	23,1%
Online storage / Collaboration platform	3	23,1%
Blog app	2	15,4%
QR Scanner app	2	15,4%
Free multimedia apps	1	7,7%
E-book reader	1	7,7%
Facebook	1	7,7%
Email	1	7,7%
Text to Speech	1	7,7%
Non specified free apps	1	7,7%

Hardware used for MASLL purposes. The data in Table 10 shows how the different mobile device's hardware is mainly used for MASLL. The increased use of Internet as a support for learning activities is demonstrated by the importance of the use of devices that can offer Wi-Fi and/or mobile internet capabilities (60%) helping the students to access learning material anytime anywhere. Using the wi-fi allows the learner to access learning material and other online resources such as dictionaries on ubiquitous basis [26]. It is also used to support online communication [27], as well as to share self-created material [28].

Built-in microphone (27%), built-in camera (25%) and the built-in speakers (23%) represent the next more used components, as they allow L2 learners to create their own learning material and perform task-based activities to develop different L2 skills.

The built-in microphone supports all kind of task that involve the oral skill. It is used to record text or dialogues that will be sent after to the teacher or other students as part of a particular task [28]. Furthermore, by utilizing speech recognition software students are, for instance, supported to improve their pronunciation [29]. The microphone is also used as a tool to communicate with other peers and teachers [30], as well as for the creation of multimedia material [31].

The built-in camera allows the L2 learners to take photos of relevant material such as vocabulary lists [31]. The camera can also be used to create flashcards [32], and scan QR codes as part of learning tasks [33]. Other hardware components presented were GPS (8%), SD memory cards for storing multimedia material (4%), and other components (6%) such as the use of projectors. However, 14% of the papers did not specify the hardware used for MASLL purposes.

Table 10. Hardware used

Hardware type	Frequency	%
Wi-Fi/Mobile internet	31	59,6%
Built-in microphone	14	26,9%
Built-in camera	13	25,0%
Built-in speakers	12	23,1%
Non specified	7	13,5%
GPS	4	7,7%
Others	3	5,8%
SD memory card	2	3,8%

4.6 Pedagogical practice

Pedagogical practices found in the selected articles focus on improving L2 proficiency and were clustered into four subcategories: general practices to improve L2 proficiency, vocabulary learning, speaking/listening skills and reading/writing skills.

Table 11 presents in detail the frequency of documents discussing the different subcategories. The table shows that the number of articles addressing practices in only one subcategory represented 46% of the total sample while the studies that addressed two or more subcategories represented 42%.

Vocabulary learning is the most relevant subcategory as 54% of the analyzed documents includes it. It is discussed as a single subcategory in 12 documents (23%) and described together with at others in 16 (31%). It is also the main informal learning practice as 7 out of 8 informal learning practices involve vocabulary learning. Taking pictures for associating words with images/real objects [33], getting vocabulary list via SMS [34], creating own definitions of new words or situational vocabulary learning [35] are examples of the practices described in the reviewed research papers.

Table 11. Pedagogical practices for improving L2 proficiency

	Educational Form							
	Formal		**Informal**		**Blended**		**Total**	
	Frequency	***%***	***Frequency***	***%***	***Frequency***	***%***	***Frequency***	***%***
General L2 proficiency (GP)	10	19,2%					10	19,2%
Vocabulary learning (VL)	7	13,5%	4	7,7%	1	1,9%	12	23,1%
Speaking /Listening skills (S/L)	2	3,8%					2	3,8%
Reading/Writing skills (R/W)								
More than one learning skill								
GP + VL	5	9,6%	2	3,8%			7	13,5%
GP + S/L	3	5,8%	1	1,9%			4	7,7%
GE + R/W	2	3,8%					2	3,8%
GP + VL +S/L	1	1,9%					1	1,9%
GP + VL + R/W	1	1,9%					1	1,9%
VL + S/L	3	5,8%	1	1,9%			4	7,7%
VL + R/W	3	5,8%					3	5,8%
Total	37	71,2%	8	15,4%	1	1,9%	46	88,5%

MASLL practices focused on improving general skills are the second in frequency, as they are described in 25 documents (48%). Task-based language learning to improve particular skills [26], repetition by using mobile learning applications anytime anywhere [36] and the creation of personalized learning material by using video recording, images and photos [32] are examples of practices in this subcategory.

The proportion of documents describing practices to improve the Speaking/Listening and Reading/Writing skills is low compared with the ones focusing on vocabulary learning or improving general skills. Activities focused on improving the speaking/listening proficiency are mentioned in a total of 9 documents (2 single studies and seven mixed) representing 17% of the total. Some examples of practices included in this cluster are the use of podcast [37] and videos with captions for improving listening comprehension, recordings of oral presentations to improve oral skills, and the use of task-based activities to practice L2 with native speakers in real situations [27].

Improving the reading/writing proficiency is the less addressed subcategory. There are no papers that focus only on the development of those skills, being always described together with at least one of the other three subcategories. Writing in blogs [32], using online dictionaries for improving the writing skill [11], and reading personalized material [38] are described as some of the activities to improve reading and writing proficiency in L2.

4.7 Learning Impact

The codes concerning the learning impact found in the different reviewed articles were grouped into three different categories: knowledge acquisition and understanding, affective and/or motivational impact, and impact on the social skills. Table 12 shows the categories mentioned above by the type of research design. The 46 % of the documents presented learning outcomes of only one category while 54% was formed by studies that reported a learning impact in two or more categories.

Table 12. Type of learning impact by research design

	Research Design									**Total**
	Quasi Exp.	***Survey***	***Mixed Methods***	***Case Study***	***Exp.***	***Correl.***	***DBR***	***Qual.***	***Frequency***	***%***
Knowledge acquisition and understanding (KA)	8	3	1		4				16	30,8%
Affective and/or motivational impact (AM)		4	1	2		1			8	15,4%
Social Skills (SS)			1	1				1	3	5,8%
More than one LI										
KA + AM	6	3				1			10	19,2%
KA + SS	4		3	1			1	1	10	19,2%
KA + AM + SS	2		1						3	5,8%
AM + SS		1	1						2	3,8%
Total	20	11	8	4	4	2	1	2	52	100,0%

Knowledge acquisition and understanding outcomes presented the highest proportion compared with the other groups as they were reported in 39 papers (75%). In those cases, the papers also presented outcomes in other categories such as motivational impact. The learning impact in this category describes how the use of different mobile assisted practices supports L2 learning by increasing the language proficiency both in general aspects as in particular skills. Examples of this outcomes include:

- The interaction with the real world enhances the language skills and increase the learning performance [27].
- The use of mobile applications helps L2 learners to remember new vocabulary for a longer time compared with traditional learning practices [39].
- The association of words with images and/or real objects helps the L2 learner to understand the meaning of the word, increasing they vocabulary [40].
- The use of podcasts increases the listening proficiency of L2 students [37].
- These of MASLL in a real world context helps to improve the oral performance of L2 learners, particularly when practicing with native speakers [41].
- L2 learners benefit from adaptive reading material by improving the reading effectiveness and comprehension, reducing the cognitive load and improving the student satisfaction [38].

The group formed by affective and/or motivational outcomes is the second most representative with a proportion of 42% of the total sample. The use of mobile applications helps to increase the student motivation to learn [42] which also have a direct impact on language proficiency. The use of MASLL also helps to reduce learners' anxiety [37] and decrease cognitive load.

The outcomes related to social skills are found in the 35% of the coded papers. The learning outcomes identified in the coded papers focus on describing how the use of MASLL influences the students' collaboration. Some findings support that the use of mobile messenger applications, blogs and social networks by L2 students supports the development of collaborative skills [43]. Another impact is collaborative peer coaching as a form to reduce the gaps between L2 learners with high and low proficiency [44].

5 Discussion

As it was stated at the beginning of the document, the aim of this research was to investigate the use of mobile technologies to support L2 learning by examining the current research trends. By using the research terms, we identified 1424 papers that were related to MALL and SLL. This number was reduced to 52 documents after applying the inclusion and exclusion criteria as it was important to identify only the papers that addressed the specific use of MASLL since 2010. For assuring the quality of the papers, only published studies, in term of journals and conference papers, were considered.

5.1 Major trends in studies about the use of mobile technologies as a tool for second language learning.

During the review, it was possible to see that most of the selected papers focused on the use of MASLL learning within formal education. Mobile devices have been included as a part of language courses curricula, using them as support in the classroom. In other cases, the students are encouraged to use mobile devices for performing activities after class to repeat the material seen during class. Current studies have prioritized to explore the effects of MASLL within students in higher education, followed in minor proportion by primary school learners, representing in total 75% of all the coded papers, being secondary school students.

Regarding the countries where MASLL is seen as an active research topic, is possible to see that most of the research is done in Asia. 46% of the studies has taken place in Easter Asian countries, showing the importance of technology adoption for learning purposes in the region. The research has focused mainly on the use of MASLL for supporting the learning of English and Chinese as second and/or foreign language. The other regions that have performed research on this topic have not present the same activity.

5.2 Major methodologies and outcomes identified

The reviews papers indicated that the most popular methodology in research projects on MASLL is the quasi-experimental design, representing 40% of all coded papers. The main characteristic of the coded documents that used this methodology is the lack of randomization in the control and experimental groups, and the use of pre-test and post-test that allows measuring if the utilization of a mobile learning had an impact on the language skills of the L2 learners that participated in the students. Therefore, the outcomes related to this approach are all related to knowledge acquisition and understanding.

Survey and mixed methods are the two following major methodologies. Surveys characterized for exploring the attitudes, opinions, and perceptions of L2 learners regarding their experience with MALL. On the other hand, the use of mixed methods methodology allowed the researchers to use both quantitative and qualitative data collection methods. Consequently, it was possible to measure both the effects of the use of MASLL as well as the attitudes of the L2 students that participated in the research. The research designs discussed above represents 75% of all the coded documents.

Concerning the learning impact of MASLL, the outcomes identified were mainly related the effects of mobile learning on the students' proficiency in the target language. A large number of the coded papers indicated that the L2 learners that were involved in MASLL activities improved their language proficiency compared with the students using traditional practices. Most of them referred to a general proficiency, followed by increased vocabulary learning. The remaining documents focused on the development of the reading, oral and listening skills.

The second group of outcomes focused on the impact of attitudes and/or motivation of the L2 students and in some cases on the teachers. In this regards, [27] pointed out that higher motivation has a positive influence particularly in students with medium/low language proficiency. Other findings in this category showed that the flexibility to access learning materials in different context transforms the L2 students from passive to active.

Finally, the outcomes related to social skills indicated that the use of mobile devices in teams, particularly when two or more users share one device, increased the social interaction between learners. Increasing communication between L2 learners gives the possibility to discuss learning material, and creates a collaborative environment that support development of collaborative skills. In cases when the collaboration takes place between students with different language proficiency, the main impact is the use of a collaborative coaching where students with high L2 proficiency helped medium and low proficiency students to learn. This activity contributes to reduce the gap between high and low achievers.

5.3 Role of mobile technologies on second language learning

This review showed that language learning is supported by mobile devices as well as different mobile applications. It is a common practice to use educational applica-

tions, particularly to support vocabulary learning. There are several free applications in the market that can support MASLL activities. However, many non-educational applications and software such as audio/video players is used to support MASLL. In this regards, the built-in components (camera, microphone, and speakers) are relevant tools to create different kind of multimedia material, as well as support communication via messenger applications.

Pedagogical practices supported by mobile technologies. The coded papers showed that MASLL pedagogical practices focus on the improvement of the L2 proficiency, with a particular focus on vocabulary learning. L2 learners can improve their vocabulary by the use of different educational applications such as context-aware games that allow play and learn in a real environment. Another common practice for vocabulary learning is the association of words with images and/or real objects both in a classroom or in the real world.

MASLL also supports ubiquitous learning. Students can access learning material outside the classroom being able to learn in different context, for example during transport time. Another practice is the use of task-based activities supported by mobile devices. L2 instructors can design different task for improving a specific skill, such as the use of podcast for improving the listening comprehension or using social networks for practicing the writing skill. The activities can also include interactions with the real world, such as interacting with native speakers to improve the oral skills. The creation of personalized material is another pedagogical practice that can help the L2 student to increase proficiency in the target language. The student can create material that fits their learning style and needs by using mobile devices. At the same time, it is possible to share this material with other students by using mobile applications, blogs, and social networks, increasing the collaboration between peers and teachers.

5.4 Context where mobile technologies are utilized for second-language learning

All the technological resources that have been discussed previously has developed a variety of pedagogical practices supported by mobile technology that are mainly taking place indoors, both in a classroom and a non-classroom context. The use of mobile devices has also allowed extending the SLL task outdoors, generating a blended environment that supports situated and ubiquitous second language learning. There is, however, a lack of studies that focus only on MASLL outdoors, as most of the practices in an outdoors context observed also include tasks indoors.

5.5 Major similarities and contradictions of these studies

Even if each project studied MASLL from a different perspective, all of them agree on the positive impact of mobile devices for enhancing the L2 learning process. The result can be seen as an improvement in the proficiency of the target language, in the learning motivation, or in both of them. There was no research finding showing a negative impact on performance as a result of using mobile devices. At the same time, all studies that presented results related to collaborative practices agreed that working

in groups is beneficial for L2 learners, creating a motivating and enjoyable environment. Another major similarity is the increased attention in the use of educational software within MASLL. Furthermore, there is an increasing interest in the creation of software that can specifically adapt to the needs of the L2 students or the particular objectives of course curricula.

5.6 Which are the gaps not addressed in these studies?

The current systematic review has explored the main tendencies of current MASLL research which has taken place mostly in Asia and Europe. The studies in the American region has been minimal, for instance in Latin America where only one document was identified. Therefore, there is still a lot to investigate regarding the effects of mobile devices for second language learning in this region, as well as how MASLL can support second language learning in African countries.

Most of the studies have tried to show the impact of the use of mobile technologies in second language learning, focusing mainly on its integration of formal education in primary school and higher education. However, few papers have reported in the same detail how MASLL can support informal independent learning, as well as studies that focus on MASLL between secondary school learners. There is also many opportunities to explore how to develop MASLL within an outdoors context that does not involve indoors activities.

Another area that is subject to future studies is the use of MASLL for improving the reading and writing skills of L2 learners. Research has paid more attention to how the use of mobile devices can support L2 learning for improving languages skills in general terms as well as how MASLL support vocabulary learning. There are, however, few papers investigating MASLL practices that support the improvement of oral and listening skills, or the proficiency in L2 reading and writing. Additionally, the main focus on the use of smartphones has left the use of tablets for L2 learning almost unexplored, creating a gap in the technological aspect of MASLL.

6 Conclusions

The current study presented a snapshot of the research on mobile assisted second language learning which is representative of a state of the art up to date. The systematic review, allowed to identify not only the positive outcomes of the use of mobile technologies to support second language learning, but also the main trends within research, such as an increasing interest in the development of mobile learning applications.

The papers were coded to detect patterns within the educational form and level being studied, the major methodologies used, the context in which MASLL is taking place as well as which technology and how is being used for learning purposes. Additionally, it was reviewed the different pedagogical practices that use mobiles devices, especially smartphones, to support L2 learning and how they impact the student language proficiency, motivation, and collaboration. While most of the reviewed docu-

ments focused on the integration of MASLL, especially among primary school and higher education students, there is still a lack of research on informal language learning. The review also showed a trend to study MASLL as a tool to improve vocabulary learning and general skills development, underrepresenting how mobile technologies can improve the reading, writing, listening and oral skills.

MASLL is an area that still needs to be studied. Further studies can be helpful to study in detail how mobile technologies can support informal language learning, as well as studies regarding pedagogical practices to improve the underrepresented language skills. Additionally, the lack of a relevant number of studies including the tablet PC gives an opportunity to explore how their particular characteristics can be useful to support SLL.

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Design of Multimedia-based Digital Storybooks for Preschool Education

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Abstract—Storytelling is one of the suitable approaches to deliver the right information and build the character education of young children. The story content presented by utilizing multimedia elements is able to offer more attractive and increase interest for children. This paper proposes an ICT approach through multimedia-based digital storybook design with an EPUB reflowable format that can be accessed using various electronic devices, whether desktop, laptop, or mobile. The research subjects are limited to 4-5-year-old preschool children. The research reveals that children were very enthusiastic about storybooks, with or without support from teachers.

Keywords—digital, storybooks, multimedia, preschool, education

1 Introduction

Education is the right approach to prepare the next generation with the excellent characters. Walsh [1] defines education as the process that prepares young people for their social inheritance and advocates three dimensions of education—development of knowledge, training of mental abilities, and development of character. Almost all countries in the world have the same opinion that kindergarten education is considered very important [2]. However, they are the ones who will become the next generation. Therefore, it is also very important for the kindergarten children themselves to begin to engage in early learning experiences for the provision when they adults. The key role of preschool education for improving educational outcomes has gained international recognition, especially among developing countries [3].

There are several approaches which can be taken to deliver information and apply character education values for pre-school age children, one of the most compelling and effective approaches is through stories. Storytelling is an act of reading or telling a story to children. Storytelling is an engaging activity, “Imaginary worlds are enjoyed not only by those who visit them but also by those who invent.” [4]. Storytelling is also used as a learning opportunity to create content and connect it to context. As reported by Sanchez [5], some types of stories can be utilized to develop values

and morality in preschool age children. The use of stories has become one of the strategies applied in the practice of character education, particularly intended for children and teenagers. To reach the optimal results, character education should be initiated in as early as possible, since early childhood.

Along with the development of the era, the delivery of the story began to be done by utilizing the approach of Information and Communication Technology (ICT). As UNESCO suggests, in order to achieve the EFA goals so ICT approach should be included as a part of formal education at every level [6]. Kindergarten education is one of the most appropriate levels to utilize ICT and this important issue has been investigated and believed to be true in the last decades [7]. Research on the effect of ICT in education has actually been studied for a long time, around the early 1970s, and has increasingly asserted that ICTs could support students in formal education [8]. According to Zaranis [9], the introduction of ICTs in kindergarten education provides more opportunities for children to gain rich, diverse, and positive knowledge.

One form of ICT implementation in the field of storytelling is the use of digital storybooks. In principle, the story's digital book is able to accommodate all the contents of a printed book and supplemented with other digital content that is not in the printed book. The storybook approach presented by utilizing multimedia elements (text, pictures, audio, animation, and video) can provide reinforcement to increase children's motivation. The multimedia used as demonstration and research of learning allow the development of teaching and learning environment [11]. As Hughes [12] said, the multimedia-based learning system approach can effectively achieve resource sharing. According to Ni [13], teaching approach with adoption of multimedia contents can provide various learning information and make language practice learning effectively.

Until now, there are many children's digital storybooks that can be obtained easily. But it is still rare to find a digital book with a flexible design and emphasize all the elements of multimedia, and more specifically with the Indonesian language. Referring to the current urgency and potential, this paper presents a multimedia storybook design based on multimedia with the EPUB (electronic publication) format that can be accessed flexibly, either through the desktop or mobile devices. Digital book format used in this study is EPUB which is the rich contents and standard format of future books which supports mobile activities, whenever and wherever. The research subjects are restricted to 4-5-year-old preschool children. The research reveals that children were very enthusiastic about storybooks, with or without support from teachers.

2 Digital Storybooks

The digital era has brought significant changes in human lives. There are many previously conventional (analog) activities which now can be easily done through digital technology. For example, people used to listen to analog radio networks, but now they have various selections of digital radio network on the internet. It goes hand

in hand with reading. Nowadays, there are a growing number of people who read digital books which can be accessed easily without having to pay.

In general, a digital book comes in an electronic form, which often called an electronic book, e-book, eBook, e-Book, ebook, digital book, or even e-edition. Although the idea of eBook has existed since the 1960s, there is still much confusion about the basic definition of an eBook [14]. Hughes [15] has stated that the eBook definition has become a subject of renewed interest, "involving more complex than that of merely any digital text read via a glass screen". In principle, an eBook is quite similar to a printed book except for their different media, i.e. paper and electronic [16].

There are many kinds of literature that we find in previous years which states that the digital storybooks (also known as electronic storybooks, electronic talking books or digital books) can be beneficial to children's early learning [17]. According to Glasgow [18], CD-ROM storybooks consists of combining text, sound, and graphics, and it motivates young students to learn beginning reading and writing skills. CD-ROM story-books make it easy for readers to abandon their strategic use of cueing systems to decode words and read for meaning [19]. The advantages of digital storybooks can be highly motivational for young children [20]. The benefit of the digital storybook is also very much felt, in which they can be used to assist children to learn about text directionality, letter-sound relationships, sight words and comprehension [21].

Digital books are highly utilized in the academic environment. However, the application of eBooks for learning is quite late compared to its existence. Fasimpaur [22] proposed that students find e-books to be "a new and unique medium" and as a result, students often read more when having access to e-books. E-books have been used by young readers [23]. Meadows argued that digital storytelling is the social practice of telling stories that make use of low-cost digital cameras, non-linear authoring tools, and computers to create short multimedia stories [24]. In the context of childhood education, the utilization of digital book is absolutely potential. Digital books are rich in content so that they can support interesting stories. Digital storytelling can also be used to help students organize their thoughts, use reflection in their critical thinking, as their portfolio for the prospective employers, or as a part of a course project [25].

The format of digital books has been known since the establishment of a project called Gutenberg Project. This project is a voluntary project aimed to digitalize, collect and distribute cultural works. Digital books offer various superiorities, such as their mobile characteristic, high availability, and flexible format/can be accessed on many devices (desktop or mobile). Also, digital books have relatively low production cost so that they are less expensive than printed books. Nowadays, there are various digital book formats available. The most used three are PDF, HTML, and EPUB.

2.1 PDF

PDF (Portable Document Format) is the earliest format of digital books managed by Adobe system in the form of a proprietary format and then released as an open standard in 2008. The main advantage of PDF is in its fixed-width format which is

suitable for printing and reading only. On the other hand, it still lacks the ability to support dynamic and interactive content.

2.2 HTML

HTML (HyperText Markup Language) is a standard foundation of the web application. The major point of digital books in an HTML format is its uniform accessibility through every web browser, device, and platform. In contrast, HTML does not support content protection which is commonly found in Digital Rights Management (DRM) technology of electronic book.

2.3 EPUB

EPUB is an open standard developed by the International Digital Publishing Forum (IDPF). The main advantage of EPUB is its reflowable design and ability to present dynamic contents interactively. EPUB is designed for reflowable content, meaning that the text display can be optimized for the particular display device used by the reader of the EPUB-formatted book. EPUB format became famous for being used by the issuer and also a lot of support from the manufacturer and the device reader application for the reader.

3 Design of Digital Storybooks

3.1 Research Design

The product that will be produced in this research is an application design of digital storybook. Referring to the product characteristics, this research adopts the model of waterfall software process. According to Pressman [26], the waterfall process model consists of 5 main stages, communication, planning, modeling, construction, and deployment. One of the reasons underlying the selection of this model is based on very well-known requirements, stable product definition, and understood support technology.

The waterfall model is very appropriate to resolve the existing problem with the sequence applied approach. The stages of development model can be described as follows:

1. **Communication:** The communication is the most important step in the waterfall model process. Communication stage is the initiation of the project and aims to gather the digital storybook requirements specification. So, in this phase, we identify problem domain, product solution, and product requirements specification.
2. **Planning:** This phase focused on the product planning activities, including estimating, scheduling, and tracking. The main activity of project planning is the process of clearing to complete each activity within a single project.

3. **Modeling:** There are two main activities in modeling phase, called analysis and design. We use requirements in the previous phase to establish the software and hardware needed for the proper completion of the project. The following step is the requirements, that are gathered in the previous phase are broken down into logical units so that they will become easy for implementation.
4. **Construction:** This phase consists of two main activities, namely code, and test. A code is to translate the previous modeling result to machine-readable or software application. Once we successfully get the product application, the next step is to make sure that the product is meeting with the requirements specification through a series of tests.
5. **Deployment:** The last phase aims to deliver product application broadly so it can be used by the target users. In this phase, we also provide support and feedback from the user.

The phases of the waterfall model of software development carried out systematically and sequentially. Each stage in this model is related, the next stage requires the previous stages as input, and so on until all the stages completed [27]. This characteristic will produce a product that has a higher cohesion because everything in each phase we well understood.

3.2 Product Description

The suggested application product is a digital storybook application written in the EPUB open standard format. This digital storybook can be accessed flexibility through a variety of user devices, such as desktop computer, notebook, tablet PC, or smartphone. To read this digital book on their respective devices, the user only needs to provide EPUB readers, such as Apple iBooks, Google Play Books, Amazon Kindle, and Azardi.

This digital storybook product especially targets preschool age children. Therefore, the contents of storybooks are designed to be simple by featuring familiar objects around children, e.g. animals, fruits, and plants. The contents are also accompanied by short texts to provide ease for children in understanding their meanings. However, it does not rule out the possibility to be accessed by teachers, institutions, and the general public as references in preschool education, especially for strengthening character values.

The advantages offered and at the same time characterize the design of this book is to emphasize the content with the composition of multimedia elements, able to adjust the screen size of the user (reflowable), and story content that contains character education for children. The use of multimedia elements in the storybook is expected to be able to provide a strong attractiveness and to motivate children. Open standard digital book approach allows the product to be easily accessible through various digital book reader devices.

3.3 Research subject

To find out the implementation of the digital storybook design, limited tests were conducted on preschool children (4-5 years). The subjects were taken from two partner kindergartens, each located in the suburbs and downtown of Malang, East Java, Indonesia. The selected two categories have at least represented the groups of preschool age children.

The number of students involved in this research was 10 students from each kindergarten. Therefore, since there were more than 10 children in the class, the random sampling approach was utilized in the data collection. This approach was considered appropriate because the children have equal abilities. The assumption was the children can operate a computer and smartphone/computer tablet.

3.4 Research instruments

The measuring instrument was used to assess the satisfaction level of users upon the developed digital book products. This instrument was in the form of checklists questionnaire on the product functionality given to the experts and samples of the research partners. Filling the questionnaire instruments for children performed by accompanying teachers by asking them one by one

Table 1. Design of questionnaire for participants

No	Question	Answer		
		Yes	*No*	*No Idea*
1	Do you like this (model/design) digital storybook?			
2	Is the use of text, images, audio, and video (multimedia) very interesting?			
3	Is this digital storybook easy to use?			
4	Is the read-aloud feature (the sound that read the story) very interesting?			
5	Do you have any plans to use this digital storybook?			

3.5 Product Evaluation

Evaluation is an essential phase to inspect the product compliance with the initial specifications. This phase includes the activities of executing the product in the stipulated condition as well as evaluating the results. The product evaluation was divided into two, namely internal and external evaluations. The internal evaluation was conducted by the product developer team and subjected to further revision; if any. The external evaluation involved experts in the field of material substances and media.

The external evaluation by the media expert referred to the aspects of LORI (Learning Object Review Instrument) 1.5 evaluation developed by Nesbit, Belfer, and Leacock [28]. The aspects developed by LORI comprises content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability, and standard compliance.

4 Product Development

The development phase aims to realize the analysis and design findings into a digital storybook application. The product development was done through two supporting editor software, i.e. iBooks Author and Sigil (https://sigil-ebook.com/). Some manual codings such as HTML tags and CSS style settings are also made to customize the digital book design.

4.1 Development Result

The development of digital book application emphasized the interface design with clear visual images to achieve children's understanding. The page view came with a design which has been familiarized with children's daily lives, which is expected to be able to draw children's interest. The cover page shows the main image which represents the topic of the story. For instance, the topic of the storybook in Figure 1 is sweeping the floor, and it is entitled as "*Aku Bisa Menyapu*" (I Can Sweep the Floor).

Fig. 1. Cover design result of a digital storybook

However, the structure of the digital book design is still adapting to the general printed book. So, on the first page we will find the cover page, then copyright page, introduction page, table of content page, chapter, and so on. The content page design is made consistent so that it will not distract children's concentration. In accordance with its goal, this book emphasizes moral messages through simple daily stories. The content pages emphasize the theme of the story presented with multimedia elements, such as texts, pictures, animation, and video. Therefore, the story can be more interesting and meaningful for children as shown in Figure 2.

The advantages of multimedia content are really realized in the design of this digital storybook. Another very interesting content is represented by a short video that presents a meaningful scene. For example, in the story of sweeping the floor, Figure 3 shown the video about how to dispose of the garbage correctly. Aside from being a part of the story, this approach is also expected to play the role of education for children.

Referring to the EPUB 3.0 specification, this digital book design also utilizes one excellent feature, that is very interesting, which is read aloud. This feature represents text-to-speech that can read EPUB text content. Basically, read aloud is playing the recorded audio first in accordance with the text that appears [29]. View of a digital book with read-aloud feature support is shown in Figure 4.

Fig. 2. Text and image content of digital book

Fig. 3. Video content how to dispose of the garbage correctly

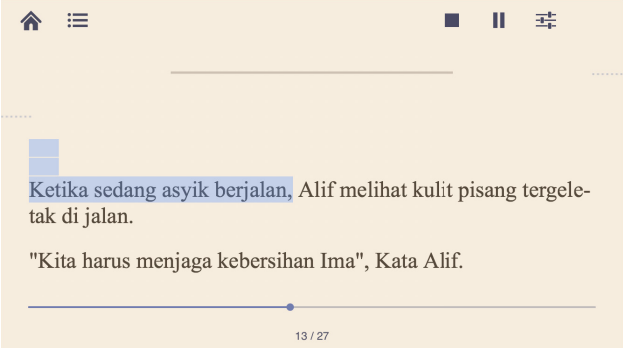

Fig. 4. Digital storybook with read-aloud feature

The read-aloud feature is very useful if children want to access the book without the accompanying their parents because there is an available voice recording that will read the contents of the story.

4.2 Evaluation Results

The internal evaluation is conducted by the developer through a series of product functionality testing. The test procedure is performed by running the product and observing the behavior based on the given input. In this test, if the product has responded in accordance with the initial specifications, then the product is declared to work properly.

On the other side, the external evaluation in the form of review or validation was executed by the material and media experts according to LORI instruments. The validation was performed to identify the product validity. It aimed to ensure whether or not the material substances have been appropriate so that the media validity can be identified.

A person with the relevant competence was selected to conduct the material validity test. The chosen material experts are two teachers at Al Hikmah Integrated Islamic preschool/kindergarten, in Malang city, Indonesia. Such material experts have highly relevant qualifications and professions with the developed application.

There were 20 questions used for the material validity test. The reviewer conducted the material validation phase by referring to the instrument provided for material validation. Subsequently, the assessor directly filled her statements based on the evaluation results of the application.

The validation by a media expert was conducted to point out the validity of the learning media so that the level of validity of the media can be identified. This phase involved a competent media expert, a lecturer or practitioner who is competent in the field of computer-assisted learning media. A relevant person has been chosen to perform the product evaluation. The reviewer has qualifications in the field of computer and multimedia assisted learning. Additionally, the reviewer, whose profession is a lecturer in Department of Learning Technology, State University of Malang also has experienced in the fields of academic advisory and learning media industry.

Fig. 5. Content validation by the kindergarten teacher

Once the product design is complete, the next step is to perform limited testing. The first field test was done to 10 students of "Lab" kindergarten (around 4-5 years old) who were randomly selected by their teacher. The test was performed by providing a laptop or desktop computer with the digital storybook application to children as shown in Figure 6. Teachers and the research team guided the students in operating the application. It can be seen that the children were enjoying the presented digital storybook.

The second field test was also done to 10 children of kindergarten in the Al Hikmah kindergarten. In this test, as shown in Figure 7, we focus on the use of tablet PC devices to access the digital storybook. The results of the observation show that the children were more excited to read the provided story.

Overall, both of the field tests held in two different locations shown that children were very enthusiastic and enjoy the story presented in the digital storybook. After the children have tried enough, the next step is to provide a questionnaire to find out the response of the children. In this case, we provided simple statements since the children were still very young and did not know about the specifics of the product.

In order to maintain the objectivity of instrument filling, teacher accompanied the children in turn without any intervention. The teacher would read every item of the statement, such as: "Is this digital storybook easy to use?" the available choices were "Yes," "No," and "No Idea." The teacher then filled the given answers of the children until the finish.

Fig. 6. Field test in preschool children

Fig. 7. Product test by using a mobile device

4.3 Discussion

The advancement of digital children storybook application with EPUB format has a strategic potential to be further implemented, especially in Indonesia. This digital storybook can be accessed on various devices (whether desktop or mobile) and can be distributed easily. It also supports the geographic condition and various economic characteristics of the society in Indonesia as an archipelago country.

The use of multimedia elements (texts, pictures, sounds, animation, and video) in the storybooks can produce educative and interesting contents for children. The optimum presentation of such various contents can produce more meaningful stories. It can be seen that the children were very enthusiastic and enjoy the given story.

The results of the evaluation by the material expert which used 20 statements showed an average value of 91.25%. The scores of 4 were given to 14 statements regarding with material substances, language, and writing style and the score of 3 were given to the rest 6 statements.

The results of evaluation by the material expert involving 24 statements shows an average value of 87.5%. The scores of 4 were given to 14 statements regarding with multimedia support, educative characteristic, theme simplicity, the element of character value, and the capability to give motivation, and the scores of 3 were given to the rest 10 statements.

The material expert gave a minor suggestion regarding with sentences simplification in the story to make it easier to be understood by children. The media expert also gave a minor suggestion to clarify and enlarge the pictures to deliver the meaning easily. After the product had been subsequently revised, it was shown to the experts and then tested to the product users.

The results of the first field study involving 10 students by using PC desktop stated that the product is already appropriate for use, with a percentage of 90%. Meanwhile, the results of the field study conducted in the second partner school by using Tablet PC show that the product is appropriate for use, with a percentage of 96%. Therefore, the average percentage of the field tests is 93% showing a high validity.

5 Conclusion

The development results of multimedia-based digital storybooks can be a practical solution to improve preschool age children's knowledge and character values. This approach at least becomes an interesting supplement besides the existing conventional media.

The presentation of simple stories with the themes of daily lives is easy to be understood by children. The representation of story objects using clear text, image, audio, and video elements makes the story more interesting. The read-aloud feature voiced with the kind of children's sounds is getting more and more attention for children and looks very enthusiastic about enjoying the story content. In addition, the moral messages provided in the stories are also very important for motivating children in improving their character values.

The results of the evaluation point out that the initial specifications of the product are already appropriate for use. Thus, the product could be used on a larger scale to identify its benefits.

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Perceived Promoters of and Barriers to Use of a Learning Management System in an Undergraduate Nursing Program

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Abstract—Effective presentation of information is essential in teaching and learning. We assessed the promoters of and barriers to utilization of a learning management system, namely Blackboard® (Blackboard Inc., Washington DC, USA), by undergraduate nursing students. We investigated their utilization of Blackboard® and provided recommendations to improve their teaching and learning. We conducted a cross-sectional survey of 304 women in their second to fourth years of study using a validated questionnaire that evaluated their perceptions of Blackboard® utilization. Data were collected between January and February 2017 and analyzed using descriptive and comparative statistics. The response rate was 67.5%. The most frequently reported promoters of Blackboard® utilization were factors related to obtaining course specifications, materials, and grades (means: 3.54 ± 1.18, 3.54 ± 1.25, and 3.55 ± 1.34, respectively). The most commonly mentioned barriers to Blackboard® utilization were factors related to loss of communication and feedback from educators (mean: 4.21 ± 1.05). Our results revealed that students experiences of using such systems are often negative, especially in terms of communication, interaction, and feedback. Investment in staff training and creation of new roles to monitor, maintain, and audit the quality of such systems are recommended.

Keywords—student perception, learning management system, E-learning, nursing.

1 Introduction

As the knowledge base of medical education expands, effective presentation of information during teaching and learning becomes an increasingly important consideration. Improvements in technology enhanced learning environments have enabled e-learning, which has demonstrated potential to improve the learning process. E-learning allows learners to perform tasks of their choosing, access resources at any

time, and receive learning support according to their needs, encouraging self-directed learning. [1]

The revolution in technology enhanced learning environments has encouraged educational institutions to adopt and invest in self-directed learning approaches. [2,3] These approaches are delivered by educational software such as learning management systems (LMSs). Defined as software systems created to help educators deliver learning content, facilitate student interactions, and conduct assessments, LMSs are fundamental resources for higher education. [2,4,5] Higher educational institutions worldwide have realized the potential of these systems and invested money, time, and staff in the support of such initiatives. [2,4]

Regardless of the positive attitudes towards such technologies, there is some concern that LMSs are mainly used for distributing teaching materials and course grades rather than for instructional or assessment purposes.[5] One reason for this is the low level of experience of these systems among educators.[5] Moreover, some LMSs do not support interaction or personalization of content, and students prefer to engage with systems offering these features.[6] According to the literature, both students' and lecturers' opinions of LMSs greatly influence the successful adoption of such systems.[3,7]

Although many international studies have shown the advantages of technology enhanced learning environments, their benefits in nursing programs have not been investigated. In this study, we examined the barriers to and promoters of LMS utilization by undergraduate nursing students. Furthermore, we investigated students' perceptions of LMS utilization during study for a bachelor's degree in nursing.

2 Methods

2.1 Study sample

This study was conducted a public University in Riyadh, Saudi Arabia, in a women-only campus. We distributed a validated self-administered questionnaire to all nursing students in their second to fourth years of study. [3] Data collection took place between January and February 2017. Information sheets were distributed to all participants that explained the aims and background of the study. Participants were also informed that participating in the study was voluntary and that all personal information would remain confidential. Ethical approval was sought from the institutional review board before the study began.

2.2 Questionnaire

The validated questionnaire examined students' experiences of using an LMS, namely Blackboard® (Bb; Blackboard Inc., Washington DC, USA). The questionnaire consisted of three domains assessed using five-point Likert scales. The first part retrieved demographic data (two items); the second part identified difficulties in Bb utilization (15 items); and the third part examined students' perceptions of utilizing

Bb (10 items). For each item, the score ranged from 5 for "strongly disagree" to 1 for "strongly agree". Approval to use the tool was sought by the authors before starting the study.3 Descriptive data analysis (mean ± standard deviation) was performed using SPSS Version 10 (SPSS Inc., Chicago, IL, USA). Associations between categorical outcomes were measured using Pearson's chi-squared test.

3 Results

3.1 Demographic information

In total, 450 questionnaires were distributed to nursing students. The response rate was 67.5% (n = 304). Of the respondents, 22.5% (n = 102) were in Year 2, 23.3% (n = 105) were in Year 3, and 21.5% (n = 97) were in Year 4.

Utilization of the Blackboard® learning management system. As shown in Table 1, the overall mean was 3.8 ± 12.18, indicating marked disagreement with the questionnaire items. The highest mean disagreement reported by all students was 4.21 ± 1.05 for the item "Bb was useful for communication with the instructor". The second highest mean disagreement was 4.12 ± 1 for the item "I like to use the multimedia available in Bb", followed by 4.1 ± 1.1 for the item "Bb was useful for communication with other students".

Conversely, the lowest means were 3.54 ± 1.18 and 3.54 ± 1.25, indicating strong agreement with items "Bb was useful for obtaining the course description" and "Bb was useful for obtaining lecture materials for the course", respectively. These were followed by a mean of 3.55 ± 1.34 for the item "Bb was useful for getting course grades and feedback".

Barriers perceived by undergraduate nurses to Blackboard learning management system use. As presented in Table 2, the overall mean was 2.6 ± 1.14, indicating agreement with the questionnaire items. The highest mean disagreement was 4.32 ± 1.02 for the item "I have difficulty using a computer". The next highest mean disagreement was 2.91 ± 1.19 for the item "I faced technical problems logging on to Bb".

In contrast, the lowest mean was 2.15 ± 1.26 for the item "user instructions are not clear in Bb", followed by a mean of 2.3 ± 1.09 for the item "The Bb front page is overloaded with information".

The highest percentage agreement was 66.4% for the item "user instructions are not clear in Bb". Conversely, the highest percentage disagreement was 86.5% for the item "I have difficulty using a computer".

Further comparative analysis found that female students in their second, third, and fourth years report weak interaction with the faculty in Bb ($p = 0.0001$). However, they also reported difficulty using computers ($p = 0.059$).

Table 1. Items used to obtain information from undergraduate nursing students about Blackboard® utilization.

Items	*n**	Strongly agree *n* (%)		Agree *n* (%)		Don't know *n* (%)		Disagree *n* (%)		Strongly disagree *n* (%)		Mean	SD
Bb was useful for obtaining the course description	304	18	5.9%	39	12.8%	76	25%	87	28.6%	84	27.6%	3.54	1.18
Bb was useful for obtaining the course objectives	304	11	3.6%	33	10.9%	74	24.3%	92	30.3%	94	30.9%	3.71	1.15
Bb was useful for obtaining the course requirements	304	8	2.6%	35	11.5%	80	26.3%	82	27%	99	32.6%	3.7	1.13
Bb was useful for obtaining the course references	304	14	4.6%	29	9.5%	77	25.3%	84	27.6%	100	32.9%	3.74	1.14
Bb was useful for obtaining lecture materials for the course	304	27	8.9%	44	14.5%	50	16.4%	85	28%	98	32.2%	3.54	1.25
Bb was useful for communication with the instructor	304	8	2.6%	15	4.9%	46	15.1%	90	29.6%	145	47.7%	4.21	1.05
Bb was useful for communication with other students	304	10	3.3%	22	7.2%	40	13.2%	94	30.9%	138	45.4%	4.1	1.1
Bb was useful for e-mailing the faculty	304	17	5.6%	28	9.2%	52	17.1%	77	25.3%	130	42.8%	3.88	1.21
Bb was useful for e-mailing colleagues	304	30	9.9%	27	8.9%	41	13.5%	72	23.7%	134	44.1%	3.8	1.25
I like to use the multimedia available in Bb	304	8	2.6%	9	3.0%	65	21.4%	98	32.2%	124	40.8%	4.12	1
Bb was useful for obtaining homework	304	20	6.6%	23	7.6%	51	16.8%	90	29.6%	120	39.5%	3.84	1.02
Bb was useful for submitting homework and assignments	304	22	7.2%	33	10.9%	40	13.2%	75	24.7%	134	44.1%	3.86	1.34
Bb was useful for obtaining the exam schedule	304	18	5.9%	32	10.5%	53	17.4%	76	25%	125	41.1%	3.74	1.3
Bb was useful for receiving announcements	304	30	9.9%	38	12.5%	48	15.8%	88	28.9%	100	32.9%	3.62	1.28
Bb was useful for getting course grades and feedback	304	30	9.9%	34	11.2%	65	21.4%	70	23.0%	105	34.5%	3.55	1.34
Average score	304	18.07	0.06	29.4	0.1	57.2	0.19	84	0.28	115.33	0.38	3.8	1.18

SD, standard deviation; Bb, Blackboard®.

Table 2. Perceptions of nursing undergraduates of Blackboard® utilization.

Items	*n**	Strongly agree *n* (%)		Agree *n* (%)		Don't know *n* (%)		Disagree *n* (%)		Strongly disagree *n* (%)		Mean	SD
Lack of training in Bb	304	89	29.3%	101	33.2%	75	24.7%	23	7.6%	16	5.3%	2.31	1.1
Bb increases the curriculum burden	304	40	13.2%	61	20.1%	122	40.1%	58	19.1%	23	7.6%	2.9	1.12
Bb use is time consuming	304	41	13.5%	72	23.7%	80	26.3%	81	26.6%	30	9.9%	2.9	1.1
Limitations of Bb services	304	78	25.7%	86	28.3%	114	37.5%	17	5.6%	9	3%	2.38	1.2
User instructions are not clear in Bb	304	108	35.5%	94	30.9%	68	22.4%	23	7.6%	11	3.6%	2.15	1.26
The Bb front page is overloaded with information	304	65	21.4%	94	30.9%	90	29.6%	43	14.1%	12	3.9%	2.3	1.09
Weak interaction from the faculty in Bb	304	100	32.9%	84	27.6%	100	32.9%	10	3.3%	10	3.3%	2.33	1.12
I faced technical problems logging on to Bb	304	45	14.8%	50	16.4%	114	37.5%	70	23%	25	8.2%	2.91	1.19
Technical difficulties with Bb	304	59	19.4%	70	23%	140	46.1%	20	6.6%	15	4.9%	2.41	1.2
I have difficulty using a computer	304	3	1%	8	2.6%	30	9.9%	108	35.5%	155	51%	4.32	1.02
Average score	304	62.8	0.21	72	0.24	93.3	0.31	45.3	0.15	30.6	0.1	2.69	1.14

SD, standard deviation; Bb, Blackboard®.

4 Discussion

Technology enhanced learning delivered by LMSs has demonstrated potential to enhance self-directed learning by students. [8] Interestingly, our results showed the opposite. The expected benefits of LMS utilization were not perceived by our students. This finding is consistent with that of another study performed in Saudi Arabia involving medical students. [3] Our students expressed a negative attitude toward the implementation of an LMS in their study program. Although our students reported proficiency in computer use, they found the LMS difficult to use. However, a recent study undertaken in Saudi Arabia confirmed that students value LMSs, and that LMSs improve the learning process. [9]

Our students reported a lack of communication with their teachers and with other students. Thus, the benefits of the LMS as a collaborative learning environment were not perceived. This may have been caused by a lack of student training in use of the LMS or failure of the educators to successfully implement the LMS. However, the students professed good computer skills. This calls into question the educators' abilities to implement LMS objectives. Our results suggest that, although higher educational institutions are investing in LMSs, they lack qualified and trained teaching staff who understand the concept of self-directed learning and how to achieve it by successful exploitation of LMS resources. Therefore, educators need to take a more ac-

tive role in developing LMS content. Alternatively, college administrations must create new roles, such as e-learning managers or directors of medical education, to monitor, maintain, and audit LMSs. [8]

The strongest promoter of Bb utilization perceived by our students was its ability to provide course information, materials, and grades. This result was similar to that of many other studies on the benefits of LMSs. [9,10] In contrast, the strongest barriers to Bb use perceived by our students were the lack of clear instructions on how to use the interface and that the front page was overloaded with information. Educators may believe that filling the front page with material makes it easier for students to access and find information. Overloading may also result from educators' lack of experience in setting up their course page. Whatever the cause, an overloaded first page may confer a higher cognitive load on students, consequently discouraging them from interacting with learning materials. [1]

Nursing students reported that they rarely experience difficulty using computers, yet they faced technical problems logging into Bb. This was confirmed by a recent study, which reported that nursing students demonstrate informatics competencies, including computer skills. The study explained that the recent cohort of undergraduate students, termed the "net generation", are aware of technologies and communication innovations. [11] This awareness gives them the requisite computer skills to use LMSs.

When we compared the responses of nursing students in their third and fourth years, the results confirmed that our students faced problems interacting with their educators as well as their peers. Again, this indicates that educators did not exploit the communication and interactivity features supported by the LMS as a result of either a lack of awareness of these features or a lack of proper training on LMS content development. In order to enhance self-directed learning among students, it is crucial for feedback, interaction, and communication to occur within the e-learning environment. In particular, nursing students are educated to value communication, interaction and feedback as they are key concepts of patient care and safety. [12-14] The negative perception of communication via the LMS among our students may have compromised their learning and prevented them from achieving the course objectives. Therefore, to enhance self-directed learning through LMS use, it is essential to create an interactive learning environment.

In summary, this study highlights the barriers to and promoters of LMS utilization in a nursing program. The most commonly mentioned barriers to LMS utilization were related to the lack of interaction, communication, and feedback from educators via the LMS. The most commonly mentioned promoters of LMS utilization were related to obtaining course specifications, materials, and grades.

This study was conducted at one educational institution in women alone, which may represent a limitation with regard to the generalizability of the data. We recommend further study on the faculty perception of Bb utilization. Indeed, adding a qualitative investigation on the perception of Bb utilization among students and educators will enrich the results by exploring their feelings, insights, and thoughts. [15]

5 Conclusion

The results of this study highlight the promoters of and barriers to LMS utilization by female nursing students. We found that accessing course specifications, materials, and grades were the most commonly reported promoters of LMS utilization by nursing students. Conversely, a lack of interaction, communication, and feedback were the most commonly reported barriers to LMS utilization. Interestingly, although nursing students reported competency in computer use, they still found the LMS difficult to use in a beneficial way.

The implications and recommendations of this study are that higher educational institutions should invest in LMS environments, but that they should also invest in staff training and create new roles to monitor, maintain, and audit the quality of LMS content. The content must also be mapped to the program and course learning outcomes to achieve the maximum benefits of such environments.

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