The Effective of Learning by Augmented Reality on Android Platform

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Abstract. In this paper, we present the effective of Learning system based on Android operating system in Physics. The objective of this system is to advice student to learn Physics more convenient through mobile platform. The design approaches and functional components of this system were described and this application was developed on Knowledge. A quasi-experimental design of the pretest, posttest for non-randomized control group design was employed for this project. And, it was divided the result by the research purposes into 2 parts: developing the Mobile application for students and testing and evaluating the system. Black box technique was used to evaluate application performances and Questionnaires were applied to measure user satisfaction with system usability by experts and students.

Keywords: Augmented reality · Android platform · Quasi-experimental · Black box technique

1 Introduction

In the recent years, smart phone has prevalently become as a significant medium to completely change and support in many aspects of life. With no longer barrier by space and time, advance technologies has changed the way of e-Learning and mobile learning systems. According to [1], the use of technology is essential in teaching communications, mathematics and science and it is no less important in the arts. Educational technology has three significant contributions for teaching and learning: the use of technology can accelerate the learning; technology can access more information related to any topic; and the Internet can serve as a method of multiple communications among numerous individuals, organizations and communities. Also, MoLeNet [2], mobile learning was defined "The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning." Augmented Reality (AR) is a technology that allows computer-generated virtual 3D objects with a live direct or indirect real-world environment in real time [3, 4]. Furthermore, Johnson, et al. [5] claimed that, "AR has strong potential to provide both powerful contextual, on-sitelearning experiences and serendipitous exploration and discovery of the connected nature of information in the real world." Augmented Reality (AR) plays an important rule to dramatically shift the

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way of the location and timing of learning and training, moreover, it effects on the future of education [6].

The remainder of this paper is organized as follows. Section 2 presents related works used in this work. Section 3 we describe the experimental design based on the purposed model and Sect. 4 shows the results of this experiment. Finally, the conclusion and future research are presented in Sect. 5.

2 Related Works

In this section, we describe the related concepts used in the specific literature and also adapted in the proposed application. Gwo-Jen Hwang and et al. [7] proposed method to conducted research in a natural science course on an elementary school and the experimental results show that the proposed approach not only enhances learning attitudes, but also improves the learning achievements of the students. The application was designed to be customizable by teachers and, based on collected data from observation, video and interviews, the design process and trial illustrate application use, and how it supports a geospatial approach to science education and raises issues around mobile technologies, teacher pedagogies and adoption [8]. D. Pérez-López and M. Contero [9] proposed the use of augmented reality (AR) for delivering multimedia content to support the teaching and learning process of the digestive and circulatory systems at the primary school level and the results show using AR multimedia is a promising tool to improve students' motivation and interest in contents. The effects of the use of augmented reality (AR) technologies was conducted in science laboratories on university students' laboratory skills and attitudes towards laboratories by using a quasi-experimental pre-test post-test control group design approach [10]. The SMILE project is a fantasy 3D virtual environment game to engage deaf and hearing children in math and science-based educational tasks that shows the key elements of successful computer games, emotionally appealing graphics, and realistic real-time 3D signing, with goal-oriented, standards-based learning activities that are grounded in research on effective pedagogy [11]. Hannes Kaufmann et al. [12] presented an augmented reality application that observed 3D objects in their textbooks and interacted to improve student's spatial abilities. However, when educational learning and AR technology are combined together, learners can gain experience and improve learning with a hugely positive way. Additionally, mobile application was used to provide management of learning environment [13]. There is much of research that indicated how to provide requirements for design of a mobile learning [14]. R. Rattanachai et al. [15] developed the lifestyles of Thai Buddhist application based on Android operating system to learn about lifestyle of Thai Buddhist serving.

3 Experimental Design

RAD (Rapid Application Development) was used to implement the mobile learning application [16], and user's requirements were analyzed for design processes to indicate student's interest in a mobile learning device and this prototype is effectiveness

and usefulness to enhance their abilities. According to Kunyanuth et al. [17], the architecture of the system consists of 3 parts: the User Interface part, the Application part, and Data Storage part, as shown in Fig. 1. The user interface part receives input from the user and sends the information to the related parts for processing. Student/learners can register his/her profile, such as personnel information, email address, username and password, and etc., and he/she is assigned to take pre-test so as to initialize the student profile. Moreover, students can search supplementary information on demand by choosing the words or phrase appeared in the content page. In learning content module will prepare content for learning. This module consisted of conversion lesson content and indexed the topic of the lesson in database. Search module shows results related with the lessons and Fig. 2 presented the overview of this application.

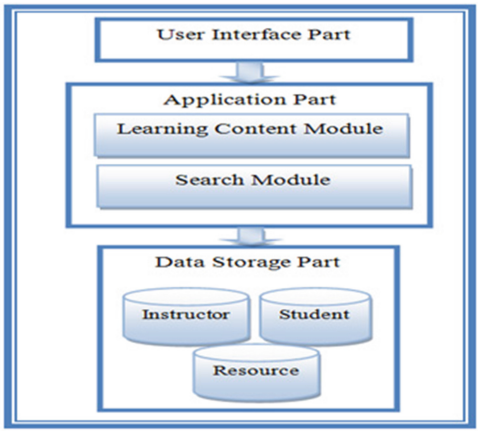

Fig. 1. The system architecture

The research aims to implement mobile learning system in Physics subject based on AR technology and to determine the comparative effect of the uses of standard materials and a supplemental instructional activity. The sample of this project consisted of 29 students using this prototype and the control group consisted of 30 students in the primary school level during academic year.

Also, this research is the quasi experimental research and, on the development of learning and teaching, the instruments used to collect data were: (1) a questionnaire and interview forms inquiring about the mobile learning course (2) a lesson plan for Physics course (3) an achievement pre-test and post-test (4) a questionnaires inquiring the students' opinion for this application. The collected data were analyzed by the statistical means $(\bar{x})$, standard deviation (S.D.) and the t-test statistical analysis. The level of the significance was $p = 0.05$ that formed the basis for or rejecting or not rejecting each of the hypotheses.

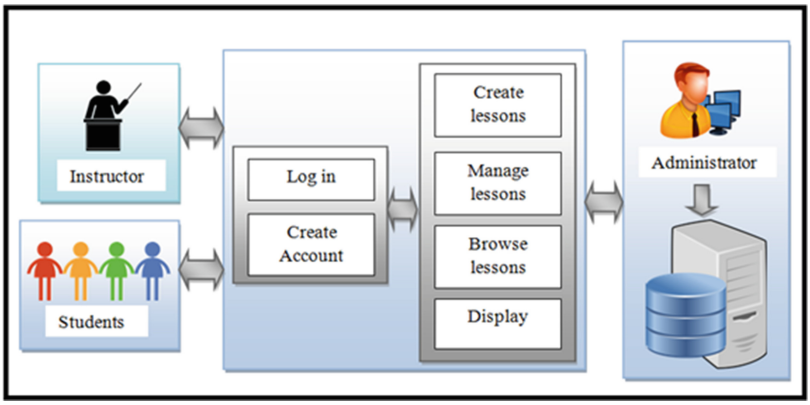

Fig. 2. Framework of the system

To compare physics learning achievement between the experimental and control groups, null hypotheses were formulated and tested at p = 0.05 to obtain answers to the research questions:

Research hypotheses

- There is no significant difference in the performance students learning with standard instructional materials
- There is no significant difference in the performance of the students learning with a supplemental instructional activity.

To assess students' learning achievements in the experiment of this study, two groups of students were pretested before learning. After testing was completed, the teacher taught the first group in a regular classroom, while the second group was introduced to learn from this application concurrently. Also, after week later, 2 groups of students were tested to find out students' achievement after learning. The instrument was examined by experts and teachers. Student from the control group and experimental group were took a pre and post-test that contain 30 items 4 option multiple choice objective test. Moreover, this research took Black box Testing and Questionnaires to test and evaluate the qualities of this application. Black Box testing was assessed in the error of the project as following: functional requirement test, Function test, Usability test, Performance test and Security test. The experimental procedure included participants used and learned mobile application and after finished, participants were asked for rating the quality of the application. A 5-point Likert scale was utilized to range from "strongly agree" to "strongly disagree".

4 Experimental Results

In this section, experimental results were separated to 2 parts: assessing students' learning achievements; and evaluating the performance and satisfaction of the application.

4.1 Assessing Students' Learning Achievements

The system was evaluated by students at the primary school level. This study took places in a class with 59 students. SPSS was used to analyze the student learning achievement of both the experimental and control groups. Table 1 displays the means and standard deviations in pre-tests and post-tests of the learning evaluation.

Table 1. The results of the students' learning achievement

Group	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental group	29	17.85	2.98	42.03	4.95
Control group	30	18.22	4.15	39.30	3.88

The result in Table 1 indicates that learning achievement of students who learned under AR mobile application was significantly higher than that of students who learned under conventional instruction at the .05 level. The experimental results showed that experimental group taught with instructional materials achieved better scores than those taught without instructional materials and this project can help student learning and reduce time consuming study. To evaluate the effectiveness of learning material collected data from test and post-test was analyzed and measured by using E1/E2 effectiveness with 80/80 condition.

$$E_1 = \frac{\frac{\sum X}{N}}{A} \times 100 \tag{1}$$

$$E_2 = \frac{\frac{\sum F}{N}}{B} \times 100 \tag{2}$$

When

E1 = the efficiency of the developed material
E2 = the efficiency of performance result
$\sum X$ = total score from lesson testing
$\sum F$ = total score from post-test
A = Total score of lesson testing
B = Total score of post-test
N = total number of students

The result shows that the effectiveness of learning material was effective 80.75/82.25 with the criteria 80/80. Also, students were asked to give their opinions towards this application and the findings revealed that they had positively high attitudes with this application at rated above 4.05.

4.2 Evaluating the Performance and Satisfaction of the Application

Developing the Physics Learning system based on Android operating system, Fig. 3 shows the example results of application. In the experiment of this study, students took a pre-test and completed a questionnaire for analyzing their knowledge before participating in the mobile learning. Also, user can search for available learning resources, learn the interested lessons and take an exam through mobile application.

Fig. 3. The example result of application

To test and evaluate the qualities of the system, Black box Testing and Questionnaires by teachers and students were used to test this application. Black Box testing was assessed in the error of the project as following: functional requirement test, Function test, Usability test, Performance test and Security test. The ability of this application was evaluated by Functional Requirement test in needs of the users and Functional test was used to evaluate the accuracy of the system. Usability test was tested the suitability of the system. Performance test was used the processing speed of the system. Finally, Security test was evaluated the security of the system.

The results revealed that means for teachers and students in all aspects were 4.07 and 4.10, and standard deviation for teachers and users were 0.67 and 0.74 respectively as shown in Table 2.

Table 2. The results of Black box testing

	Teachers		Students	
	$\bar{x}$	SD	$\bar{x}$	SD
1. Function requirement Test	4.18	0.62	4.03	0.75
2. Functional test	3.91	0.74	4.03	0.66
3. Usability test	4.06	0.76	4.25	0.74
4. Performance test	4.15	0.55	4.03	0.80
5. Security test	3.91	0.55	4.29	0.78
Summary	4.07	0.67	4.10	0.74

5 Conclusion and Future Works

In this paper, the Physics Learning system based on Android operating system was proposed and this application can assists students to enhance student's abilities. The experimental group had significantly better performance in learning achievements. This system can be beneficial to use in different courses so that students can enhance and improve their ability and also this system supports teachers in handling and managing their course. However, in term of the future experiments, this supported material should be available into all subjects and teachers should adapt the social network like Facebook to participate during class. Also, we are looking forward to advanced technologies to support in learning preferences and interest of learners based on social networks and to create adaptive learning for learners.

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