A Review of Mobile Based Learning through Augmented Reality in Education

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ABSTRACT

Technology has changed how people reflect and use knowledge. Today, one of the interactive ways of learning experience is using Augmented Reality (AR). AR was used in many fields such as education, medical, automotive and industrial design. This paper presents a review of mobile based learning by using AR and its implementation in education field. AR learning applications are the approach to improve class participation and interactive session. The review protocol is used for the methodology to include several literatures for this research. Furthermore, this research is focusing on the information about mobile based augmented reality as teaching and learning tools to improve the quality of education.

Key Words: Augmented reality, mobile game, education, review.

1. INTRODUCTION

In today's society, people can easily learn and practice specific information and knowledge through technology such as computers and mobile phones besides using conventional methods like textbooks in classroom. One of the learning tools that have a potential in teaching and learning process is by integrating mobile and Augmented Reality (AR) because of the increasing in mobile usage across the world (Nincarean, Ali, Abdul Halim & Abdul Rahman, 2013). As stated in the research paper, AR is a combination of real world and virtual life whose include simulated input like sound, video and pictures (Chavan, 2016). AR works through mobile application. The mobile phone's camera detects and interprets a marker which contains a black and white barcode image. The application tracking the marker and creates a virtual object overlay on the mobile phone's screen, tied to the position of the camera. Thus, the application uses the camera to take the angles and distance of the marker from the mobile phone and the object shows within its position of the real world (Kumar, 2017).

Currently, AR is most applied in medicine field followed by other areas such as manufacturing, education, automotive and more (Klimova, Bilyatdinova, & Karsakov, 2018). For example, classroom AR can be one of the approaches for interactive learning and teaching experience by capturing and storing the teacher's movement. Digital information can be added to help the process of delivering teaching materials such as simulation of an object for teaching physics (Almeida, 2011). Moreover, in the field of architecture, AR is used to assist user for visualizing and adjust the position of suitable furniture to be fitted in any areas before buying the furniture. Nevertheless, AR technology is moving slowly in education sector in Malaysia (Saidin, Abd Halim, & Yahaya, 2015). Hence it is advisable for educators to enhance their teaching and learning activities by using this technology as supported by AR. (Burton et al., 2011) indicates that participants were motivated to learn and sharing new knowledge by using AR technology. In addition, AR provides a student-oriented and flexible space and time for learning opportunities. Thus, this research focuses on a review of using AR in teaching practices and provides suggestions on integrating pedagogical and activities using AR technology into learning process.

2. RESEARCH METHODOLOGY

The target of this review is to determine the usage of AR in different areas of education. The review protocol will be used as our methodology to ensure that all relevant literature will be included into this

research. There are four steps in the review protocol which include database selection, searching with keywords, screening the abstract and identify the theory. The electronic database selections for this research are ACM Digital Library, Google Scholar and ScienceDirect. Then, the searching keyword to find related articles is "Mobile Augmented Reality in Education". All the three databases are going through a refinement which is publication year from 2011 until 2019 and the language selected for the search articles is English. There were 204,263 file type:pdf found at ACM Digital Library database after a refinement had been made and the total videos of 8,256 are removed from the database. Meanwhile, there are 27,400 results showed at Google Scholar after the refinement. Besides, 2,078 results match with the searched keyword at ScienceDirect database. The third step is abstract screening. The selected articles are based on their abstract and full-text studies for inclusion. The studies are focused on the most relavant articles for further action taken into the next step. Hence, there are 12 articles accepted from combining all three database selection. The last step is identify the theory that will be discussed in the section 3 Discussion and Results by summarizing the most related articles of mobile augmented reality in education. In this step, we will go through second and third step from the related references that are come across when investigating every related article. Figure 1 shows the review protocol that being used for this research.
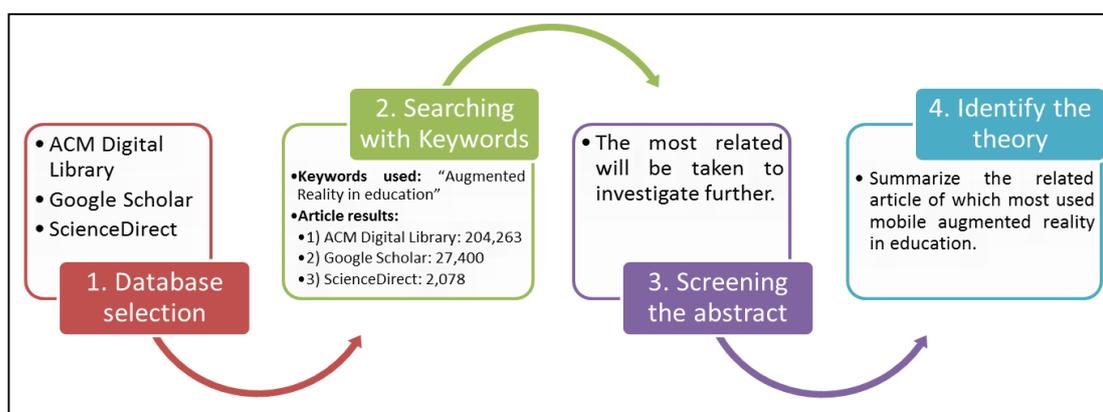

Figure 12: The Review Protocol

3. DISCUSSION AND RESULTS

In this section, we will discuss all related articles from the perspective of programming language used, platform and features of mobile AR application. Table 1 shows the summarization of mobile based application using AR in education field.

Table 10 Summarization of mobile based application using augmented reality in education

Name of Mobile Game	Programming Language	Platform	Features	Reference
AR Human Anatomy	JAVA for Android	Android	It can interactively display the whole body or parts of the human organs. • Science	Kurniawan et al. (2018)
AR Serious Game	C#	Android and iOS	An attractive way of learning method to provide the children very good long-term knowledge about different kind of animals living in a zoo. • Science	Zarzuela et al. (2013)
ARBio	C++ and Java	Android	The user is able to learn, browse and read information about animals with 3D image. • Science	Ifthene & Trandabat (2018)

Name of Mobile Game	Programming Language	Platform	Features	Reference
GeoAR Application	Java	Android	The user learns the geography of Europe (countries, capitals, flags and neighbors). • Geography	Ifthene & Trandabat (2018)
Name of Mobile Game	**Programming Language**	**Platform**	**Features**	**Reference**
New Media	Not stated	Multi-platform applications	It offers much more interesting information at one place in a real space-time. • History and Tourism	Kysela & Storkova (2015)
AR Flashcards Animals-Alphabet AR Alphabet Flashcards	Not stated	iOS (iPad view)	These two apps provide English alphabet initials of pets and predators using 3D letter, sound of each animal and animated movements to learn the letters of English alphabet. • Language	Safar et al. (2017)

3.1 AR HUMAN ANATOMY

AR Human Anatomy is an application for learning human anatomy using AR technology to assist student to a better understanding in learning which needs visualization and can be used interactively. It provides help for visualizing organs by seeing different layers of the human body and shows details information for learning purposes (Kurniawan et al., 2018). The application shows the data in 3D models form and arranges the part models using a marker. Students can use the application to learn the position of human internal and external organ which can be viewed from various perspectives. The application started with the main menu page, camera on the android device will detect the markers and it will show 3D models of the selected internal or external organs as shown in Figure 2. User can touch the parts of the body such as the hearts then it will display the detailed information include the name and description of the selected organs. Besides, users can interact by touching the screen or move the device to see 3D models that appear from different angles. The interaction will help students visualize the materials they learn through the 3D model of the human body anatomy. This application is able to help high school students and medical students in learning the human anatomy with an interactive learning environment.
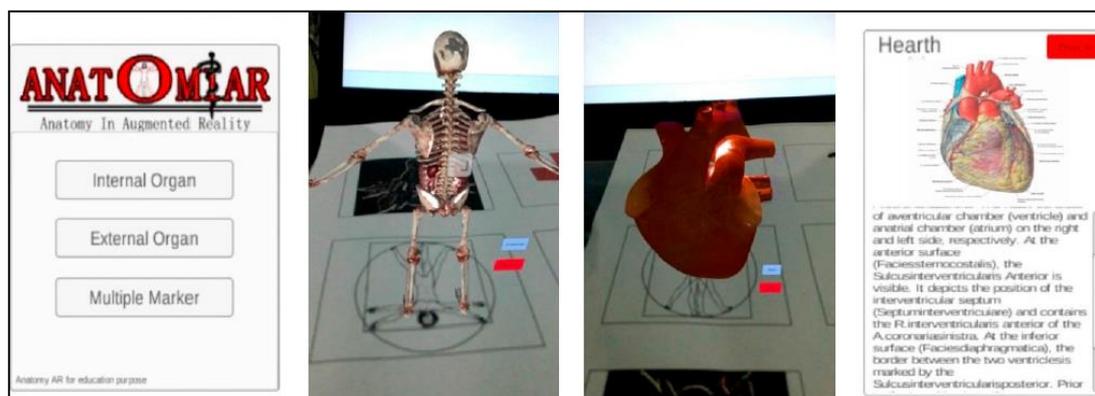

Figure 2: Application Interface of AR Human Anatomy

3.2 NEW MEDIA

This application is developed to show that AR can be used a medium for teaching history and tourism. It provides an interactive and fun interest to students in this area. Students can get a new experience on the explanation of history and try to understand it better compared to traditional learning method like through films, photos and others. Student can used their smartphone to detect the location and position of the smartphone. Multimedia content such as 3D animation in the real time, description of the place, audio, video and pictures are placed into the image captured as shown in Figure 3(a) and 3(b). Student gets to learn about new places and discovering local history with description of the places

(Kysela & Storkova, 2015). Hence, this application will benefit the student to motivate them in learning history with new and attractive features through multimedia content in mobile device.
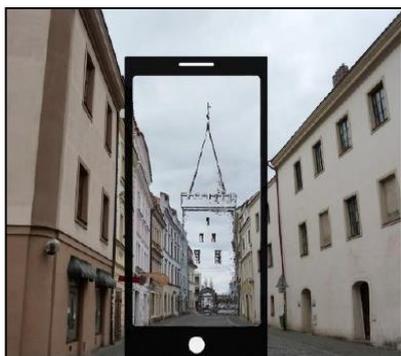

Figure 3(a): real space

Figure 3(b): real space-time with AR

3.3 AR SERIOUS GAME

This application was intended for the user especially kids and handicapped to increase his knowledge about animals. It provides an efficient learning experience for the user with the AR technology by different perspective of the real environment. The user can see a virtual zoo that can be displayed anywhere with a smartphone and a marker as shown in Figure 4(a). The game is divided into many scenes. The scenes are related to an animal that live in a zoo. During the game, the user can choose among different scenes, each of them with a different task related to the animal selected in the main scene as shown in Figure 4(b). Six 3D animals provided in the zoo which include giraffe, elephant, lion, deer, panda bear and rhinoceros. As stated in the research paper, a testing was performed for group of 5 kids. The results of using this application were attractive way of learning for them and they were able to learn the questions and answers about animals by using their visual memory when visualizing the 3D animals in the zoo (Zarzuela et al., 2013).
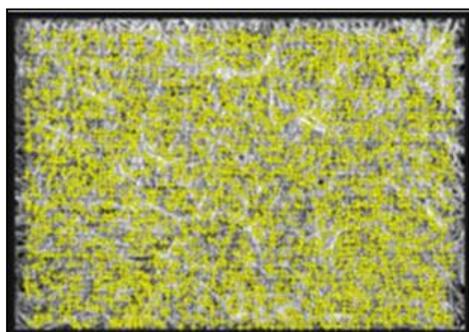

Figure 4(a): Markers

Figure 4(b): Main scene

3.4 GeoAR Application

This application lets student of secondary school to learn the geography of Europe by learning the materials of countries, capitals, flags and neighbors. The students are able to play and learn about the country at the same time. It tests and provides better understanding of their knowledge in the memory with a several game of questions based on different level of difficulties. For instance, the game displays several flags that have some same colors to make the user memorize the correct flags and familiar with the flags of other countries which resembles each other flags. For more information about the particular country, the application provides the user to the Wikipedia page containing the country's information. The markers used in this application are the contours for each country display in the maps. The user can see the name of the country, flag, capital and neighbors through smartphone camera as shown in Figure 5. As a result, this application consists of three modules which are Learn Europe by showing the interface of the map, Test Your Knowledge by giving questions to test the user understanding and Find out more module by redirect the user to the Wikipedia page of the selected country (Ifthene & Trandabat, 2018). Thus, the students will easily memorize the maps through this

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application and the evaluation provided is not as stressful and emotional as a traditional method of answering the written test or as an oral evaluation.

Figure 5: GeoAR – the Information View is based on the Marker

4. CONCLUSION

The introduction of AR applications to smartphones cover new and innovative learning experience in real world environment. Besides, AR can be used in many fields for everyday users. AR technology gives us many benefits to make teaching and learning activities more fun and interesting while it helps student to learn the difficult subjects into an easier way which is a concept of visualization (Hazidar & Sulaiman, 2014). In addition, AR allows the learning to be student-oriented and engage with the technology to create better understanding of the content displayed. The advantages of using AR technology in education as follows (Cai H., 2013):

i. Present simple and attractive form of learning materials that allows user interaction with information.
ii. Enhance educational method of teaching and learning experience with new technology.
iii. Effective in term of cost and the ability to further development.
iv. Creative innovation of teaching and learning process.

This research paper covered the use of mobile AR in education such as for learning Science, Geography, History, Tourism and Language. Thus, AR technology can be an optimal choice for future trends of teaching and learning methods. In future, AR technology can be implemented in the Programming subject and more to enhance the understanding, motivation, performance and attitude of the students for the subject of programming. The use of AR will continue to grow and becoming an important part of education and create interest of the learners and teachers as well as for the benefit of educational institutions.

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