Mobile Augmented Reality Application for High School History Subject (SejarAR)

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ABSTRACT

The Fourth Industrial Revolution (IR 4.0) is expected to change how we live, work, study and communicate; it is also likely to change the things we value in the future. Presently, we can already see changing business models and learning & teaching mediums. The existing teaching and learning method should evolve alongside it as well, current high school students are no longer interested in reading and studying from the static textbook hence the demand of learning to be more fun and interactive is increasing. History is a must pass subject in Sijil Pelajaran Malaysia (SPM). Many works have been reported about the actual state of the History subject textbook which are boring, not fun and no interaction when studying the subject.

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KEYWORDS

Augmented reality; Self-directed learning; Mobile application; History subject; High school students

The aim of this project is to develop a mobile alternative learning tool which will leverage on the immersive nature of augmented reality (AR). The results obtained from this study seems positive towards learning history with AR compared to learning on other mobile application without AR.

INTRODUCTION

History is a very important subject to be taught in school in a diverse country like Malaysia, it can be used as a medium to foster national integration and unity [1]. Furthermore, learning world history allow us to understand the people and society from the past to improve our life in the future and learn from mankind's past mistakes [2]. A civilization thrives when it learns from the destruction of the past civilization and a civilization that does not learn from its past are destined for its downfall. In Malaysia education system from 2013, history became a compulsory subject for students to pass in order to obtain the Malaysia Education Certificate or Sijil Pelajaran Malaysia (SPM) [3]. It is now even more important than before for students to grasp a good understanding in learning history.

On the other hand, information and communication technologies (ICT) is the infrastructure and components that enables all modern computing. There are various ways to define ICT based on the different industry and user, but it generally means range of technologies for gathering, storing, retrieving, processing, analyzing and transmitting information in both hardware and software which are connected to allow interaction between them digitally. ICT literally shaped and changed the way we live in the 21st century, from conventional phones sending SMS to smartphones making real-time video calls while wearing a wireless earphone with Bluetooth technology, these would not be possible without ICT. It has truly revolutionized the way we interact and live more than we realized.

As part of the evolution of ICT, the popularity of augmented reality (AR) has increased tremendously in the recent years, AR is a technology that allows the integration of digital information on top of the user's real world and project the digital information such as images, 3D models etc. onto the real world through the AR device. This creates an interaction of virtual object and physical object. There are a number of successful and popular AR application which are currently commercially available such as the wildly popular Pokémon Go where user interact with physical location to catch Pokémon and fight in gyms, IKEA application which allow user to place the furniture in an augmented world before buying it, a museum application which animate and make the ancient artifact alive again, and these are some of the popular application of AR in mobile.

PROBLEM STATEMENT

History lesson, although as important as we have mentioned in the earlier section, has always had a stigma of being boring, dull and overlooked by students while studying. A recent study collected opinions from 45 students in two groups on perception of history subject in school shows that a staggering of 75% and 64% student do not like history in school and 45% of those dislikes mentioned it as not interesting, 22% mentioned that it is hard to understand [4]. The lack of creativity in delivering the history lesson contributes to the boredom of students [5].

Learning experience can become the hindrance between student and knowledge. A study also reveal that text books ranked amongst the lowest (15.6%) of preferred learning medium amongst students and ironically it is the primary way of teachers delivering study materials and contents to students [4].

Furthermore, there are currently lack of available innovative solutions for the students in Malaysia to learn history through mobile devices [4]. Most application are just a digital version of exam questions or text book in a mobile or digital format which does not help motivate the students to learn history, because they are essentially doing the same thing on different platform.

In response to the problems mentioned, an augmented reality (AR) mobile application for high school students will be proposed as a solution to bridge the gap between the history subject in school and students.

LITERATURE REVIEW

Mobile Learning (M-Learning)

M-Learning stems out as a subset of electronic learning (e-learning), m-learning generally inherits the traits of e-learning by allowing students by accessing teaching materials via electronic devices. M-learning on the other hand is more niche than that and has its distinct differences and principle which impacts on the student's learning. Mobile learning as the term suggest, uses mobile devices such as smartphones and tablets to deliver information.

The Current State of Learning History in Malaysia

Learning about history has always been important, on a global scale it allows us to understand the people and society from the past to improve our life in the future and learn from mankind's past

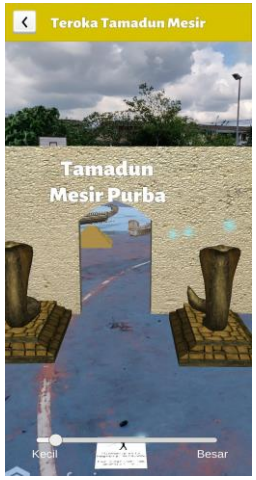

Figure 1 (left): Marker-less AR of SejarAR
Figure 2 (right): Marker-based AR of SejarAR

Figure 3 (left): Quiz gamification of Content
Figure 4 (right): Mini game gamification of Content

mistakes [2]. A civilization thrives when it learns from the destruction of the past civilization and a civilization that does not learn from its past are destined for its downfall. On a national level, learning history can actually foster national integration and unity among the citizen of the country [1].

In a study by researchers from UiTM, Malaysia they have conducted a study based on the study on 45 students found out that 60% of the students dislike history lesson in and among the 60%, 45% are not interested in learning history and 22% thinks it is hard to memorize and understand and the reason behind it is caused by the overwhelming amount of information facts and dates that are hard to memorize [4]. To counter the boredom experienced by students in history lessons, educator could actually improve the situation by incorporating game elements into the lesson to improve their attention [12] [6].

Potential of Augmented Reality (AR) in Mobile Learning (M-Learning)

Augmented Reality (AR) in a simple term is a way to overlay digital information into the real world usually via mobile devices, head-mounted display or projectors. The definition of AR has evolved through time but generally it AR has been accepted to be the real time use of information and integrate it with real-world objects [7].

AR has gained a lot of attention in the recent years as a technology which combines digital information with the physical environment in real time. Due to the recent technological advancement, AR is undergoing a tremendous growth in the recent years [8], with the continuous growth it is becoming more portable and accessible to the mass consumer. Although AR are more frequently used in gaming application, it has also been used successfully in education and Horizon Reports from the New Media Consortium's Emerging Technology Initiative predicts that AR will soon see a massive uses in the United States college campuses [9].

Throughout the years, multiple researchers have studied the use of augmented reality in education and they believe that AR poses a huge potential and various benefits by adapting the augmented reality technology in students learning environment [10], [11]. The main attraction and advantage of AR is that it has a potential to increase engagement and interest of the students, and indirectly increase students motivation to explore and learn [12]. Furthermore, it allows students to explore and interact with things which are impossible or not feasible in the real world [8], this is especially applicable in the domain of history where it is impossible or not feasible to travel back to prehistoric

Table 1: SUS Score Analysis of SejarAR

Demographic	*Average Score*
Male	71.7
Female	78.1
Overall	74.2

Table 2: Participant Preference on Application

Application	*Person*
SejarAR	23
Memory Booster	2

**Memory Booster is an existing m-learning application*

Table 3: Participant Preference on AR functionality

Functionality	*Person*
Marker-less	15
Marker-based	10

Table 4: Rating of Application

Description	*Rating*
Enjoyable	4.76 / 5.00
Recommendable	4.64 / 5.00

times, visiting the Rentap while he is defending his people or travel to Egypt to visit the Pyramids. This results in a more interactive environment for students to learn and are less rigid, by introducing a more playful environment, it has also been studied that playfulness increases users' motivation to use a specific product and therefore increases its engagement [13]. Another study also reveals that students has an extremely high acceptance towards AR technology in m-learning and are excited while using the application [14]. This also suggest the great potential of using AR in m-learning.

PURPOSE OF EVALUATION

The purpose of this evaluation is to test the usability of the application and to test out two hypotheses and a usability testing as below:

1. Compare learning with AR and without AR(Table2)
    a. H_0: Learning history on mobile device with AR is less enjoyable compared to learning history on mobile devices without AR. ($H_0 > H_1$)
    b. H_1: Learning history on mobile device with AR is more enjoyable compared to learning history on mobile devices without AR. ($H_0 < H_1$)
2. Compare learning with marker-less AR and marker-based AR(Table 3)
    a. H_0: Learning history with marker-less AR (explore) is preferred compared to learning history with marker-based AR (learn). ($H_0 > H_1$)
    b. H_1: Learning history with markerless-based AR (explore) is less preferred compared to learning history with marker AR (learn). ($H_0 < H_1$)
3. Usability Testing with SUS evaluation (Table 1 and 4).

The first hypothesis will be comparing between SejarAR application and Memory Booster SPM. Memory Booster SPM is an existing mobile learning application for high school students in Malaysia with various subjects including the history subject.

RESULTS AND ANALYSIS

The study was conducted in a group of 25 students in SMK Seri Serdang in November 2018. Comparing between both SejarAR application and also a mobile learning application Memory Booster SPM by Oxford Fajar. After the interview it shows that 23 out of 25 participants (92%) actually prefers using SejarAR compared to Memory Booster SPM(Table 2).

SejarAR has scored an average of 74.2 with 25 participants for the usability testing based on the SUS evaluation. A score of 68 signifies an average application and any score above that is above average(Table 1 and 4).

Further breakdown of the analysis shows that there is only a slight significance of score achieved by the male student participant and the female student participant with a score of 71.7 and 78.1 (Table 1) respectively. This translate into that both female and male students have similar thoughts and perception towards using the application.

Another purpose of the testing session also aims to understand if there are any preferences between the two types of AR. The result shows that both type of AR in the application marker-less AR and marker-based AR has 15 votes and 10 votes respectively (Table 3).

CONCLUSION

In conclusion, based to the SUS score the SejarAR application has achieved a score of 74.2 which is considered to be an application which is above average for a system under the SUS scale. Based on the results of overall satisfaction of SejarAR with an average score of 4.60 / 5.00 and 23 out of 25 respondent preferred SejarAR over Memory Booster SPM, in hypothesis 1 we can accept where learning history with AR on mobile devices is more enjoyable. In hypothesis 2, based on the results of the respondents who prefer learning with markerless and marker-based AR. There is not enough evidence to proof if markerless AR is less enjoyable compared to learning history with marker-based AR (learn). Therefore, we cannot conclude if one AR technique is better than the other in a mobile learning environment.

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