Research Article

The Development of Mobile Augmented Reality Application to Facilitate High School Students with Various Learning Strategies in Learning History

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Article History: Received: 10 November 2020; Revised: 12 January 2021; Accepted: 27 January 2021; Published online: 05 April 2021

Abstract : Augmented Reality is a demanding feature that widely embeds in our mobile devices. With the current mobile networks this feature will be increasingly accessible in many areas such as education. The current situation in learning history is boring and unattractive to high school students. In addition, the current history books as well as additional revision books are very textual and contain less pictures. The aim of this paper is to describe the mapping of the different learning styles that the students have employed onto the AR mobile application in learning history. The mapping should facilitate all learning styles so that learning history becomes more interactive and engaging.

Keywords: Mobile Augmented Reality Application, High school students, Learning styles, History

1. Introduction

The Industrial Revolution 4.0 (IR 4.0) has given a new impetus to educational transformation. Technology has become a very useable and useful tool as either to assist teaching and learning or to complement the traditional learner effort in mastering a particular subject. The technology advantage has been consistently applied to various ages of children and students (since kinder garden till university level). Mobile technology has conquered many sectors including education. (Mueller, 2019) has reported that the number of smartphone users in Malaysia is estimated to reach 18.4 million. As a result, many mobile applications have been built to assist students from various education backgrounds. It is also expected that younger generations learning experience will change due to the technological advancement in education (Taharim et al. 2016).

Secondary education level in Malaysia consists of three national levels of examination. One of the pertinent examinations is Sijil Pelajaran Malaysia (SPM). In 2013, the history subject along with Bahasa Malaysia have been upgraded to be a must-pass subject. Also, it helps the younger generation to learn from the past and foster national unity (Salleh and Ayuddin, 2010)

History subject has been reported by several researchers to be boring and not interesting (Taharim, et al. 2016) to learn by students. Current history text books in Malaysia are considered as static with long texts and minimal images (Idris and Kamaruddin, 2018). Hence, this method only supports textual and visual learning strategies. To date, we discovered that none of the text books or supporting materials for history have applied AR technology for their supporting history materials on line or in any app store. In addition, teachers who teach history also have difficulties in making this subject fun and attractive students to learn this subject. In this paper, our objective is to describe the development of the mobile app that compliments three learning strategies: text, audio and kinesthetic.

2. Related Works

2.1 Learning Strategies

Amongst issues and debates about teaching and learning History subject are: lack of history references and up-to-date text books (Gomez, 2014); current method of teaching history which requires the students to memorize the facts and dates (Malaysia Insider, 2013); exam-oriented systems and others. Ministry of Education(MOE) is aware about the debates and changed the Malaysian education curriculum including History. In Malaysian Education Blueprint 2013-2025 has launched a new Secondary School Standard Curriculum with the objectives that students will acquire a balanced set of knowledge and skills such as creative thinking, innovation, problem-solving and leadership“ and to shift the exam-oriented to less emphasis on examination (Shakila et al. 2014).

Each student has different styles of learning. They will use their senses to take in information (Abbas Pourhosein Gilakjani Dec 2011) and (Hussain et al,. 2020). Video, audio and kinesthetic(VAK) and visual,

aural, reading and writing, kinaesthetic (VARK) are among the common and popular learning styles that students employ and used in many studies. Teachers must prepare various techniques and strategies to adapt their student learning styles. Hence, to instill students with more intresting learning techniques that map with their leaning styles (VAK and VARK).

Text books and other suplementary reading materials mostly contains static information and images. Based on our assumption, these type of text books are suitable for students who use visual and reading and writing learning styles. Then, the physical text books has evolved to e-book, a good initiatizes by the Malaysia Ministry of Education where it is designed to have good features that support rich media content and mobile ability. MOE has shown that technology does plays it part in supporting the education environement. In some of the topics, they embed video and audio to support learners with visual and audio. To date, with advance technology we believed that this could provide better solution to assist kinaesthetic learners. Augmented reality(AR), virtual reliality (VR) and mixed reality (MR) are technology that can engage kinaesthetic learners as well as other type of learners. Section 2.2 describes and explains about technologies used that supported other subjects in school.

2.2 Technologies For Learning

Education is one of the important domains where technology has been used to facilitate learning and teaching. The transition from static text book learning to dynamic learning with technology has shown the satisfaction with the technology of many students as well as teachers. Mobile devices ranges from smartphone, PDA, tablets and iPODs are used for learning purposes in this era (Abachi & Muhammad, 2014). According to Carvalho et al. (2015), Connolly et al. (2012), Hussain et al., (2020b), Crookall (2010), Sandholtz (1997) students who used mobile learning have shown that they can engage with the learning environment. In addition, the mobile technology with AR technology keeps improving to support many user's activities and tasks. AR is the combination of real and digital world. Therefore, AR has found to be very useful and beneficial in education. It has indicated that the AR technology can increase student retention and studies effectively (Billinghurst & Dunser, 2012).

Many researchers have reported that mobile learning with AR has successfully been built for science subjects (Setiawan, Rostianingsih, Widodo, 2018). Moreover, other mobile applications with AR has also been built to create awareness and improve learning experiences for instance: cultural heritage by Voinea, Girbacia , Postelnicu, Marto (2019) , Zukhi et al,. (2020) , Law (2018), and vocabulary (Ibrahim et al. 2018). History subject is one of the lessons that need AR technology for a better student learning experience and have been seen in other research works either using local or global contents. Following this, we will describe some research works that emphasezed history subject as a content in the AR mobile application development for high school students.

Augmented Reality based in Learning about Malay Patriots (ARMyPAT) by Mokhsin et al. (2019) is a mobile application using AR in learning Malay historical Patriots. This medium is used to attract students aged 10 to 15 years about Malaysian patriots. It used the Android platform. ARMyPAT converted the text and image information into more interactive learning medium which trasnformed the Malay Patriots image into a 3D model. The main objective is to attract students interest in knowing the Malay heroes. In addition, this mobile app embeded the interactive game.

Another study by Azhar, Diah, Ahmad, & Ismail (2019) about the effect of combining AR technology with the traditional information to create excitement in learning history. Their work focused about Malacca Empire. The motivation of their study was about bored and unintresting traditional learning method by text book. This discourages the younger generations to understand about the Malaysia history particulary about the fall of Malacca. The implementation of the AR mobile app has improved the youngters engagement and understanding about Malacca history.

While another study by Raghaw, Paulose, & Goswami (2018) proposed a system model for AR mobile app for India history subject. Students learn the history through the augmented videos. However, the success of the system model is still at questioned because the development work is still ongoing.

Another study called Teach Me a Story by Schiavi, Gechter, Gechter, & Rizzo (2018) that supported the French history teaching task. The content for the protocol was Mesopotamia. One of the objective of this topic was to build the Mesopotamia city. It was quite difficult and challenging to produce the Mesopotamia city by using 2D and traditional materials and docuements such as blueprints, images and mock-ups. The Teach Me a Story AR mobile application has helped the students to learn an abstract concepts in a more simple and intresting

way. Whereas, the teacher was also satisfied to use the app in facilitating their teaching activity. Based on the experiemental results, the students reported that they have a better understanding using the mobile app compared to the traditional materials.

As a conclusion from the literature study conducted, we have identified that the previous works have never focused their study towards high school learning history with different learning styles. As a result, our work will aim to use the AR mobile application to facilitate high students with different learning styles.

3. Methodology

We used Agile approach to develop the mobile application. Agile approach anticipates change and allows for much more flexibility than traditional methods. User involvement in the development creates several changes in the design and development. In addition, it was chosen as it suits with mobile application development.

Analyse Phase

Understanding user is the first phase in this approach. We selected a secondary school that was located nearby our location. First, we contacted and met the headmaster of Sekolah Menengah Sri Serdang to ask her permission to conduct a study at her school. Then, we were advised to follow the Education Ministry prcedure for conducting a research at any public schools in Malaysia by filling up the information requested from the Educational Research Application System (Eras2.0) [https://eras.moe.gov.my/].

Once our application was approved, we set-up a few meetings with one of the best secondary school teacher for History subject, students attitudes about History subject and how had the subject been conducted in class. We also asked for some content or topics that were difficult for the students. As a result, we were advised to select Mesir Civilisation topic to be the content for our prototype development. Then, we requested from the History teacher to provide us with students from Form 4 and Form 5 with various history grades to involve in our requirement gathering until prototype design and evaluation. The total number of students involved was 10. Moreover, we also analysed and studied history text book and history reference books to better understand about the content and used the understanding to provide some design solutions. We named our history mobile application as SejarAR.

Design Phase

The requirement analyzed in the analysis phase was used in the design phase. The design phase started with low-fidelity prototype. In this phase, we used low-fidelity prototype to test our conceptual design with the students. Few iterations conducted until we had a firm design decision to be developed.

Development Phase

The development of the mobile application was implemented by using Unity3D game engine which is a game engine that can design game for cross-platform operating system. The implementation of SejarAR uses the C# language in Visual Studio to write scripts that the Unity3D engine uses. Several other SDKs were used for the development of this application such as the Vuforia SDK for AR supports.

Implementation Phase

The implementation was done with a number of iterations followed to confirm the design decision with Form 4 and 5 high school students and their excellent history teacher. The Learn and Explore use cases with the combination of multimedia elements have complemented the development of SejarAR mobile app. The Explore features made the students move finding a spatial space such as a wide field to be able the 3D model of Mesir Civilisation images appears in front of ths students.

Evaluation Phase

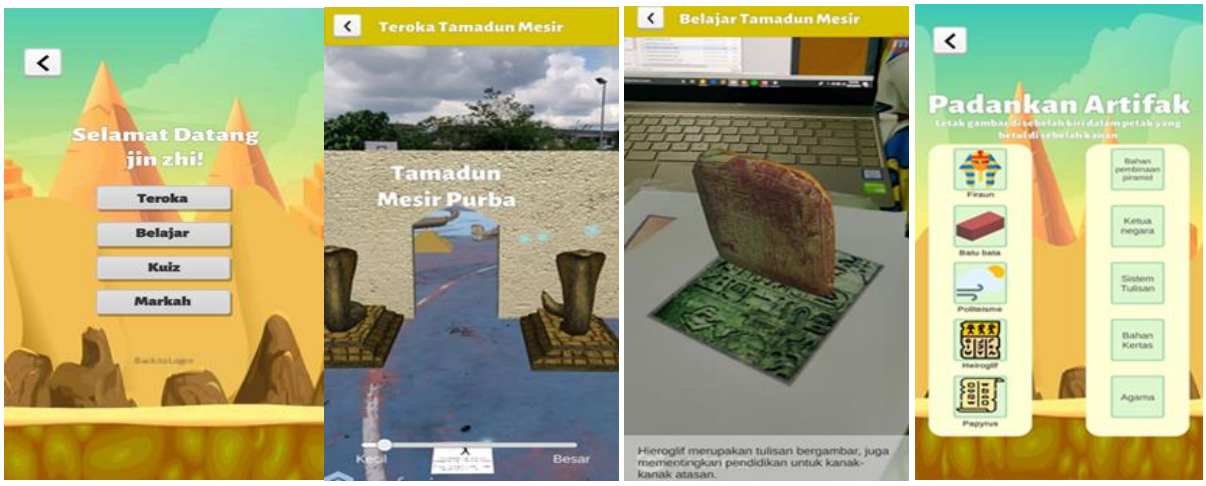
Both formative and summative evaluation had been conducted to test our hypothesis and students preferences. Formative evaluation had been administred in between the stages to make sure we build based on the students requirements and expectaions. The final evaluation conducted was usability testing (Low et al 2019). Nevertheless, in this paper, we will not explain the usability testing process conducted.

4. Development of the History AR Mobile Application

SejarAR is the AR mobile application built to facilitate high school student's learning history subject. Based on the user understanding analysis, we discovered five interesting use-cases model to portray the SejarAR mobile application. They are: Learn, Explore, Assessment and Tracking score. Therefore, to prove the conceptual of the use-cases we transformed the use-cases identified into the VARK learning styles. The SejarAR mobile application development was chosen to realize the transformation of VARK learning styles onto the use-cases model identified. In order to verify our model, we conducted several evaluation for example: System Usability Scale (SUS), Malaysian high-school student preferences (Low et al. 2019).

4.1 Explore Model

This model signifies the kinesthetic learning strategy. This type of learning strategy requires the students to move around. Hence, the explore model indicates a maker-less AR functionality which requires users to scan on any flat surface to augment an ancient civilisation for the students to explore. This model allows kinaesthetic learner to actively engage with the content by immersing themselves in the Mesir Civilisation. The contents as well as the 3D models used in the application were based on the Ministry of Education syllabus. The Mesir Civilisation topic was suggested by the excellence history teacher of the school. The exploration model also consists of audio and textual descriptions to inform the students about the model emerge from the detection (refer Figure 1(b)). In this model, students can move out to the field and immersive themselves with image detection. They can see objects that existed during Mesir Civilisation for instance: mumia, Nil River, pyramid and others with audio and text description.



(a) Main Features **(b) Explore Model** **(c) Learn Model** **(d) Assesement Model**

Figure 1. The SejarAR Mobile Application UI

4.2 Learn Model

This model represents the audio and visual type learning strategy. The learn model uses a marker-based AR functionality which complements the textbook and requires users to scan images on the textbook to unlock additional information. In addition, it also provides video for students to watch about certain sections in this topic. Both textual, audio and visual compliment this type of learning strategy if they want to stay in one position (refer Figure 1(c). The student who employs textual and visual can utilise this model where the student needs to point their mobile device on the text book, then the video and also the 3D image will pop-out from the text book.

4.3 Assessment Model

The assessment model consists of Quiz and Marks functionality. These features help students to test their understanding about the topic. The model that we proposed does not only focus about the learning aspects but also the assessment aspect. This model applied the gamification-type content for students to engage with the learning. Hence, this model also increases the excitement of student by implementing a level and time-based quiz to gamify the learning contents (refer Figure 1 (d).

The development of the use-cases model identify are able to map with students learning styles. With the usage of AR mobile app development, we can conclude that the students learning experience has changed from boring and traditional learning to interactive and more engaging in learning history subject.

5. Conclusion

This paper has discussed about the conceptual model of learning history for high-school students in Malaysia. The model has been translated into the development of SejarAR the mobile application with AR technology. The development of the mobile application is to facilitate different types of learning strategies for learning history subject. The evaluation of the mobile application has been evaluated (Low et. al 2019). Next stage of the project is to build own 3D model and further improve the content of the mobile application.

6. Acknowledgment

This research was supported by HILTI ASIA IT SERVICES, Petaling Jaya, Malaysia with the project titled " SejarAR – Augmented Reality Application for High School History Subject" dated 25 September 2018. In addition, our gratitude to HAITS for sponsoring the AIIC2020 conference fee. Special thanks to our Form 4 & 5 students and teachers of Sekolah Menengah Kebangsaan Sri Serdang, Selangor for their co-operation in making this project a success.

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