

# OS-Learn: Mobile Learning Application for Operating System with Augmented Reality

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Received Date: 2 September 2020

Accepted Date: 12 October 2020

## ABSTRACT

*Theoretical subjects or courses are often disliked among students due to its massive load of information which often lead to misconception or confusion. As a result, most students would resolve to rote learning instead. Therefore, the purpose of this research is to design and develop OS-Learn, a mobile application created to help students in learning theoretical subjects such as operating systems concepts. The core element of OS-Learn would be active engagement, such as the use of visualization and improving memory retention. OS-Learn use AR elements as part of its visualization technique. ADDIE model was selected as the framework to design and develop the application. User acceptance testing was performed after the development phase to obtain feedback from potential users which are university students. Thirty students were selected to evaluate the mobile app based on its design, navigation, and content. Each respondent was given set of tasks and were required to complete a questionnaire based on their experience using the application. The outcome was mostly positive where most respondents were satisfied with the overall design of the mobile application. Feedback and suggestions were also collected then reviewed to make necessary adjustments to the application before being deployed.*

**Keywords:** Mobile application, mobile learning, augmented reality, theoretical subject learning

## INTRODUCTION

In the current age, drastic changes in the social and economic lifestyles of modern people become possible because of the advancement in handheld portable devices and wireless technology. However, these developments have only been limited to social communication and just some people solely think about mobile learning as a key educational activity (El-Hussein & Cronje, 2010). Mobile learning was seen to be widely used where it was proven by the growing size and the frequency of dedicated conferences, seminars, and workshops internationally (Traxler, 2005).

Learning theoretical subjects or courses, such as operating system concepts can be difficult as the topics are mostly relying on the students' imagination to visualize the whole concept of operating systems components and functions. Failure to digest massive number of key concepts within a subject would lead to rote learning. To avoid rote learning, different approach should be taken to tackle such difficult courses. Individuals should focus on both concepts and narratives for an effective learning process, as well as having active engagement in their study plan (Chakraborty, 2019). Within active engagement, these individuals can learn better by simply having visualization of the knowledge instead of long lines of text. As a result, memory retention is also improved.

Nowadays, learning can be done anywhere, anytime according to the user's convenience. This can happen with the help of mobile learning applications. Though, having these convenience does not mean that they can have a better understanding just by reading. With the help of augmented reality, students will get better understanding visually and can improve their memory. This is because the image projected using augmented reality technology can help them understand more about the subject and to strengthen the interest of the users to use the mobile learning application. Augmented reality offers us unique affordances where physical and virtual worlds are combined to alter our interaction with reality. It improves the user's perception and interaction with reality by bringing virtual information to the user's indirect view of the real-world environment (Kesim & Ozarslan, 2012). It is an interactive environment where real life is enhanced by virtual things in real-time.

## **LITERATURE REVIEW**

### **Current State of Mobile Learning**

In recent years, technology-enhanced learning (TEL) work has focused increasingly on emerging technologies such as increased reality, ubiquitous learning (u-learning), mobile learning (m-learning), serious games and learning analytics to boost user satisfaction and interactions in enriched multimodal learning environments (Johnson, Adams Becker, Estrada & Freeman, 2014). Such research take advantage of technological innovations in mobile device hardware and software and their increasing popularity among people as well as the significant creation of user modelling and personalisation processes that put the student at the core of the learning process.

Alzaza and Yaakub (2011) suggested that today's high school students have sufficient technical skills, awareness and self-motivation to use mobile technologies to support their learning. They also conclude that many higher institutions have the necessary technological infrastructure within the curriculum to implement mobile learning activities. Data services and multimedia messaging systems and increasing awareness among students about the potential use of mobile technology in the learning environment (Uzunboylu, Cavus & Ercag, 2009).

### **Augmented Reality in Education**

Augmented reality (AR) can be described as a technology that overlays the real world with virtual objects (augmented components) (Akçayır & Akçayır, 2017). Then these virtual objects seem to coexist in the same space as real world objects (Azuma et al., 2001). A research by Cuendet, Bonnard, Do-Lenh, & Dillenbourg, (2013), implies that AR refers to technology projecting digital materials on objects in the real world. Such meanings are based on one of AR's functions, which means that virtual knowledge can be superimposed on real objects. By incorporating virtual objects to actual environments, AR allows the inclusion of missing information in real life (El Sayed, Zayed, & Sharawy, 2011).

AR technology has matured to the extent that it can be applied to a wider range of applications. Education is an area in which this technology could be of particular value (Billinghurst, 2002). Augmented Reality's educational experience is different for several reasons. One of the reasons is it is supported for seamless interaction of real and virtual environments. Next, the use of a tangible metaphor interface to manipulate objects is also one of the factors. Physical objects or props are commonly used in educational settings to convey purpose. There is an intimate relationship in Augmented Reality between virtual and physical objects (Billinghurst, 2002). Physical objects can be enhanced by providing dynamic information overlay, private and public data display, context-sensitive visual appearance, and physically based interactions in ways that are not normally possible.

## METHODOLOGY

The method used in this research is the ADDIE model. ADDIE model is an instructional methodology where it would assist to organize and streamline course content development. The model is divided into several phases which are analysis, design, development, implementation, and evaluation as shown in Figure 1. The model focuses on reflection and iteration while is being based on each phase. The model gives a streamlined, oriented strategy that offers continuous improvement feedback.



Figure 1: The ADDIE model used for this research

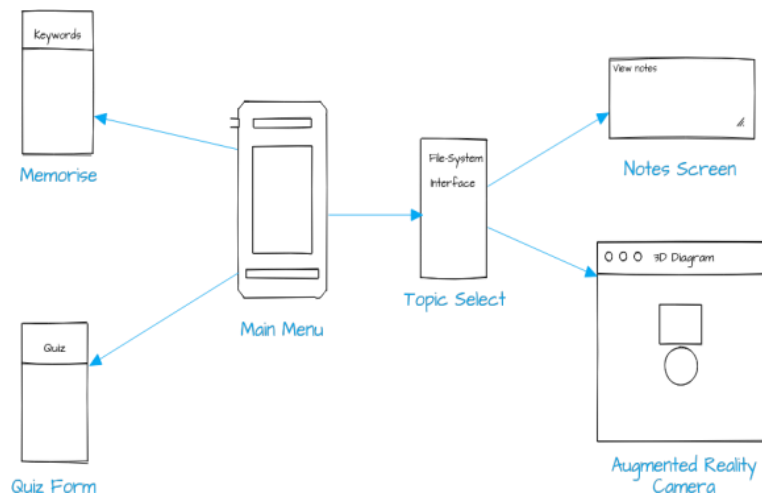


Figure 2: OS-Learn Storyboard

Based on Figure 2, the storyboard explained the interface design and the flow of OS-Learn application. Upon launching the application, the user would be directed to the main menu. In the main menu, the user has four options where they can navigate to notes page, quiz page, memorise page or to quit the application. When they tapped on to the note page, they will be directed to a topic selection menu. They can view notes based on the topic they choose. The notes page also has a function where the user can use the augmented reality camera to view selected structures. When the user tapped on the quiz page, they will be directed to the quiz page where they would be able to view and attempt. The user can do

assessments based on the materials in the notes page. When the user tapped on the memorise page, the user will be directed to the keyword viewing page. In that page, user will be able to view keyword and its description.

## Development Phase

Vuforia is an augmented reality software development kit (SDK) for mobile devices that enables the creation of augmented reality applications and can be found easily in the build settings in Unity editor. The developers used the built-in Vuforia assets in the Unity Editor to enable OS-Learn project the ability to use AR features. It uses computer vision technology to recognize and track planar images and 3D objects in real time. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world objects when they are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with the perspective on the target. It thus appears that the virtual object is a part of the real-world scene.

The AR element needed in this app were created using Paint 3D. This can be done by drag and dropping the created 3D model onto the element. Once the items were added into the image target, the developer needs to readjust the placement of the 3D object to make it more presentable. Figure 3 shows the preview in the editor on how to manipulate the 3D object positions. As a result, Figure 5 shows an example of viewing AR content in OS-Learn. When the user chooses “3D Diagram”, they will be navigated to the AR Camera interface. The interface would launch the user’s smartphone camera. User can then use the AR features once they point the camera to the designated marker where a 3D diagram will be projected. The user would be able to view three structures which are Single-layer Diagram, Two-layer Diagram and Tree Structure diagram. Once the user finished using the camera and wanted to navigate back to the menu, there is a “Back” button on the bottom left for the user to click on.

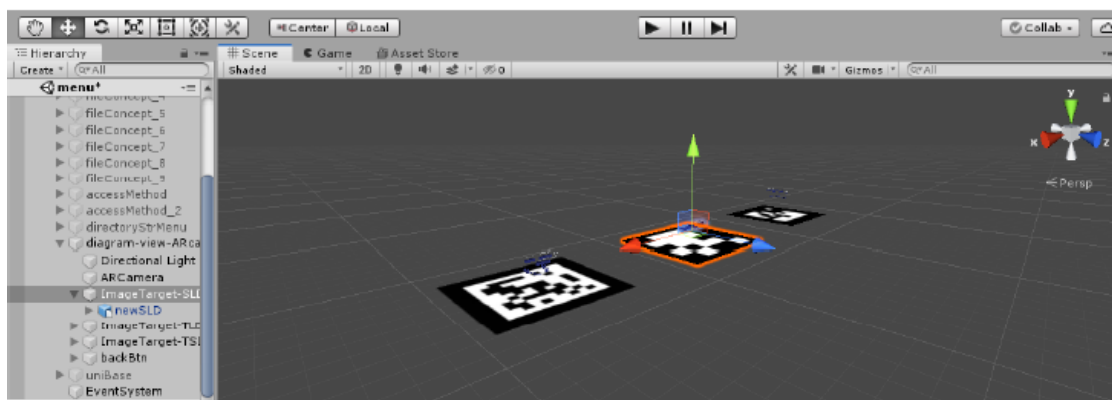


Figure 3: Manipulating 3D object positions to set markers for the AR content

Figure 4 shows an example of OS-Learn learning content. In the “Notes” menu, users can choose the topic they want to view. File concept and access methods topics will display simple notes for the user

to read. There is also a “Back” button for the users to use if they want to transition back to the main menu.

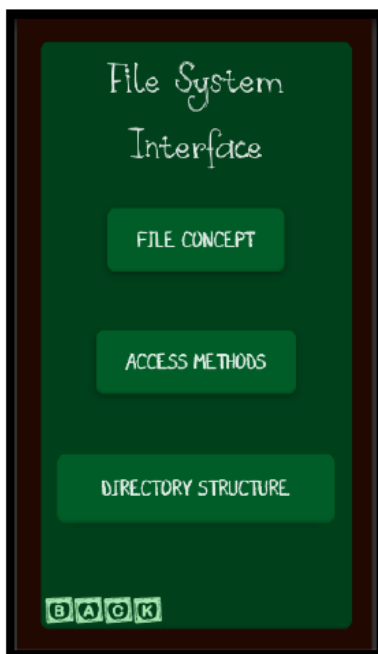


Figure 4: Example of Notes menu in OS-Learn App

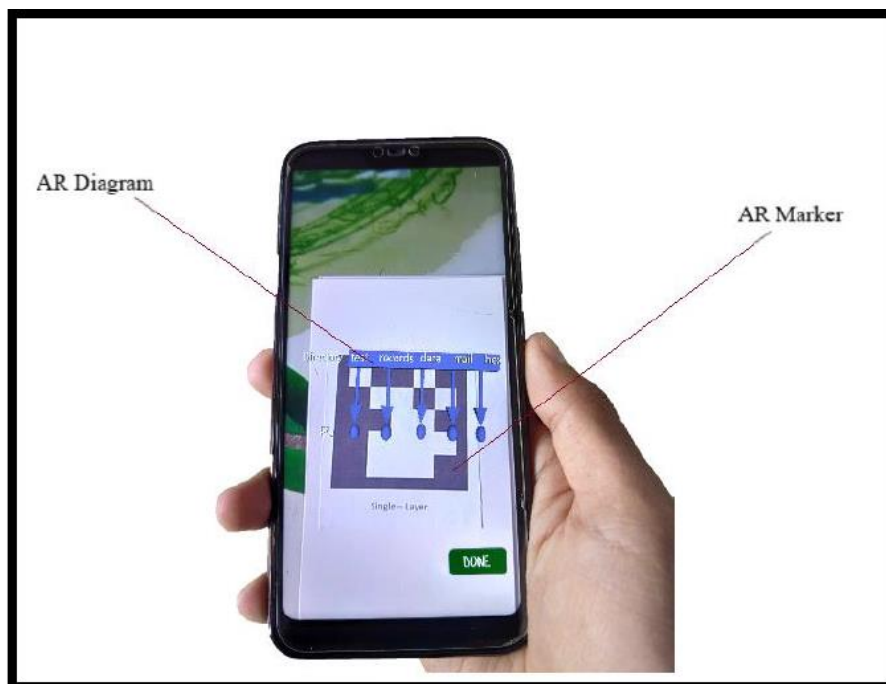


Figure 5: Example of Directory Structure content using AR

## FINDINGS AND DISCUSSION

User acceptance testing was carried out after development phase to ensure the research objectives can be achieved. Thirty respondents were selected among students in UiTM Perlis Branch to evaluate the mobile application. Each respondent was provided a questionnaire using Google Form which contains a set of tasks required to complete the evaluation. During evaluation, respondents were observed carefully by the researcher. All the tasks given were sorted according to four major criteria, which are reaction to the application, interface design, navigation, and finally the content of the mobile app itself. Finally, respondents are also advised to leave feedback or suggestions related to the mobile application.

Table 1: User Acceptance Testing Results

No	Criteria 1: Reaction to the application	Min	Max	Mean
Q1	I am able to complete all the tasks in this application.	4	5	<b>4.60</b>
Q2	This application is easy to use.	4	5	<b>4.70</b>
Q3	This application is really useful.	3	5	<b>4.23</b>
	<b>Criteria 2: Interface design</b>			
Q1	The user interface design is interesting.	3	5	<b>4.23</b>
Q2	The color used is attractive.	3	5	<b>4.03</b>
Q3	The text is clear and readable.	4	5	<b>4.63</b>
	<b>Criteria 3: Navigation</b>			
Q1	It is easy to move from one screen to another screen.	4	5	<b>4.70</b>
Q2	The button provided is easy to interact.	3	5	<b>4.23</b>
Q3	The instruction given is clear.	3	5	<b>4.17</b>
	<b>Criteria 4: Content</b>			
Q1	The content provided is clear and well arrange.	4	5	<b>4.63</b>
Q2	The information provided is easy to understand.	3	5	<b>4.20</b>
Q3	The application has all the functions according to user expectation.	4	5	<b>4.80</b>

Table 2: Overall Results for Each Criteria

Criteria	Min	Max	Mean
Reaction to the application	4.23	4.70	4.51
Interface design	4.03	4.63	4.30
Navigation	4.17	4.70	4.37
Content	4.20	4.80	4.54

Table 2 shows the overall result for each criterion that were summarized from Table 1. The mean for reaction to the app is 4.51. For interface design, the mean is 4.30. For the navigation, the mean is 4.37 and a content criterion, the mean is 4.54. Therefore, the reaction to the app is the highest value which is the users can easily use the application without any difficulties. The interface design criteria are the lowest value which is needed to redesign the interface of the app to make it more interesting. Therefore, the overall response from each criterion can be concluded that users gave out positive feedback, thus can be translated to users were satisfied with the mobile application.

## CONCLUSION AND RECOMMENDATION

This mobile app will help students to tackle learning theoretical subjects or courses by having a lot of improvements especially in visualization of the content. For example, the mobile app provides 3D diagrams as part of visualization technique using AR elements to help users or students firmly grasp the subject's key concepts. The researcher invites any feedback to further improve the application in the future. Several recommendations can be issued to further improve the efficiency, effectiveness, and user-friendliness of OS-Learn app. Firstly, the user interface needs to be further improved to make it more appealing. Secondly, expand the augmented reality functions by enabling multiple tracking to give the ability to track multiple marker targets and display multiple diagrams at once. Thirdly, give the ability for the user to add their own keywords for more flexibility in memorizing.

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