

Integrating Augmented Reality in Storage Technology Learning Module (ARStore)

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Abstract:

The importance of innovation in technology has led to various uses in all fields including education. The integration of this technology in education always opens new opportunities for students to have a new learning environment in a subject they learnt, especially for university students. One of the technology that have been integrated in education is Augmented Reality (AR). This study aims to plan and develop the teaching and learning module with the integration of AR technology. The combination of multimedia elements and 3D models will be able to attract students in the teaching and learning process. The development of this game application was developed by Unity software as the main platform, Adobe Illustrator to design icons and buttons for applications and Vuforia for AR parts. In order to develop the application systematically, the developers use the Hybrid ADDIE as development methodology. Expert review and functionality test had been done during the evaluation phase and the results show that the experts agree that ARStore fulfills all the required functions. It is hope that this module can be used for student to learn this subject and the idea can be expand for the use in other subject.

Keywords: AR, Multimedia, Module Learning, Data Storage

1. Introduction

Innovation in technology has led to various uses in all fields including education (Wahyudi & Wulandari, 2019). According to Budiman (2014), the development of this technology look like mushroom grows after rain to the whole world as well as the integration of education in technology as it opens new opportunities for students to improve their interest in a subject, especially for university students. The use of technology in teaching is very important in improving the skills of teachers and students through the use of tools and learning methods themselves (Anshor, 2018). There are various sources of technology that have been integrated in the field of education and one of them is Augmented Reality (AR) which can attract students to learn a subject. AR technology has the potential to bridge the gap between formal and informal learning contexts (Danakorn, 2013). In the study by Ramli et al. (2018), it is expected that AR modules with 3D object models can increase understanding of complex

content due to objects existing and can be manipulated by students as well as supporting immersive learning.

Previous studies found that among the factors that contribute to teaching and learning problems are the environment, basic knowledge and teaching methods of lecturers (Norabeerah et al., 2012). For example in university, most learning process that occurs now is through conventional method in which lecturer using presentation slide while students listen to the lecture. Even there are many new teaching and learning tools, they still implement conventional learning. This can cause students to be ignorant to what they are learning. In addition, the knowledge imparted to students is insufficient and soon students will be less interested in the lessons given. Therefore, interactive slide-based technology and animation, AR can be implemented in their teaching and learning process.

The purpose of this project is to develop an AR integrated learning module consisting the topic optical disk drive, cloud storage and the latest storage technology to help students who take Information Technology for Education (TMDP) course at Faculty of Technical and Vocational Education (FPTV), Universiti Tun Hussein Onn Malaysia. The objectives of this project are:

- Design the AR integrated learning module for the topic Storage Technology in TMDP course.
- Develop the AR integrated learning module for the topic Storage Technology in TMDP course.
- To test the functionality of AR integrated learning module for the topic Storage Technology in TMDP course.

1.1 Research Background

The emergence of various new technologies in Information and Communication Technology (ICT) is a catalyst for the existence of opportunities in the field of education. ICT can also serve as a paradigm shift and pedagogical content (Billinghurst, 2011). AR is a combination of real world and virtual objects in three-dimensional (3D) animation and is interactive in real time. AR is also part of the Virtual Environment (VE) or known as Virtual Reality (VR) which gives users a visualization of the integration of the real world and the virtual world in the same place. The principle in AR technology is to combine between the real world and virtual objects (Martono, 2011). AR user able to walk interactively in the real world and also having integration between in the real world. The fusion between real and virtual objects is using appropriate and interactive display technologies required at certain stages (Rusnandi et al., 2015). Setiawan et al., (2014) stated that the use of AR has been applied in various lives because the latest technological developments have supported the development in displaying various forms of the object to be conveyed and AR will provide additional information in a piece of information.

The existence of technology has helped in the teaching and learning system in schools. In fact, AR has many opportunities that can be developed to attract the attention and interest of students. In addition, AR can be implemented in a wide variety of media including printed media such as magazines, newspapers and pamphlets (Apriyani & Gustianto, 2015). It can be said that AR technology makes the user's body move and the camera as eyes to produce a virtual real on the screen using AR applications (Kamelia, 2019).

The design of teaching and learning module is one of the most important elements in designing lesson plan. Teaching and learning modules are usually provided to assist lecturers or instructors in teaching a course and students will usually understand in more detail about a course based on the modules provided. Teaching modules usually have several units where each topic has sub-topics or more learning standards. All three of these design models were originally used during the second world war where psychologists conducted studies and research according to methods that would need to be used in military training (Arab et al., 2015).

Learning modules are packages that have been designed with a neat and systematic planning based on syllabus and subtopics to help lecturers or instructors and allow students to learn according to their

own understanding to understand a course. Hassan and Markom (2006), stated that most of the modules developed are the main reference source in the teaching and learning process in the classroom because this is one of the most frequently used methods. Usually, the concept of the module used is in distance learning and the students themselves need to ensure that the information in the module is correctly achieved or not.

The study of Ahmad et al, (2016) shown that most graduates from universities need extensive knowledge and skills with the job market, especially in this age of information technology sophistication. Related skills include the competence of cognitive theory that students need to have in - depth knowledge of the field involved, problem-solving skills and skills in decision making by maintaining seriousness in learning a course. According to Kassim & Ahmad (2010) students can control learning better through collaborative, interactive and solitary learning because the modules provide a learning environment with concepts anywhere and anytime. Therefore, this project will integrate AR technology with learning module to introduce new learning environment for students.

2. Methodology

ARStore had been developed using Hybrid ADDIE methodology. This methodology is the most suitable because this methodology involve user in all phases so that user can make sure that each phases fulfill their needs. Hybrid ADDIE is the combination between ADDIE model and AGILE model. The AGILE model is user-focused that connects users with developers. The study by Zulkifli & Majid (2017) combines the elements of ADDIE Model and AGILE Model to ensure application development runs smoothly and will determine the action needed during development process. There are five phases contained in the Hybrid ADDIE methodology which are Analysis, Design, Development, Implementation and Evaluation. The end of each phase is the evaluation phase known as Scrum process which is to facilitate developers to study and improve the weaknesses of the phase. This integration forming a new model known as the Hybrid ADDIE methodology.

The First phase is analysis phase. This analysis phase will identify all the user needs to ensure that an object is achieved. This phase will determine whether this project will be carried out or vice versa in terms of the feasibility of the module, subtopics and schedules. This process had been done to find the cause of the problem as well as to identify the problem that needs to be solved. The target users of the product have also been identified which are students of Creative Multimedia programs at FPTV, UTHM who take the TMDP course for the Data Storage subtopic.

The design phase is the second phase contain the planning information that has been obtained from the analysis phase. In this phase several activities will be produced such as storyboards. The storyboard explains the overall view of the design, content, type of media used as well as the technology used in the development of ARStore. In this phase as well, the developer defined the use of text and color for the interface. Developers chose easy-to-read and medium-sized text so that users can understand the displayed text. The use of attractive background colors is to attract the attention and interest of users to use this application. Figure 1 shows a storyboard design designed using Adobe Illustrator software. In this phase, the process of planning and organizing the content and presentation of information were based on the current presentation slides and other information technology learning modules that have been stated in the actual syllabus.

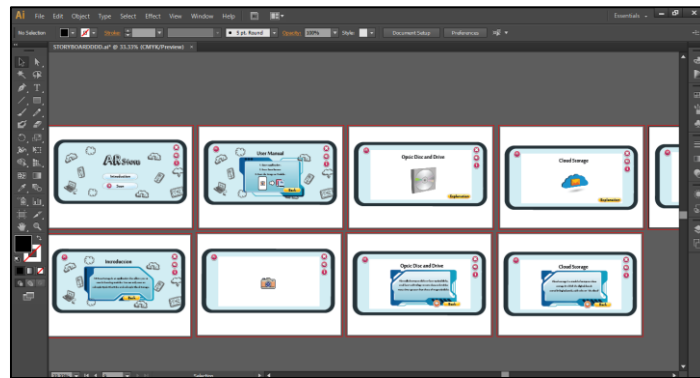


Figure 1: Storyboard Design in Adobe Illustrator Software

The third phase is development phase, This development phase had been implemented after the completion of the design phase along with the evaluation phase of Scrum Sprint 2. This development phase is guided by the design phase that has been planned and set. In this phase, 3D Max software had been chosen because this software has a selection of 3D model development. Then Unity and Vuforia software were used to connect the 3D models to the android mobile platform. Figure 2 shows 3D Model in Cloud Storage topic appear when the camera scan the image target.

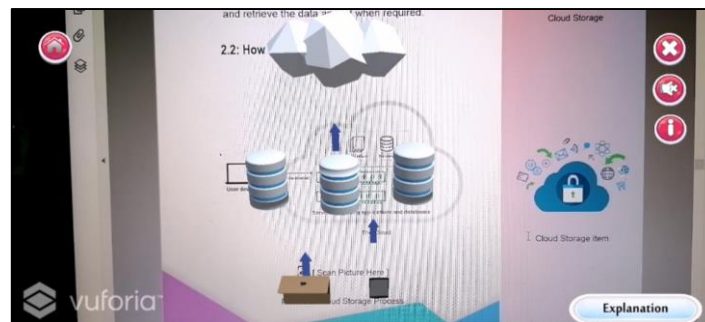


Figure 2: 3D Model in Cloud Storage Subtopic

The implementation phase occurs after the completion of the testing process in the development phase. The developed product will improved as needed and any improvements and errors were repaired based on the feedback of the target users. In this phase as well, users are asked to find bugs and test the functionality of ARStore. Figure 3 shows the explanation panel when user press the explanation button and audio will appear. The user can also mute and unmute the audio.



Figure 3: 3D Model in Cloud Storage Subtopic

The last phase is the evaluation phase. Evaluation is a systematic process that will determine the quality and effectiveness of the development of ARStore. The importance of this phase is to ensure that whether the product development objectives can be achieved. In this phase, target users or actual users were selected as respondents involved in the evaluation of this developed ARStore application. The testing of ARStore focused on the multimedia elements used in the overall presentation of content and

learning about storage storage. The testing and evaluation of this product evaluated by experts in two aspects, namely the content aspect and interface design. The evaluation of the content of this design was evaluated by three students who took the TMDP course at FPTV.

3. Results and Discussion

3.1 Result

The interface design and usability analysis section is part B found in the expert evaluation form. There are 25 items constructed to analyze the level of interface design and usability of the development of ARStore that have been developed. The analyzed data presented in the form of frequency and percentage values as shown in Table 1.

Table 1 shows the interface design expert analysis table. Items one to three were agreed upon by all three experts by obtaining a percentage value of 100%. Only the fourth item of the percentage value got 66.7% because one expert disagreed with the content of the application being linked to existing knowledge. Whereas, items 5 to 25 got full frequency with the highest percentage value of 100%.

Table 1: Expert Data Analysis For Interface Design

No	Item	Frequency		Percentage (%)
		Yes	No	
1.	This application can help students' interest.	3	0	100
2.	The instructions provided in the app are easy to understand.	3	0	100
3.	The content of the application is easy to understand.	3	0	100
4.	The content provided is linked to existing knowledge.	2	1	66.7
5.	English is suitable as the language of delivery.	3	0	100
6.	The content helps to remember the input learned.	3	0	100
7.	The use of the interaction buttons used is appropriate.	3	0	100
8.	All the interaction buttons available in the app work fine.	3	0	100
9.	The interaction buttons used work well.	3	0	100
10.	The panel display interaction buttons work well.	3	0	100
11.	The position of the interaction buttons is consistent.	3	0	100
12.	Background audio can be heard clearly.	3	0	100
13.	Background audio works well.	3	0	100
14.	The descriptive audio matches the background.	3	0	100
15.	The scanner camera display works well.	3	0	100
16.	The 3D model display is well displayed.	3	0	100
17.	The font size used is suitable for the application.	3	0	100
18.	The type of font used is appropriate for the application.	3	0	100
19.	The background of the application makes the application look attractive.	3	0	100
20.	The content of the learning module is easy to understand.	3	0	100
21.	The content of the learning module is clear.	3	0	100
22.	Interesting choice of learning modules.	3	0	100
23.	The type of font used on the module is clear.	3	0	100
24.	The font size of the module used is appropriate.	3	0	100
25.	The graphic image of the displayed module is clear.	3	0	100

Table 2 shows the evaluation for the Scrum Sprint 2 interface design i.e. there were 14 elements evaluated by three selected students. The table shows that all items from items one to fourteen get a high percentage value of 100%.

Table 2: Scrum Sprint 2 Interface Design

No	Item	Frequency		Percentage (%)
		Yes	No	
1.	Helps students understand lessons more quickly.	3	0	100
2.	Help students master the theme of learning.	3	0	100
3.	Students get the desired learning criteria.	3	0	100
4.	Students will be more motivated to learn the subtopics studied.	3	0	100
5.	Help students improve thinking skills.	3	0	100
6.	Helps remember the input learned.	3	0	100
7.	Students can measure or evaluate their own learning outcomes.	3	0	100
8.	The use of modules makes it easier for students to better understand.	3	0	100
9.	Help students receive learned input.	3	0	100
10.	Help students apply the subtopics learned.	3	0	100
11.	Provide a fun learning environment for students.	3	0	100
12.	Plan and implement learning activities either individually or in groups.	3	0	100
13.	Assist in carrying out activities in a planned and systematic manner.	3	0	100
14.	Helps coordinate content especially on learning involving students and lecturers.	3	0	100

Table 3 shows the evaluation for the Scrum Sprint 3 functionality analysis i.e there were 14 elements evaluated by three selected students. The table shows that all items from items one to fourteen get a high percentage value of 100%.

Table 3: Scrum Sprint 3 Functionality Analysis

No	Item	Frequency		Percentage (%)
		Yes	No	
1.	The simple user manual display is clear.	3	0	100
2.	The user manual display is easy to understand.	3	0	100
3.	The 3D Model display is interesting.	3	0	100
4.	The 3D Model display is easy to understand.	3	0	100
5.	The 3D Model display is appropriate.	3	0	100
6.	The display of video hyperlinks is appropriate to the topic.	3	0	100
7.	Video length is appropriate.	3	0	100
8.	English is suitable for use as the language of delivery.	3	0	100
9.	Quiz questions that have a timeline increase the excitement to the students.	3	0	100
10.	The display of video hyperlinks helps to engage students	3	0	100
11.	Graphic Picture Display is easy to understand.	3	0	100
12.	Graphic picture display is clear.	3	0	100
13.	The graphic picture display is interesting.	3	0	100
14.	The display color of the module is appropriate.	3	0	100
15.	The use of graphic colors used is appropriate.	3	0	100
16.	The graphics used have a clear resolution.	3	0	100

Table 4 shows the evaluation for the Scrum Sprint 4 functionality analysis i.e there were 18 elements evaluated by three selected students. The table shows that all items from items one to eighteen get a high percentage value of 100%.

Table 4: Scrum Sprint 4 Functionality Analysis

No	Item	Frequency		Percentage
		Yes	No	(%)
1.	The position of the application buttons is easy to use.	3	0	100
2.	The interaction buttons used work well.	3	0	100
3.	Interaction buttons use the appropriate icons.	3	0	100
4.	The interaction buttons used are user -friendly.	3	0	100
5.	Interaction buttons are well functioning.	3	0	100
6.	The position of the interaction buttons is consistent.	3	0	100
7.	Background audio can be heard clearly.	3	0	100
8.	Background audio works well.	3	0	100
9.	The descriptive audio matches the background.	3	0	100
10.	The scanner camera display works well.	3	0	100
11.	Easy application.	3	0	100
12.	The content in the module allows students to easily understand.	3	0	100
13.	The content of the module is clear.	3	0	100
14.	Allows lessons to be easier to understand on each subtopic.	3	0	100
15.	Helps identify students' level of understanding.	3	0	100
16.	Used as a more effective collaborative learning.	3	0	100
17.	The Module Guide is clear.	3	0	100
18.	User Manual module display is easy to understand.	3	0	100

4. Conclusion

The testing and evaluation process plays a very important role in evaluating the quality and testing of the functionality of the developed ARStore application. The process in this phase can serve as a guide to developers and resources to improve the applications developed to be of better quality and to help developers achieve their product development objectives. In conclusion, the developers found that this ARStore application has good learning features to students. As such, this ARStore needs improvement in the future to be more attractive and suitable for all students not necessarily students who take TMDP course only.

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