Article 2

Applying Augmented Reality In Teaching And Learning

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Abstract
In this era of teaching and learning, most students are fond of interactive learning compared to traditional lectures that uses whiteboard and marker pen. Because of that, educators need to be more creative in preparing their teaching material in order to attract students' attention during teaching and learning process. With the technology advancement, there is variety of software that can help educators to produce a creative material. Augmented reality, AR, is technology where virtual reality is combined with the real world. The main devices for AR are displays, computers, input and tracking devices but recent advances in smartphone technology making them suitable as an AR platforms. This augmentation technique seems relevant to be applied in teaching field because it will help teachers to develop a dynamic material that is capable to capture students' attention, engagement and participation in a classroom. In addition, AR is very helpful in learning process where students can always listen and view the lecture videos anytime they pleased. This is suitable for blended learning purpose where students can learn on their own with less supervision from lecturers. Therefore, this paper reviews the AR technology which can be utilized to enhance the process of teaching and learning.

Keywords: *Augmented Reality, Teaching Material, Interactive Learning*

Introduction

Recent advances in technology has been widely adapted by young generations in all aspects of life including in teaching and learning. These youngsters are more comfortable with gadgets rather than facing directly with educators in order to learn about their courses or subjects. The usage of YouTube video tutorial has becoming a trend and a lot of educators gradually have emerged to publish their own lecture videos. This method suits the students learning style and attract their interest to study the subject matter. Hence the existence of Augmented Reality in teaching and learning are being brought up recently to meet the students' preferences. The augmentation approach in academic field is more likely easier to grab the student's attention, engagement and participation during lecture. Besides image, lecture videos also can be used as an overlay action in augmented reality application. Therefore, apart from provide fun learning, the students also can repeatedly watch the videos whenever they scan the trigger image. In

addition, it will become a very helpful tool especially during non-face-to-face session or students' self-learning.

Literature Review

i. Augmented Reality

The research of Augmented Reality (AR) started in 1960 by Ivan Sutherland who introduced the Helmet Mounted Display (Utusan Online, 2016). During the time, helmet was used by the U.S army to shot the missiles (Rolland, 2005). In line with the current environment, the AR technology has evolved where it can be used in various field including education. Through AR, information can be displayed via virtual objects that cannot directly detected by user's senses, which allow them to possibly interact with the real world in ways never before (Gopalan et. al, 2016). In teaching and learning, the use of AR is still deemed new, but the impact of technology is growing as the platforms for AR become more widely reachable.Although AR technology has the power to transform the educational systems while helping a new generation of students learn more effectively, there are still technological and pedagogical challenges such as slow response times, incompatible software and incompatible environmental setting (Garrett et. al, 2015). Therefore, several key ideas about AR implementation in the classroom that have been established by Billighurst and Duanser (2012) can be used as a guideline in preparing teaching material that applies AR. The key ideas are as follows:

- AR technology is robust enough to convey learning experiences, especially in augmented books and mobile AR applications;
- AR experiences should not replace traditional curriculum material but complement it;
- valuable learning occurs during the development of AR content as well as in using the AR application itself; and
- AR provides real advantage for reading comprehension and in understanding spatial data, especially for those with low reading ability.

ii. Augmented Reality Applications for Education

There are about 32 AR applications that is suitable to use in a classroom which have been identified by Mike Lee (2016). Think Mobiles Team (2017) has divided the wide number of AR applications in 3 main categories as follows:

i) the most serious, heavy and specialized, best suitable for students' needs.
ii) easy and colourful, created for kids and children to engage them into learning.
iii) the best for everyone in polishing some knowledge and skills.

Table 1: Categories of AR applications

Category	Example	Description
Student	Elements 4D	Application that supports students in exploring fields of chemistry subjects by allowing to combine different elements to see how they react in reality

	Anatomy 4D	Best suitable for medical student's needs as they may customize any part of human body, observe how parts fits, how different are joint moves and how human organs functioning
Children	Math alive	Designed for prekindergarten (3 years old children). Provide practise in basic numeracy and counting skills
	Animal Alphabet AR Flashcard	The application helps children to learn letters using special cards that make the animals become real when scan on it
General	Aurasma and Layar	The two most powerful and popular tools to create AR content. Both of apps can be used for various field including education. Recommended for AR beginners since both of apps have most user-friendly constructors, also supported with tons of guides and tutorials.

iii. Augmented Reality Implementation in Teaching and Learning

The emergence of various AR apps with the sole purpose for education as discussed earlier ease the educators to embed AR in their teaching material. The AR software works in two stages namely tracking and reconstruction. The AR device will recognize what it looks at during the tracking stage, while in reconstruction stage, it brings up a second tier of information. In the tracking stage, the trigger point is needed and it can be any image. If the trigger image scanned, it will move to reconstruction phase that resulting the overlay displayed (Wagner &Schmalstieg, 2006). In teaching and learning, AR is best applied for the topic that needs additional elaboration such as 3D image or video that elevate student understanding. By using a few simple steps, teachers can embed their teaching material with AR while students can experience the AR. Both teachers and students need to download and launch the chosen AR application in order to create and experience AR. For instance, when the students point

their camera on the trigger image provided in the teaching material, they immediately can view the overlay such as the video on how to solve the tutorial question that prepared by their lecturer.

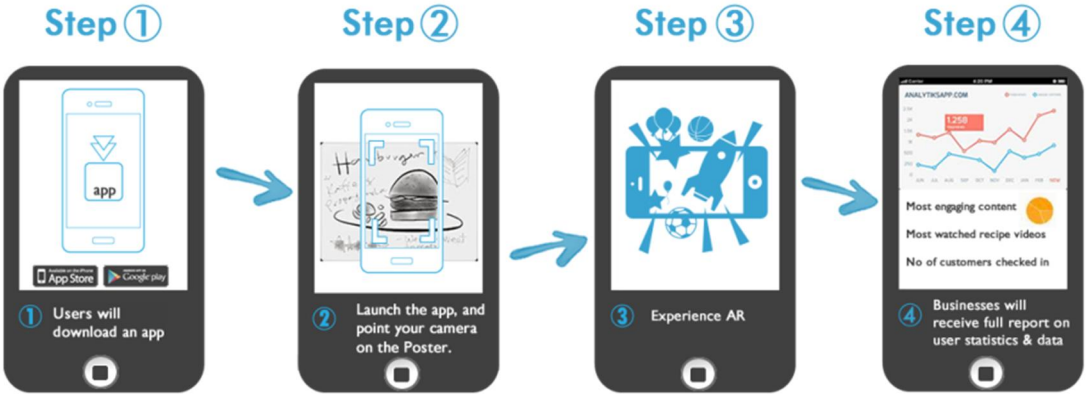

Figure 1: Steps to experience AR
Source: virtualmob.co.uk

On-going Research

For many years, schools and universities had to change the way they work and teach in order to fit in with technology. The approach of AR in teaching programming languages can become a very helpful tool to conduct teaching programming languages subject. Since this subject requires an ability to visualize how to design and code, thus this approach can easily be implemented to help students because AR has the potential of bringing abstract concepts or topics into the physical world. Additionally, AR can make the studying experience more fun since it can provide engaging content and interactions for students. Students can use AR to get explanation on a topic of interest as well as obtaining additional information. For this project, the tutorial questions have been chosen to be embed with AR. For instance, when students scan the trigger image on the page of their tutorial, a video of their teacher helping them solve a problem will be pop out. In order to develop the aura (the page that have been embedded with AR), this project is using Aurasma application which is available for smartphone and computer. The following figure is the example of the developed aura for tutorial of computer programming tutorial subject:

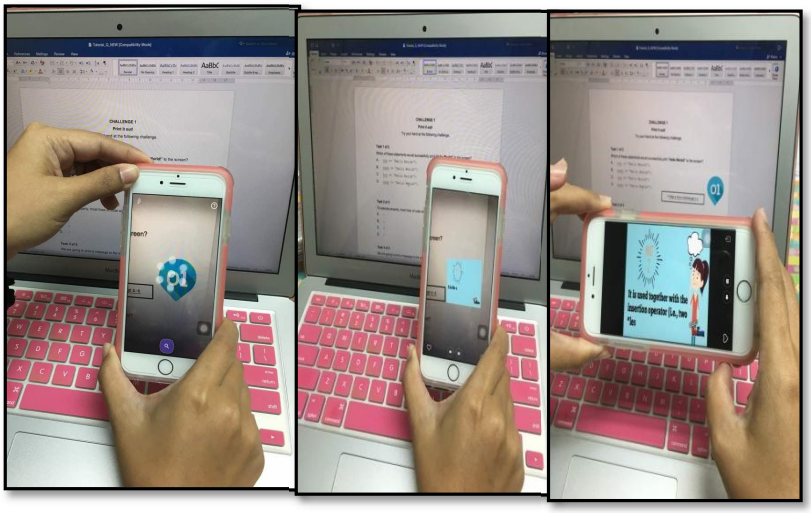

Figure 2: Example of Aura

Conclusion

The research of this article supported the use of augmented reality as an alternative for student in learning computer programming. The use of this technology is beneficial to the educators and the learners where it may help to improve the quality of teaching and learning. Hence, the AR technology provide positive suggestion for future research and innovation in teaching and learning. It is hoped that the aura which being developed can be completed soon so that it can be used widely by other students and teachers who learn and teach computer programming. Also, through this research other teachers may get some knowledge and inspired to apply AR technology later on.

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