3D Augmented Reality Mobile Application as an Innovative Instructional Media

Virgiawan Adi Kristianto[1], Harijadi Gunawan Buntoro Wahjono[2]
{virgiawan.adi.kristianto@mail.unnes.ac.id[1], harijadi@mail.unnes.ac.id[2]}

Civil Engineering Department Universitas Negeri Semarang Indonesia[1]

Abstract. One of the ubiquitous gadget used by most students are Android – based smartphones. However, they are considered as hindrances to the learning process as they often disrupt students' attention. Therefore, this present study aims to develop Android – based 3D Augmented reality mobile application. This application was used to show 3D dimensional model of buildings as learning media. It aided students to create exposition text. This study used mixed approach, case study and survey design, to describe the development of Android – based 3D Augmented reality mobile application and provide descriptive statistics data on students' response to the application. The case study revealed that the English for Civil Engineering Class required instructional media to aid students in writing exposition text. The survey showed that the mobile application is categorized as effective and efficient in aiding students in writing exposition text.

Keywords: Instructional Media, Learning Innovation, Mobile Application,

1. Introduction

Augmented reality (AR) is defined as a tool that enhances the user's perception in understanding the environment around the user [1]. AR is intelligence amplification as a tool to help humans perform their duties [2]. Augmented reality has great potential to be used in the education that can be used to provide real-world experience to learners. The use of Augmented reality in the education was hampered previously by the high cost of the equipment. However, the proliferation of affordable Android-based smart phones and the recognition of AR by the New Media Consortium and the Educause Learning Initiative have enabled AR to be widely applied in education [3]. In fact, the topic of AR has become the most discussed topic in the context of education [4], [5]. AR allows users to simulate 3-dimensional virtual objects as a tool for learning. One of the best characteristics of augmented reality is that it is student-oriented and flexible in providing learning opportunities [1]. The characteristics of Augmented Reality are sensory immersion, navigation and manipulation that generate positive emotions when learning takes place, which in turn has an impact on efficient learning and better learning outcomes [6], [7]. [8] concluded that the use of AR in the world of education can increase student motivation, increase collaboration between students and increase the ability to complete physical tasks. However, only few studies utilize AR as an instructional media in the context of Content and Language Integrated Learning (CLIL). Therefore, this present study aims to use augmented reality to simulate 3-D objects to be used as an instructional media in English for Civil Engineering conducted with the framework of Content and Language Integrated Learning.

ISET 2019, June 29, Semarang, Indonesia

DOI 10.4108/eai.29-6-2019.2290432

2. Method

2.1 Research Design

This present study used mixed approach, case study and survey design, to describe the development of Android based 3D Augmented reality mobile application and provide descriptive statistics data on expert validation. The study involved the students of Civil Engineering Department taking the English class. The total sampling was chosen because the population was too small to be taken samples.

2.2 Data Collection

Observation, interview, expert validation were used to gather the data. The expert validation was developed based on the adaptation on the ISO/IEC TS 25011:2017 Information technology Systems and software Quality Requirements and Evaluation (SQuaRE) Service quality. Observation was performed to observe the learning process during the usage of 3-D augmented reality in CLIL class. Interview was conducted to investigate students‘ perception in engaging with 3-D augmented reality. The expert validation was carried out to figure the effectiveness of the 3-D augmented reality application. The questionnaire was distributed to obtain the data on the percentage of students‘ eagerness and experience in using the 3-D augmented reality application.

2.3 Data Analysis

The 3-D augmented reality was developed by using Unity version 2019.1.3f1. The 3-D models were created by using Sketchup version 2018. The android – based application was developed by using Android studio version 3.4.1 to enable the 3-D augmented reality to run in android based mobile phones in the form of apk file. The results of the 3-D augmented reality development were tested on the android – based smartphone with the version of Android 9 or Android pie. The apk file from the Android studio version 3.4.1 was installed initially on on Nokia 6.1 plus phone and ASUS zenfone max pro m1, both phones were based on Android 9, to test its ability to show 3-D model. Then, the apk file was installed on several phones of the students to test its reliability in showing the 3-D model from the augmented reality in various phones and android versions.

The quantitative data were analyzed descriptively. The qualitative data were coded to find the emerging themes.

3. Results and Discussion

3.1 Problems on the learning process.

The observation was performed on the English for Civil Engineering class. It revealed that during the topic of discussion text, the green construction technology was chosen as the theme for the discussion text. The students were given task to write down a discussion text about the green construction technology with these following scope: 1) the problems which motivate the implementation of the green construction technology, 2) the types of green construction

technology which is used to solve the problems, and 3) the advantages and the disadvantages of green construction technology. The types of green construction technology were limited into a) water catchment well, b) natural air ventilation, and c) green energy. The students were allowed to browse for the information regarding the green construction technology on the web.

Before the implementation of the 3-D augmented reality mobile application, the students found some difficulties in writing the discussion text. They were not able to explain the types of the green construction technology and their functions despite the myriad pictures they found on the web. This result was confirmed by the survey which showed that 85% of the students were not able to write clear explanation of the green construction technology. In addition, 75% of the students cannot find the vivid picture which could illustrate the function of green construction technology on the web. Although, 95% of the students have android – based smartphones with low and high end varieties.

3.2 The development of 3-D Augmented reality.

The 3-D augmented reality mobile application with Android as its platform was then developed to overcome the problems faced by the students by using Android Studio version 3.4.1. SketchUp 2018 was used to draw the 3-D model as the visualization for the mobile application. The result of 3-D model which was exported to 2D from SketchUp 2018 can be seen on the following figure.

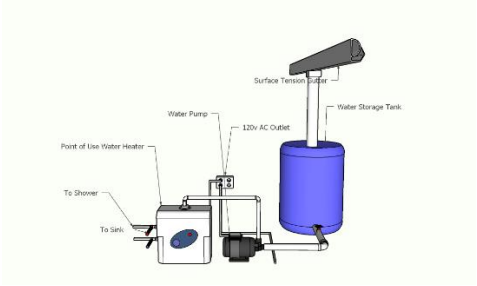

Figure 1. 3-D Model of rainwater harvesting system

The 3-D model above was created to illustrate the rainwater harvesting system as one of the types of green construction technology. The 3-D model on the house was then created to illustrate the installation of the rainwater harvesting system on the house. The 3-D house model can be seen on the following figure.

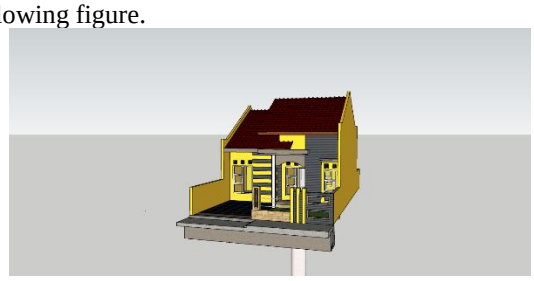

Figure 2. 3-D Model of the house

The skp file as the result of the drawing on the SketchUp 2018 was then exported to 3-D model with fbx extension. The export to fbx extension was performed to enable the model to be

imported as assets in Unity version 2019.1.3f1. Unity version 2019.1.3f1 was used simultaneously with Vuforia engine. The barcode image was created and upload in Vuforia developer site to enable it to be used as a target image in unity version 2019.1.3f1 which can be seen on the following figure.

Figure 3. Barcode image for the target image

The barcode image was used as target image to display the 3-D model of the house and the rain harvesting system. The result of the 3-D augmented reality application developed using unity version 2019.1.3f1 and Android studio 3.4.1 was the apk file for the augmented reality. It was then tested on the Nokia 6.1 plus. The result of the augmented reality on the Nokia 6.1 plus can be seen on this figure.

Figure 4. 3-D Augmented Reality Test on Nokia 6.1 plus

The apk file was then installed on ASUS max pro m1 to find out it also worked on another phone. The result can be seen on the following figure.

Figure 5. 3-D Augmented Reality Test on Asus Max Pro M1

The initial test showed that the 3-D Augmented reality mobile application can be run on both Android – based smartphones. Therefore, expert validation was performed on the mobile application. The expert validation was developed based on the adaptation on the ISO/IEC TS 25011:2017 Information technology Systems and software Quality Requirements and Evaluation (SQuaRE) Service quality models with ten criteria: 1) Effectiveness, 2) Efficiency, 3) Satisfaction, 4) Context coverage, 5) Functional suitability, 6) Performance efficiency, 7) Usability, 8) Reliability, 9) Security, and 10) Portability. Two experts on software development were involved to validate the mobile application.

Table 1. The results of the expert validation.

Criteria	Expert 1	Expert 2
Effectiveness	4	3
Efficiency	3	3
Satisfaction	4	4
Context coverage	4	4
Functional suitability	3	3
Performance efficiency	4	3
Usability	4	4
Reliability	4	4
Security	4	3
Portability	3	4
Total	37	35
Percentage	92.5%	87.5%
Average Score	90%	

The result of the expert validation showed that the score was 90%. The score was considered as very effective.

4. Conclusion

The results of the study can be concluded as 85% of the students found difficulty in writing explanation of the green construction technology. In addition, 75% of the students cannot find the vivid picture which could illustrate the function of green construction technology on the web. Although, 95% of the students have android – based smartphones with low and high end varieties. Therefore, the 3-D augmented reality mobile application was developed in this study.

The result of the mobile application development was the apk file. It was succesfully installed on two Android – based smartphones running Android 9. The apk file could be run on both phones. As a consequence, the barcode as the target image could show the 3-D image of a house with green construction concept. The 3-D augmented reality mobile application was validated by two experts. The result of the expert validation showed that the score was 90%. The score indicated that the 3-D augmented reality mobile application was effective as instructional media for English for Civil Engineering.

References

[1] Iftene, Adrian, and Diana Trandabăț.: Enhancing the Attractiveness of Learning through Augmented Reality. Procedia Computer Science. Vol. 126, pp 166-175 (2018)

[2] Brooks P F. The Computer Scientist as Toolsmith II. CACM. Vol. 39(3), pp. 61-68. (1996)

[3] Ibáñez, M. B., & Delgado-Kloos, C.: Augmented reality for STEM learning: A systematic review. Computers & Education. (2018)

[4] Akçayır, Murat, and Gökçe Akçayır.: Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review 20. pp 1-11. (2017)

[5] Bacca, Jorge, et al.: Augmented reality trends in education: a systematic review of research and applications. (2014).

[6] Cheng, Kun-Hung, and Chin-Chung Tsai.: Affordances of augmented reality in science learning: Suggestions for future research. Journal of science education and technology 22.4 pp. 449-462. (2013)

[7] Wu, Hsin-Kai, et al.: Current status, opportunities and challenges of augmented reality in education. Computers & education vol. 62. pp 41-49. (2013)

[8] Radu, Iulian.: Augmented reality in education: a meta-review and cross-media analysis." Personal and Ubiquitous Computing 18.6. pp. 1533-1543. (2014)