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IMPLEMENTATION OF AUGMENTED REALITY ON EARTHQUAKE AND TSUNAMI SOCIALIZATION IN BMKG GOES TO SCHOOL

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Abstract

Socialization of earthquake and tsunami to students is carried out regularly in the BMKG Goes to School (GTS) activity. The purpose of this study is to determine the efficiency and effectiveness of the Augmented Reality (AR) implementation in BMKG GTS earthquake and tsunami socialization. The method used in this study was a quantitative method using surveys for data collection. The results showed that AR technology through BMKG GTS is very effective and efficient in socializing the earthquake and tsunami to students. The program is expected to increase students understanding of earthquake and tsunami information as it is presented in an interactive and attractive display.

Keywords: Augmented reality, BMKG Goes to School, Earthquake, Socialization, Tsunami.

1. Introduction

Indonesian Agency for Meteorology, Climatology, and Geophysics (abbreviated as BMKG in Indonesia) is one of agencies in Indonesia that has the main task of providing and disseminating earthquake and tsunami information. The agency is obliged to always disseminate and ensure that the information provided is well received, which means that the information provided must be understood properly and correctly in order to determine the right decision.

Bandung Geophysics Station is one of the Technical Implementation Units (abbreviated as UPT in Indonesia) in the region, the station acts as an extension of the Central BMKG which has a very important role in providing correct information to the community, especially regarding earthquake and tsunami information to students. BMKG Goes to School (GTS) is an effort from BMKG to educate school children about understanding earthquakes and tsunamis.

One of the actual methods used in learning BMKG GTS is Augmented Reality (AR) with a Marker Tracking technique that uses markers to display objects or information. Earthquake and Tsunami information techniques that were socialized using the AR Marker Tracking method at the BMKG GTS included an Earthquake Shake map that were made based on land faults in West Java.

As stated in the Regulation of the Head of BMKG No. 11 of 2014 Chapter II article 6, the main tasks of Geophysics Station are to carry out observations, data management, services and support tasks including equipment maintenance, cooperation/coordination, administration, and additional tasks in the field of geophysics [1]; in this case, earthquakes and tsunamis. One of the additional tasks of the geophysics station that is important and has a direct impact on the community is the earthquake and tsunami socialization to school students which is carried out periodically in BMKG GTS.

One of the methods used in BMKG GTS learning is AR technology implementation with a Marker-Based Tracking technique that uses markers to display objects/information. The socialization uses the AR Marker-Based Tracking method at BMKG GTS which includes Shake map (Map of Shocks) for earthquakes caused by land faults in West Java. The application of AR in BMKG GTS is expected to increase students understanding of earthquake and tsunami information by school students because it is presented in an interactive and attractive display. AR allows combining and superimposing real objects and virtual objects with the information to be conveyed [2].

AR is also very effectively when used in educational content. It is because AR can increase the attractiveness of teaching and learning as well as help maximize the subject matter delivered as it supports various ways of representation, action, and various ways of involving students in the learning process [3]. AR also has the ability to overlay computer-generated virtual things into the real world changing the way we interact and making training real that can be viewed in real-time rather than a static experience [4].

Another example of AR implementation for learning is its utilization at the Bandung Geology Museum where AR is used to help visitors get fossil information and also help the museum in limited space for replica fossils [5].

The use of AR has indeed been widely applied in various fields and institutions, but for the BMKG agency itself, AR is still very rarely used. Therefore, this research is very interesting to be carried out at the BMKG agency, especially the Bandung Geophysics Station because it is the first AR application in disaster socialization activities carried out by the BMKG. Hopefully, this can be a breakthrough that will make a significant contribution specifically to services and dissemination and socialization of disasters to the general public.

In this study, the main focus is the application of AR technology in the implementation of the BMKG GTS activities carried out by the Bandung Geophysics Station. The purpose of this study is to determine the efficiency and effectiveness of the Application of Augmented Reality (AR) in Earthquake and Tsunami Socialization through BMKG GTS. The method used in this study is a quantitative method using surveys for the data collection.

2. Research Method

The method used in this study was a quantitative method using surveys for data collection.

2.1. Augmented reality (AR) as an interactive technology

AR is one part of the Virtual Environment (VE) technology, commonly referred to as Virtual Reality (VR). AR gives users an idea of the merging of the real world with the virtual world seen from the same place. AR has three characteristics, namely being interactive (increasing user interaction and perception with the real world), according to real time (real time), and in 3-dimensional form [6]. Figure 1 shows that AR is a mix of the real world and the virtual world.

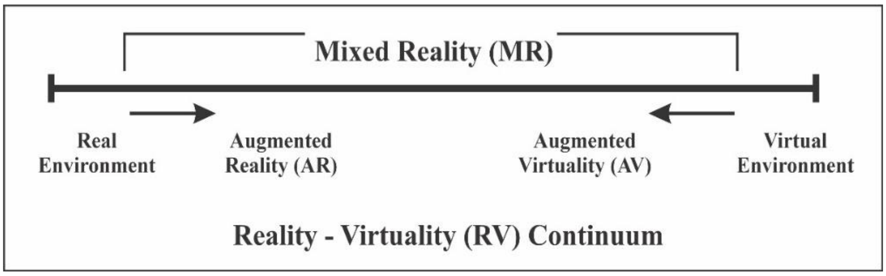

Fig. 1. Augmented reality (AR) illustration.

There are 2 (two) AR methods currently being developed, namely Marker-Based Tracking and Markless AR. Marker-Based Tracking is AR that uses markers or markers of two-dimensional objects that have a pattern that will be read by a computer through a webcam or camera connected to a computer. The marker is usually a square black-and-white illustration with a bold black border and a white background.

The Markless AR method is an AR method where users no longer need to print a marker to display digital elements. The recognized markers are in the form of device position, direction, or location. Detection of target object features and tracking of target objects based on camera poses are used as criteria in the tracking process without markers in AR technology [7] (See Fig.2).

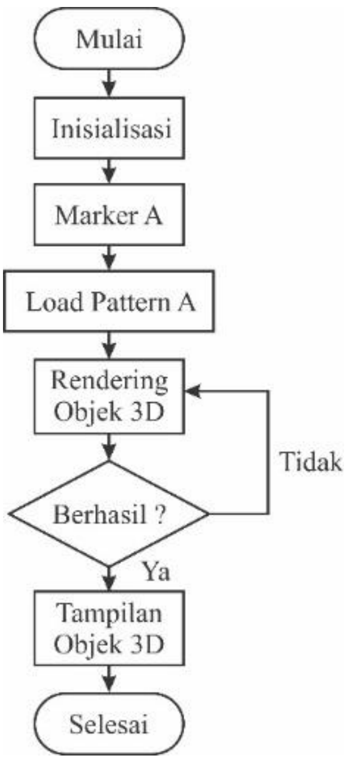

Fig. 2. Masker-based tracking AR flow diagram.

2.2. Augmented reality application development model

The development model used in making AR applications is the waterfall model. The waterfall method was developed by Winston W. Royce in 1970 to describe the practice of software products. The waterfall model consists of five phases, namely analysis, design, implementation, testing, and maintenance [8]. Each phase has a different process but is interconnected with each other [9] (See Fig. 3).

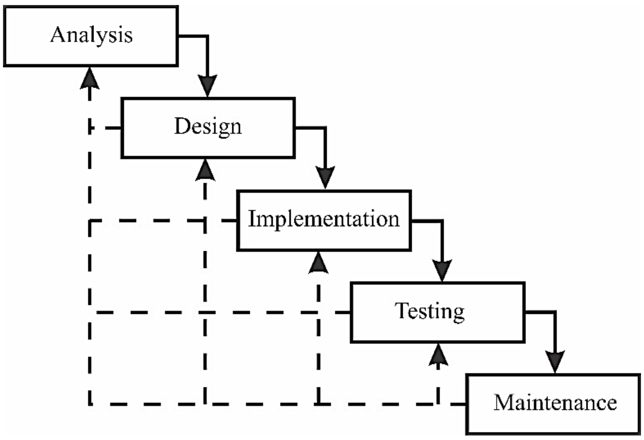

Fig. 3. Phases in the waterfall model.

a. Analysis

At the analysis stage, the data collection process is carried out to obtain information about the software that will be developed according to user needs. Data collection techniques for this analysis phase can be by observation, interviews or questionnaires.

b. Design

The design stage is used to translate software requirements from the analysis stage to the design stage. The design made is in the form of an application design sketch.

c. Implementation

After the design is made, the next stage is to create and develop software applications, namely applications that use Augmented Reality technology.

d. Testing

At the testing stage, verification and validation of software applications is carried out. The testing phase is used to find errors or debug during application development. The overall testing stages include unit testing, integration testing, system testing, and acceptance testing.

e. Maintenance

The last stage of this waterfall model is the maintenance stage. The product installation and maintenance process are carried out in the maintenance phase.

2.3. Matching pretest and post-test control group design method

This research is an experimental study used to find the effect of certain treatments on others under controlled conditions. While the research design used was Matching Pre-test-post-test Control Group Design with one type of treatment. In the Matching pre-test and Post-test Control Group Design, there are two classes that are selected directly, then given a pre-test to determine the initial state, there is a difference between the experimental class and the control class [10]. The form of this design is shown in Table 1:

Table 1. Matching pretest and post-test control group design.

Group	*Pre-Test*	*Treatment*	*Post Test*
Experiment	A1	X	A2
Control	B1	-	B2

The stages taken in the Matching pretest & Post-test Control Group Design are determining the population, determining the sample, carrying out the initial test (pretest), giving treatment (treatment), carrying out the final test (posttest), compiling the data from the pretest and posttest, processing data and drawing conclusions.

2.4. Method of collecting data

The data collection method used in the BMKG GTS activity is the collection of data from the pre-test and post-test results given to a sample of the population at the location of the activity, in this case, SMPN 2 Cipatujah Tasikmalaya. The sample is used to provide an overview of the population under study. The number of samples is determined using the formula Slovin [10] as follows:

$$n = \frac{N}{1 + N.e^2}$$

where n = Number of samples sought, N = Total population, and e = Tolerable margin of error

3. Results and Discussion

3.1. Augmented reality (AR) design used in Bandung geophysics station

The AR design describes the appearance of the SESAR application that will be used. The following is the display design of the SESAR application (Fig. 4).

Fig 4. Design SESAR application.

3.2. Use of AR in BMKG Goes to school activities

The implementation of AR used in the BMKG GTS activity is in the form of a web-based application called Simulation of Shake Map with Augmented Reality (abbreviated as SESAR) (Fig. 5-7). The steps for using the SESAR application are as follows:

i. Open the QR Code scanner application on the cell phone

ii. Scan the barcode and click Launch Zappar App, then allow requirement

Fig 5. Link SESAR application barcode.

iii. Scan image Tracking SESAR

Fig. 6. Tracking Image SESAR application.

iv. Run the SESAR application

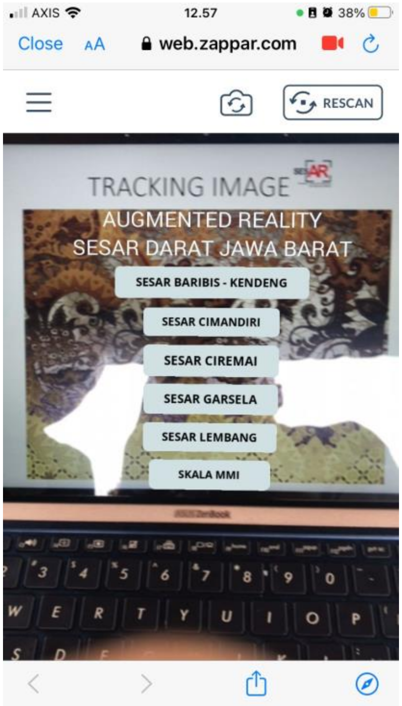

Fig. 7. SESAR application display.

3.3. Pre-Test and post test results in BMKG Goes to school activities

Based on the results of the study using the Matching pre-test & Post-test Control Group Design, treatment was given to the sample in the form of Pre-Test and Post Test with and without the use of the SESAR application. The population in this study amounted to 165 people. Based on Slovin's formulation, the number of samples obtained is 60 people. There are differences in the treatment of the sample, namely the use of the SESAR application on 30 people and 30 others using conventional learning methods (Fig. 8). The results of the pre-test and post-test assessments in the two sample groups are as follows:

a. Comparison of pre-test and post test results on samples using the SESAR application.

Based on the results of the pre-test and post-test conducted, the following results were obtained:

i. The lowest value of Pre-Test is 0
ii. The highest value of Pre-Test is 50
iii. The lowest value of Post Test is 50
iv. Post Test Highest Score is 90
v. The average value of the pre-test is 26
vi. The average post test score is 69
vii. The average increase in the value of each sample is +186%

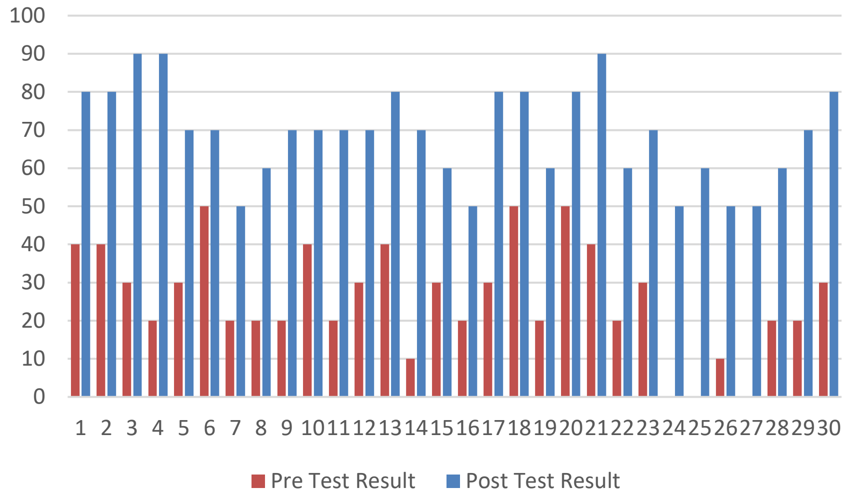

Fig. 8. Pre-Test and post test result comparison with AR application.

b. Comparison of pre-test and post test results on samples without using the SESAR application (Fig. 9).

Based on the results of the pre-test and post-test conducted, the following results were obtained:

i. The lowest value of Pre-Test is 0
ii. The highest value of Pre-Test is 70
iii. The lowest score of Post Test is 40
iv. Post Test Highest Score is 90
v. The average value of the pre-test is 34.33
vi. The average post test score is 67
vii. The average increase in the value of each sample is +129%

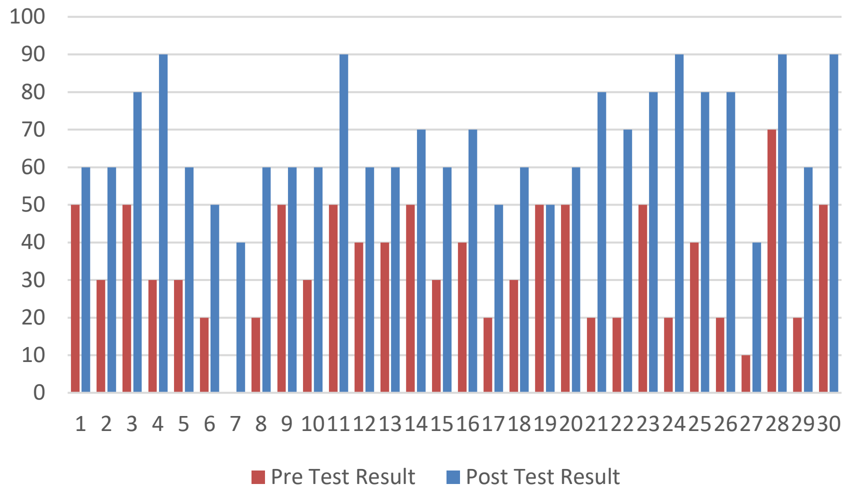

Fig. 9. Pre-test and post test result comparison without AR application.

4. Conclusion

Based on the research that has been done, the following conclusions are obtained: Determination of the sample is based on Slovin's formula from 162 people, 60 people are used as samples. There are different treatments given to a sample of 60 people, by dividing into 2 test groups, namely 30 people using the SESAR application and 30 people using conventional learning methods. Based on the results obtained through pre-test and post-test from the 2 test groups, the percentage increase in the average score for the test group using the SESAR application was 186%. Meanwhile, for the test group using conventional learning methods, the percentage increase in the average score was 129%. Based on the results obtained, it was obtained that learning using the SESAR application had a higher average rate of increase compared to conventional learning methods so that the use of Augmented Reality in this case, the SESAR application was very effective in conveying information.

Acknowledgement

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References

1. BMKG. (2014). Peraturan kepala badan meteorologi, klimatologi dan geofisika no. 11 tahun 2014 tentang uraian tugas stasiun geofisika.
2. Azuma, R.; Billinghurst, M.; and Klinker, G. (2011). Special section on mobile augmented reality. *Computers & Graphics*, 35(4), vii-viii.
3. Leinenbach, M. T.; and Corey, M. L. (2004). Universal design for learning: theory and practice. In *Society for Information Technology & Teacher Education International Conference* (pp. 4919-4926). Association for the Advancement of Computing in Education (AACE).

4. Kesim, M.; and Ozarslan, Y. (2012). Augmented reality in education: current technologies and the potential for education. *Procedia-social and behavioral sciences*, 47, 297-302.
5. Saputra, Y. A.; and Indonesia, T. I. (2014). Implementasi augmented reality (ar) pada fosil purbakala di museum geologi Bandung. *Jurnal Ilmiah Komputer dan Informatika*, 1(1), 1-8.
6. Manuri, F.; and Sanna, A. (2016). A survey on applications of augmented reality. *ACSIJ Advances in Computer Science: An International Journal*, 5(1), 18-27.
7. Gonydjaja, R.; and Mayongga, Y. (2014). Aplikasi museum zoologi berbasis augmented reality. *Prosiding KOMMIT*.
8. Bassil, Y. (2012). A simulation model for the waterfall software development life cycle. *arXiv preprint arXiv:*1205.6904.
9. Iskandar, I. D.; and Taufiqurrochman, T. (2018). Implementasi algoritma edit distance pada pengembangan aplikasi e-learning bsi menggunakan metodologi waterfall. *Prosiding Semnastek*.
10. Sugiyono, S. (2017). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta, CV.