

Mobile Augmented Reality (AR) Learning Media on Distance Material in Three Dimensions

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Abstract

The purpose of this research is to develop a mobile learning media based on augmented reality (AR) that can be used and can improve student achievement in learning mathematics on distance material in three dimensions. The approach method used in this research is R&D (Research and Development). In media development, the steps taken are as follows; research, data collection, planning, product draft development, product validation, revision of product validation results, field trials, revision of field trial results, final product improvement, and dissemination. Meanwhile, in assessing the success of the media in improving student learning achievement, the Paired Sample T-test statistical method was used. The results obtained in this study are that a mobile learning media augmented reality (AR) has been successfully developed on distance material in three dimensions in the form of an android application, which can be used and proven to significantly improve student achievement in mathematics learning on distance material in three dimensions.

Keywords: Learning Media; Mobile Augmented Reality; Distance in Three Dimensions; Learning Achievement.

INTRODUCTION

In many cases, students sometimes find it difficult to understand material about distances in three dimensions. This is because students find it difficult to imagine the shape of the three-dimensional painting given. As a result, students do not fully understand the material, and students' abstract thinking skills are not well-honed. To solve this problem, in this study, mobile augmented reality learning media were developed on distance material in three dimensions.

The use of instructional media in the teaching and learning process can generate new desires and interests, generate motivation and stimulus for learning activities, and even bring psychological influences on students (Hamalik O, 2005). Learning media have very good benefits and uses and can be one of the supporting factors in achieving the expected quality of learning (Rasam F & Candra Sari A. I, 2018). In making or determining the media, it is necessary to pay attention to the media selection criteria (Arsyad A, 2009). Criteria that must be considered include conformity with the objectives to be achieved, supporting lesson content, practical, flexible and long-lasting, teacher skills in using, target grouping, and technical quality (Fathurrohman P & Sutikno S, 2011).

Augmented reality technology is one of the breakthroughs used recently in the field of interaction. The use of this technology will be very helpful in conveying information to users. Augmented reality is an interactive technology that combines the real world and the virtual world. In augmented reality technology, there are three basic characteristics, including the combination of the real and virtual worlds,

real-time interactions, and three-dimensional or 3D objects (Apriyanai M. E & Gustianto R, 2015). There are two augmented reality methods currently being developed, namely Marker Based Tracking and Markless AR. Marker Based Tracking is an augmented reality that uses markers or two-dimensional object markers that have a pattern that will be read by a computer or smartphone via a webcam or camera that is connected to the computer or smartphone used, while Markless AR is an augmented reality method where users no longer need printing a marker to display digital elements (Haryani P & Triyono J, 2017). In this study, the type of augmented reality to be used is Marker Based Tracking.

Augmented reality can be an alternative learning media in schools. Students need an update of learning media so that they are not fixated on conventional learning media. By using augmented reality as an alternative learning media, it is hoped that learning activities can be more attractive to students. Another benefit obtained is a more advanced learning media by taking advantage of current technological developments. The advantages of augmented reality are as follows (Mustaqim I & Kurniawan N, 2017):

1. More interactive
 2. Effective in use
 3. Can be widely implemented in various media
 4. Simple object modeling, because it only displays a few objects
- Easy to operate

So, mobile augmented reality is a mobile-based technology that runs on an Android smartphone that can visualize three-dimensional shapes properly and provides flexibility to be able to see three-dimensional shapes from all directions so that this mobile augmented reality will make it easier for students to learn and can provide a fun and different learning experience especially to study distance material in three dimensions. Besides, because mobile augmented reality is run on an Android smartphone, the learning process becomes more effective, because students can learn on their own anywhere and anytime.

METHOD

The method used in this research is the method of research and development (R&D) which refers to the development model of Borg and Gall (1983) in Sukmadinata (2006: 169-170). This method is used to produce a product prototype in the form of an Android-based application that will be used as a media for mobile augmented reality (AR) learning on distance material in three dimensions. The population of this research is all students of grade 11 SMK Negeri 3 Makassar. The sample in this study were students of the 11th-grade Computer and Network Engineering Department (TKJ) at SMK Negeri 3 Makassar. The number of students involved in this test is only limited to 5 students because they are constrained by the current pandemic situation. Originally, data collection was carried out at the school but due to conditions not possible, data collection was carried out at the Pinisi Building of Universitas Negeri Makassar (UNM) located at AP Pettarani street for 2 days by inviting the five students and 1 teacher from that school.

In the development of this augmented reality mobile learning media, steps adapted from Borg and Gall are used as follows; (1) Research and data collection, (2) Planning, (3) Development of a product draft (develop a preliminary form of product), (4) Preliminary field testing, (5) Revising the results of the trials (main product revision), (6) Field testing (main field testing), (7) Improving the results of field testing (operational product revision), (8) Field testing operations (operational field testing), (9) Final product revision, (10) Dissemination and implementation.

The techniques used to collect data in this study were interviews, observations, black box testing, questionnaires, and learning outcomes tests. Interviews and observations are used at the data collection stage to find out the deficiencies that we want to find a solution to and get an idea of what kind of product is made. Black box testing is used to test the performance of the application. Questionnaires in the form of questions are used as validation sheets and to measure the level of student satisfaction in using the learning media. Learning outcomes test is used to measure whether there is a change and increase in student achievement after using augmented reality mobile learning media.

The data analysis used in this research is descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis is used to describe quantitative data, namely questionnaire data on the feasibility of using augmented reality mobile learning media and student learning outcomes data before and after using the media. The media feasibility questionnaire was made on a Likert scale then the results of the questionnaire were categorized into several categories, namely based on the category of Eko Putro Widoyoko (2013: 238):

- Very feasible = $MI + (1,8 \times STDEV \text{ Ideal})$ up to the maximum score
- Feasible = $MI + (0,6 \times STDEV \text{ Ideal})$ to $MI + (1,8 \times STDEV \text{ Ideal})$
- Fairly feasible = $MI - (0,6 \times STDEV \text{ Ideal})$ to $MI + (0,6 \times STDEV \text{ Ideal})$
- Not feasible = $MI - (1,8 \times STDEV \text{ Ideal})$ to $MI - (0,6 \times STDEV \text{ Ideal})$
- Very not feasible = Minimum Score to $MI - (1,8 \times STDEV \text{ Ideal})$

The feasibility level assessment score will be used as a reference for the results of trials by media experts, teachers, and students. The results of the scores obtained from the questionnaire will show the feasibility of the augmented reality mobile application as a learning media. So if the mean value of media experts, teachers, and student responses gets a minimum score in the “feasible” category range, then this augmented reality (AR) mobile learning media android application is declared feasible.

Inferential statistical analysis is used to determine the significance of the influence of mobile augmented reality (AR) learning media in improving student learning achievement. Activities in data analysis are grouping data based on variables from all respondents, presenting data for each variable under study, performing calculations to answer the problem formulation, and performing calculations to test the proposed hypothesis. Hypothesis testing is carried out to determine whether the hypothesis proposed in this study is accepted or rejected. Hypothesis testing is carried out using a comparative analysis of one independent variable known as the t-test. The purpose of the t-test is to determine the differences in the hypothesized variables (Riduwan & Sunarto, 2012). The t-test method used in this study was the Paired Sample T-test.

RESULTS AND DISCUSSION

Results

In this study, the mobile augmented reality (AR) learning media has been successfully developed on distance material in three dimensions in the form of an android application. The following is some documentation of the learning media that has been built which is run using an Android cellphone.

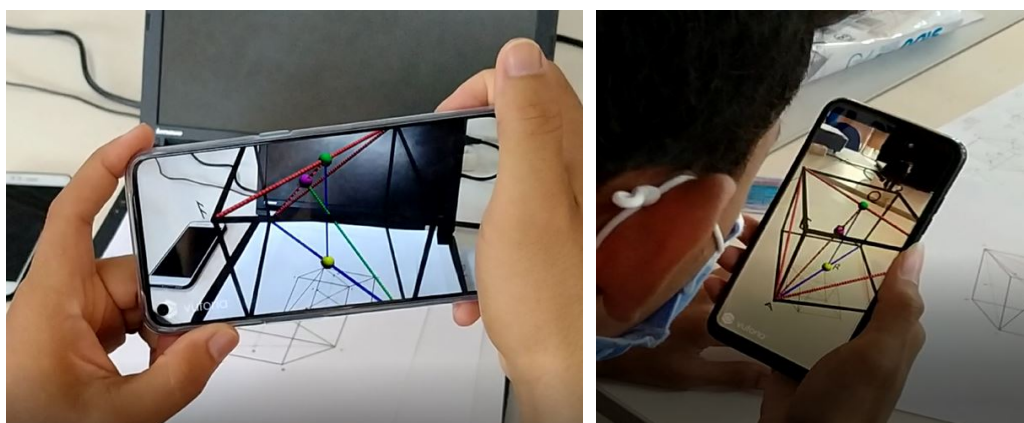


Figure 3.1 Documentation of Using Mobile AR Learning Media

The way the application works is by pointing the smartphone camera at a marker in the form of a three-dimensional image printed on paper, which will then display the three-dimensional image on the cellphone screen that looks real as in Figure 3.1 above. The following is the marker used.

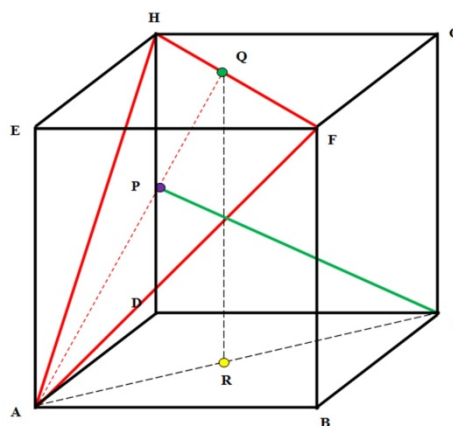


Figure 3.2 AR Marker

After the media is successfully created, the next step is to test the feasibility of using the media. The following is a descriptive result of testing the feasibility of using the media.

Table 3.3 Descriptive of Teacher and Student feasibility Categories

No.	Score Range	Category
1	$\bar{X} > 64,6$	Very feasible (SL)
2	$53,2 < \bar{X} \leq 64,6$	Feasible (L)
3	$41,8 < \bar{X} \leq 53,2$	Fairly feasible (CL)
4	$30,4 < \bar{X} \leq 41,8$	Not feasible (TL)
5	$\bar{X} \leq 30,4$	Very not feasible (STL)

Table 3.4 Descriptive feasibility Category for Media Experts

No.	Score Range	Category
1	$\bar{X} > 54,4$	Very feasible (SL)
2	$44,8 < \bar{X} \leq 54,4$	Feasible (L)
3	$35,2 < \bar{X} \leq 44,8$	Fairly feasible (CL)
4	$25,6 < \bar{X} \leq 35,2$	Not feasible (TL)
5	$\bar{X} \leq 25,6$	Very not feasible (STL)

After the feasibility test was carried out, data collection was then carried out to determine the effect of learning media on improving student learning achievement. Student learning achievement data were obtained by giving a learning outcome test in the form of essays totaling 2 numbers on three-dimensional geometry material. The pre-test was given to determine the students' initial abilities, while the post-test was given to determine the students' abilities after treatment. Following are the results of the descriptive analysis of the pre-test and post-test data obtained.

Table Pre and Post Test Data

Name	Pre-test	Post-test
Bimbi Rangkasiwi	15	45
Muh Zubair	20	50
Iva Amanda	30	50
Khafid Hudallah	15	45
Muh. Gilang	12	35

Table Descriptive Data of Pre and Post Test

Description	Mathematics Learning Achievement	
	Pre test	Post test
Number of Respondents	5	5
Mean	18.4	45
Standard Deviation	7.092249	6.123724
Mode	15	45
Maximum score	30	50
Minimum score	12	35

The results of an inferential analysis using statistical paired sample t-test are presented in table below (results of the analysis using SPSS Ver. 21).

Table Results of Paired Sample t-test analysis

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper		
Pair 1	Pretest - Posttest	- 26.60000	4.77493	2.13542	- -20.67114 32.52886	- 12.457	4	.000	

CONCLUSIONS AND SUGGESTIONS

Based on the results and previous discussion, it can be concluded that this research has been successfully carried out and produced a mobile augmented reality (AR) learning media that can or is feasible for use and has been shown to significantly improve student achievement in mathematics learning on distance material in three dimensions. As a suggestion in this study, augmented reality mobile learning media can still be developed for learning mathematics on other materials such as area and volume material or the material of plane intersections in three dimensions.

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