DEVELOPMENT OF AUGMENTED REALITY-BASED LEARNING MEDIA ON THE GEOMETRY OF SPACE FOR STUDENTS OF SMAN 6 PADANG

Riska Amelia[1, a)] and Fazri Zuzano[2, b)]

(Use the Microsoft Word template style: *Paper Author*)

"[1])"Pendidikan Teknik Informatika dan Komputer, *Fakultas Keguruan dan Ilmu Pendidikan, Bung Hatta University.*

"[2])"Pendidikan Matematika, *Faculty Keguruan dan Ilmu Pendidikan, Bung Hatta University.*

[a)]*Corresponding author: riska.amelia86@gmail.com*

[b)] *Fazrizuzano@yahoo.co.id*

Abstract. This research aims to produce an Augmented Reality-based learning media with a valid, practical and effective shaped software (android application) that can display the geometry of space material on mathematical subjects. This type of research is R&D. on the research approach used is the development Model for the development of Four-D THIAGARAJAN. This research is done processed X SMAN 6 field. The stages in this study are Define, Design, Develop, and Disseminate. To find out the feasibility of the media used this learning instruments in the form of a review of media experts and expert material of product produced. Data collection techniques used are observation, interview and the study of librarianship. Augmented Reality method used in this research is a Markerless Augmented Reality with 3D Object Tracking techniques. Test results-based learning media functionality is Augmented Reality content geometry is done with black box testing with testing on some Android phones. Black box test showed that all functions on the AR Application geometry can function properly. The results of the expert assessment of the material and media experts stated that this application is valid for use. While the response assessment according to students based on ease of use, the effectiveness of the learning time, and the appeal of the merits gained 90.93% score.

Keyword : Augmented Reality, Media, Geometry, Learning, GeoAR

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INTRODUCTION

This Mastery of middle school students in object geometry is an abstract was not as expected. From the results of previous research revealed that the mastery of the material against the geometry of space is still low. Students experiencing problems in geometry space or three dimensions especially concerning area and volume [1]. The researchers argue that students often have the wrong intuition relating to the geometry of space. In addition to the materials students, mastery of geometry still low also found error committed students in resolving a matter of geometry [2]. This is confirmed by the results of research that indicates an error (misconception) conducted the student in resolving a matter of geometry. The error is caused by a low level of mastery of the concepts of geometry and low analysis of the elements of geometry that deals with solving problems.

Based on research conducted in the field especially class 6 SMAN X in the learning problem could be that the geometry of space is the lack of motivation and achievement of students in the subjects it is characterized with low student learning outcomes in the material of the geometry of space. This is allegedly due to lack of knowledge and creativity of teachers in utilizing existing learning media (eg: GeoGebra and Google SketchUp) Besides enrichment tools outage on a learning process ever undertook to affect the motivation and student achievement in understanding the material the geometry of space. In general, the teacher relies solely on existing facilities in schools as the chalkboard and textbook just to display the object material, so students are difficult to understand and imagined what it looks like and how to shape the form of a geometric space. If any of the available enrichment tool numbers are very limited and the price is quite expensive.

It is therefore important to anticipate these things done learning media development which is able to describe the geometry of space materials in attractive, interesting and immediacy. Teaching methods that utilize computer software get more respond and popularity [3] compared to accounting for its learning. However, not all software and computer technology is capable of resolving the problems faced by students and teachers. This is due because not all the needs required by the students can be specified by a software. The solution is to make use of technology that can visualize the material taught in three dimensions. The technology can be used namely Augmented Reality. With this technology, it would be very useful for learning process where the material the geometry of space will be represented visually through a three-dimensional object that is not limited by space and time. In addition, it is hoped with implementing augmented reality to the study of the geometry of space is able to increase the motivation of students in the learning process.

METHODS

The development model is used to find, develop, and test a product based on a systematic procedure so that the resulting product has a high scientific value and can be trusted. Research on the development model used is a Model Four-D THIAGARAJAN. This model consists of four stages of development i.e. Definition (Define), Design (Design), development (Develop), and dissemination (Disseminate). Application of the main steps in the research not only trace the original version but customized to the characteristics of the subject and the place of origin of the examinee. In addition, the model to be followed will be tailored to the needs of development in the field.

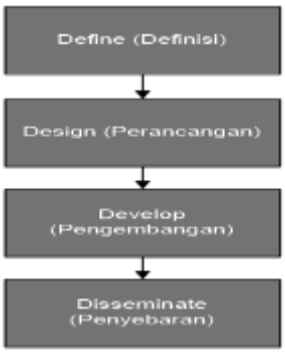

FIGURE 1. The flow model development Thiagarajan

1) Measures undertaken in this research is analyze the problems faced by students in understanding the material on the subjects and the geometry of space determines the alternative learning media development (stage Define). Time and place of the first stage of the Research will begin in February to March 2017.The sample of this research is a public high school students (SMAN) 6 Classes X Pasture as many as 20 people.

Do observations of the learning process the geometry of space at grade X.The observation is done at the time of hour learning takes place. Conduct interviews to subjects and teachers conduct interviews how motivation and achievement of students in learning the geometry of space.

The study of librarianship is all efforts undertaken by the researchers to gather information that is relevant to the topic or issue that will be or is being examined. Information can be obtained from books, articles, journals, and the writings that discuss mobile applications.

2) Design and designed a media-based learning, augmented reality in real, interesting and attractive in order to increase motivation and achievement of students in the learning process the geometry of space (stage Design). Design done in this research include the design of the system architecture and user interface design.

a. Architectural Design System

The design of the system architecture are the depiction of the workflow system to be built. Stage design is created using a system architecture modeling of the Unified Modeling Language (UML).

1. Use Case Diagram

Use case diagram the user describes the steps in the running application and isidari content applications.

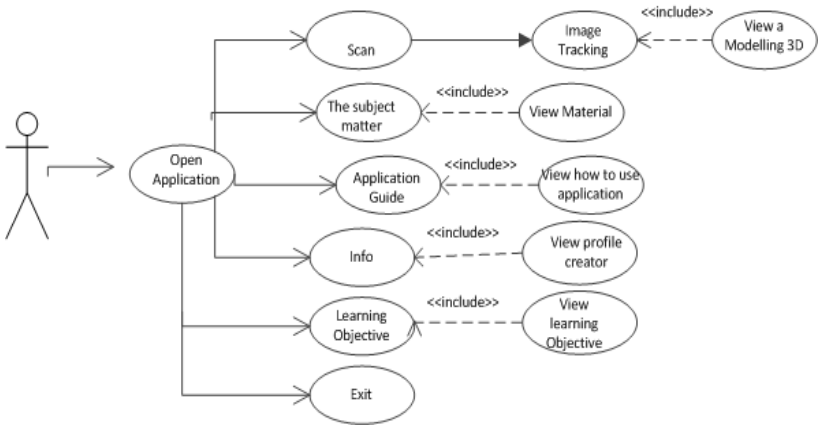

FIGURE 2. Use Case Diagram

2. Activity Diagram

Activity diagram describes the various flow activity in a system to be designed, how the flow starts, a decision that may occur, and how it ended.

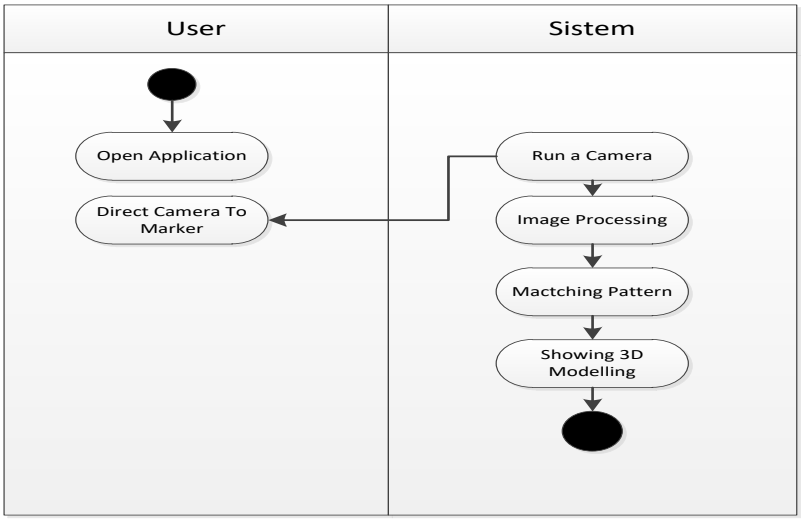

FIGURE 3. ACTIVITY DIAGRAM

3. Generate learning media on subjects the geometry of space-based augmented reality based on the revised enter from experts (stage Develop).

4. Dissemination and implementation (Dissemination and implementation). This stage is to report the results in professional meetings and in journals.

RESULTS AND DISCUSSION

The results of the development of learning media products in the form of Augmented Reality on Android platform for material the geometry of space. Geometric learning material contained on the distance learning media tailored to the syllabus in high school.

A. Realization of Learning Media

On the realization of learning, media do product manufacturing using Unity 3D software and vuforia SDK software as a supporter of the development of Augmented Reality. The products developed in the form of Augmented Reality applications that can be run on a device in the form of a mobile phone with the Android operating system and a Magic Book that contains usage instructions, a summary of the material, and the image marker. Below is the result of the realization of the media learning developed.

1) Applications of Augmented Reality

Following is the display of the form GeoAR application which has been installed in the Android phone. This application size is approximately 10 MB.

FIGURE 5. The Geometry Of Space Application Splash Screen.

1) Display The Main Menu

Main menu this is the main page of the application GeoAR. The main menu contains several sub-menu Scan, i.e. material, Instructions, Info, and exit.

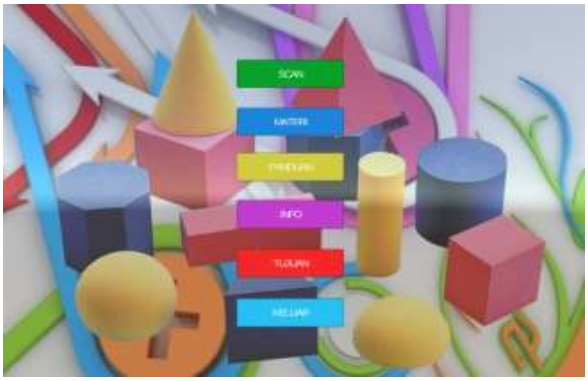

FIGURE 6. Display Main Menu.

2) Display The Menu Scan

The scan menu the scan facility contains the camera to the objective marker. The camera will detect an object and the object will show it in real-time.

FIGURE 7. Display menu scan.

B. The Results Of Validation

a. Expert Validation Test Material

Test validation of expert material serves to find out the feasibility of the material that exists in a medium of instruction. The outcome of the validation test material experts then made material improvements to the material on the media learning developed. On the research and development of this test material validation is done. by 2 people expert content, i.e. 1 person is a lecturer in the Department of mathematics education, Facultas Keguruan dan Ilmu Pendidikan, Bung Hatta University, i.e. and 1 person is lecturer in the Department of technology informatic and computer education, Faculty Keguruan dan Ilmu Pendidikan, Bung Hatta University.

Table 1. Result of test validation from 2 people expert.

Validation Aspect	Average of validation aspect	Category of validation level
Media (Augmented Realilty)	4,28	Very Valid
Design	4,28	Very Valid
Learning	4	Valid
Materials	4	Valid
Total	4,14	Very Valid

The results of the user's Response

User product trials stage is the stage of implementation of the learning media applications on a user or users, namely students, which is the main target in this research. User test aims

to find out students ' response to the learning medium of Augmented Reality products. User trials were done in class X SMAN 6 Padang as many as 20 students. User response test results against these applications obtainable that 90.93% practical.

TABLE 3. Test User Response

No.	Aspect	Assesment					Totals Response	Highest Score	% Response
		1	2	3	4	5			
A	**User Friendly**								
1	This easily accessible learning media	0	0	1	7	12	91	100	91.00 %
2	Learning media has usage instructions	0	0	0	4	16	96	100	96.00 %
3	The material presented is clear and simple	0	0	2	4	14	92	100	92.00 %
4	The language is easy to understand	0	0	1	9	10	89	100	89.00 %
5	Font size and typeface, convenient and easy-to-read	0	0	1	6	13	92	100	92.00 %
B	**The effectiveness of the learning time**								
1	Illustrations in this learning media makes me more quickly understand the material being taught	0	1	2	5	12	86	100	86.00 %
2	Media shown makes me more quickly understand the problem in question	0	1	1	8	10	85	100	85.00 %
C	**Attraction and benefits**								
A	The illustration shown help me in learning independently	0	1	1	7	11	86	100	86.00 %
B	The animation shown interesting	0	0	1	5	15	98	100	98.00 %

C	This learning Media helped me in learning independently	0	0		6	14	94	100	94.00 %
D	Steps completion problem shown clear and easy to understand	0	0	2	11	7	85	100	85.00 %
E	Problems found in the learning media makes me more trained in resolving the matter.	0	0	2	2	16	94	100	94.00 %
F	Evaluation contained in media learning help me gauge my level of understanding towards the learning material	0	0		6	14	94	100	94.00 %
G	Media-based learning, augmented reality is increasing interest and my motivation to learn	0	0		7	13	93	100	93.00 %
H	I am glad to learn to use this learning media	0	0		11	9	89	100	89.00 %
	Response Persentase						1364	1500	90.93 %

Effectiveness

Test effectiveness carried out in order to evaluate whether the media can be used to achieve the goal of effective learning outcomes in students. Data on the effectiveness of student learning results obtained from the use of the media of instruction. Based on the results of testing the effectiveness of learning media obtained the results as much as 52.30%. This means that the media is designed well enough. Here are the complete test results data effectiveness by 20 students of class X SMAN 6 field.

TABLE 3. Effectiveness

Students Name	Test No					Max Score	Score Obtained
	1	2	3	4	5		
Ok	2	3	3	2	0	30	10
Fi	3	4	5	6	1	30	19
Re	2	2	4	3	0	30	11
Ind	3	4	5	4	1	30	17
Sas	3	4	5	4	1	30	17
No	2	3	5	3	1	30	14
Sel	2	3	5	2	1	30	13
Put	3	4	5	2	1	30	15
Yo	2	3	5	3	1	30	14
Za	3	3	3	3	1	30	13
Isr	3	4	5	2	0	30	14
M.F	2	3	3	3	0	30	11
Farh	3	4	8	5	1	30	21
Med	3	3	3	2	0	30	11
Ran	3	2	4	2	0	30	11
Fem	3	4	6	4	1	30	18
Yus	3	4	8	6	6	30	27
De	3	4	5	2	1	30	15
Ok	3	4	5	5	1	30	18
Fa	3	4	7	6	5	30	25
Total	600					314	
Average Score	Score Obtained/Maximal score * 100%					52.30%	

CONCLUSION

1. Test results the functionality of media-based learning, Augmented Reality content geometry is done with black box testing and testing on some Android phones. Black box test showed that all functions on the AR Application geometry can function properly.
2. The results of the expert assessment of the material and media experts stated that this application is valid for use. While the response assessment according to students based on ease of use, the effectiveness of the learning time, and the appeal of the merits gained 90.93% score.
3. For the results of an assessment of the effectiveness of the obtained results 52.30%, for it required further development on application-based augmented reality in order to improve student learning outcomes in particular geometry of space materials

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