

The Development of Android-based Augmented Reality Learning Media for Three Dimensional Curved Surface

Sunita Indira, Mangaratua M. Simanjorang

Mathematics Education, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Medan (20221), North Sumatera, Indonesia
Sunitaindira39@gmail.com, mangaratuasimanjorang@gmail.com

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Abstrak. *The objective of this study are developing the valid Augmented Reality (AR) learning media in Android platform for three dimensional curved surface and getting the students responses. This study was using the type of Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The data collection technique was using the questionnaire, which used to validating the media and getting the students responses. The validation was obtained from lecturer in State University of Medan as the material experts and media experts. The media have been implement to the students in the 3rd grade of SMP Negeri 35 Medan. The result of this study show that the AR learning media is the very valid learning media in accordance to the total score percentage of material experts (81,25%) and media experts (82,14%). The students was responding that the AR learning media in excelent category in accordance to the total score percentage of students responses (85,88%). Therefore, based on the validation, the validity of the android-based augmented reality learning media for three dimensional curved surface has been tested. [THE DEVELOPMENT OF ANDROID-BASED AUGMENTED REALITY LEARNING MEDIA FOR THREE DIMENSIONAL CURVED SURFACE](*Jurnal Fibonacci*, 03(1): 35-41, 2022)*

Keywords: Development; Learning Media; Android; Augmented Reality

Introduction

The coronavirus disease (Covid-19) pandemic or plague has hit more than 200 countries in the world and has brought challenges to educational institutions, especially higher education institutions. Anticipating the spread of the virus, the government has issued various policies, ranging from isolation, social and physical distance to large-scale social restrictions (PSBB). This situation requires peoples to stay at home, worship, study and work at home (Jamaluddin et al., 2020:2).). This situation forces educational institutions to make breakthroughs in the learning methods and models that must be selected in order to continue learning. Even if it is done virtual (online), it will be subject to the consequences of all restrictions, including teacher skills that have not yet been fully learned online. And students with limited carrying capacity of existing infrastructure in the place of residence (Hamid et al., 2020: 1-2). Teachers and educators as important elements in education are required to migrate from face-to-face learning to online learning. Handayani (2020:17) also stated that during online learning, the delivery of material was not very

clear and the monotonous class causes students to feel bored.

Apart from these new problems, previously there have been problems in the world of education, especially in mathematics geometry material. Based on Trends in International Mathematics and Science Study (TIMSS) in 2011 which said the dimension of Indonesian students' lowest content is geometry. This is in line with the research conducted by Kariadinata (in Suganda, 2020:51) that in general students have difficulty in visualizing and constructing geometric spatial shapes. Therefore, it is necessary to design a learning experience to assist students in visualizing and constructing geometric spatial shapes.

Along with the development of technology, the development of learning media is also growing rapidly. The combination between education and technology can be an alternative in the world of education. One of the technologies currently developing is Augmented Reality (AR) technology. Augmented Reality is a technology that combines virtual objects into a real three-dimensional environment and displays them in real time, so that the object seems alive and real in front of us (Affandi, 2014:4).). The reason

that Augmented Reality technology can be used as a learning medium is because the use of AR can make learning more interactive and fun (Mustaqim, 2016:9). But until now, people's knowledge about Augmented Reality technology are still very low (Mustaqim, 2017:37).

Based on the background above, this study will develop valid learning media using Augmented Reality technology on the Android Platform for geometric materials, especially for three dimensional curved surface. The final objective of this research is to find out how students respond to the learning media that has been developed.

Review of Related Theories

According to Heinich (2002:6), learning is the development of new knowledge, skills, or attitudes as an individual interacts with information includes the physical facilities, the psychological atmosphere, instructional methods, media, and technology. The medium (plural, media) is a communication channel. The term is derived from Latin and means "between" and refers to anything that conveys information between a source and a receiver (Heinich et al., 2002: 9-10). Media are often "package" for this purpose: objectives are listed, guidance in achieving objectives is given, materials are assembled, and self-evaluation guidelines are provided (Heinich et al.,2002:12). In learning, media is expected to make a more effective and efficient learning process in accordance with the purpose of learning (Puspitarini et al., 2019:54).

The base theory of media that use in learning process by Dale's cone of experience (1946;Davis et al.,2015:2; Buhun et al.,2019:145) is:



Figure 1. Dale's cone of experience

According to Dale's Cone of Experience, the base of the cone is characterized by more concrete experiences, such as direct experiences (real-life experiences), contrived experiences (interactive models), and dramatic participation (role plays). McKown (in Miftah, 2013:100) in his book "Audio Visual Aids To

Instruction" suggests four functions of media, as follows.(a)changing the focus of formal education, (b) to generate learning motivation, (c) provide clarity, (d) to stimulate learning.

According to Precious Dube (2019:410), below are the classification of learning media:Visual, include illustrated books, (i) pictures, photographs, flashcards, charts, maps, posters, displays, self-instruction elements, flip books, bulletins, magnetic panels, flannel graphs, dioramas, drawings, mock-ups, film strips, slides, transparencies, silent films, chalkboards and drawing,(ii) Audio, include radio, language laboratories, tape and disk recording, telephone, telereading and sound distribution system, (iii) Audio-Visual, include television, films, video recordings, sound movie strips, recorded sound printed materials, study journeys and demonstration, (iv) Printed materials, include textbooks, fiction and non fiction books, booklets, pamphlets, study guides, manuals and worksheets, as well as word processed document prepared by students and teacher.

Augmented reality is a way of viewing the real world (either directly or via a device such as a camera creating a visual of the real world) and "augmenting" that real-world visual effects with computer-generated input (such as still graphics, audio, or video). However, in recent years, the definition of AR has been adopted, which also includes a more hybrid hybrid called mixed reality, in which interactions between the real world and digital augmented content can occur (Mealy,2018:8-9). According to Dianrizkita (2018:122) there are two methods usually used in Augmented Reality that is marker based and markless based . Marker Based , is a method that uses marker as a indicator on the camera feature so that the application can display objects.

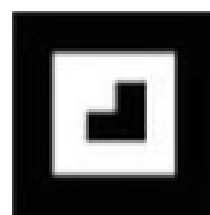


Figure 2. Sample of Android marker

Markless Based, is the method that does not use the marker as a indicator on the camera. This method only need the angle in the real to display the object of the application.

According to Heinbochel (2017:3), Geometry is the investigation of the properties associated with points, lines, planes, and various shaped objects in one, two and three dimensions. Furthermore, Geometry is the

science which treats of position, form, and magnitude (Wentworth,2010:3).In geometry there are two types of object, namely plane Geometry and solid geometry. According to Wentworth(2010:3), plane geometry treats of figures all points of which are in the same plane, while solid geometry treats of figures all points of which are not in the same plane. Plane geometry restricts itself to two-dimensional objects and their properties, while solid geometry investigates objects in a three-dimensional space (Heinbockel,2017:3).

The development of learning media is included in the type of development research. Development research (Developmental research) is oriented towards product development in which the development process is described as thoroughly as possible and the final product is evaluated (Armanto et al., 2019:5). In the implementation of research and development (R&D) there are several steps that must be taken, for that the researcher refers to the steps according to ADDIE models. According to Muruganatham (2015:53), ADDIE models have five phase that is analysis, design, development, implementation, and Evaluation.

According to Messick (in Taylor,2013:147), Validity is an integrative, evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of inferences and actions based on test scores and modes of assessment. Validation in assessment requires a clearly defined construct or criterion performance and a clear articulation of the intended score interpretations and uses (Taylor,2013:19).

The usage of learning media will get a response from students. This response arises because there are objects that are observed by students and can be in the form of opinions that are considered good if they meet rational requirements (Khairiyah et al.,2020:2).

Method

Location and Time Research

The research will be conducted in April 2021 until June 2021. The android-based Augmented Reality learning media will try in SMP Negeri 35 Medan at Jl. William Iskandar Ps.V, Kenangan Baru, Kec. Percut Sei Tuan, Kab. Deli Serdang, Sumatera Utara,20232.

Type of Research

Type of this research is development research. According to Borg and Gall in (Saputro, 2011:8), educational Research and Development (R&D) is the process used to

develop and validate educational product. This research is called Research and Development (R&D) because this research will be produce the developing of product in the form of android-based Augmented Reality Learning media in geometry. Development model uses in this research is ADDIE model that have 5 steps namely analysis, design, development, implementation and evaluation. The usage of ADDIE model because of it is clear and easy to understand.

Subject and Object of Research

In this research, the subject are the students in SMP Negeri 35 Medan, at Jl. William Iskandar Ps. V, Kenangan Baru, Kec. Percut Sei Tuan, Kab. Deli Serdang, Sumatera Utara, 20232 and the lecturer as the material expert and media expert who will validate the research instruments, while, object of this research is android-based Augmented Reality learning media in geometry.

Research design

This research is development research which aim of developing a learning media and testing the validity. The planning of this research to developing the Android-based Augmented Reality learning media. By the usage of Augmented Reality technology then the learning process more interesting and interactive because the Augmented Reality technology can showing the sound, explanation, picture and especially the real 3D object. This media will be using the marker which as the signal for the camera to showing the object in the smartphone.

Data collection technique

The data collection technique was carried out through interviews and questionnaire. Interview as a preliminary observation for research and to designing media development. Questionnaire used to assess the validity of media development and to take the respons of students. Respondents involved in data collection were students, material experts, media experts. The results of the study were then analyzed and described.

Research Instrument

Research instruments are scientific and systematic tools such as questionnaires and interviews which are used to collect data from respondents. Wilkinson (2003:3) states that research instruments are devices for obtaining

information relevant to the research project. To test the validation of learning media, we had to collect the data by using the research instrument namely validation sheet. Validation sheet used to get the data quality of three dimensional curved surface material and the lesson delivering aspect system which contained in the Android-based Augmented Reality learning media. This measurement of research using the likert scale from 1 to 4. The form of the Likert scale answer consists of very agree, agree, disagree, and very disagree (Taluke et.al.,2019:534). The instrument will be given to the media expert, material expert and students.

Research procedure

In developing the Augmented Reality learning media was using the ADDIE development model. The choosen of ADDIE model because of simple but still systematic to produce the product that feasible to used. According to Muruganatham (2015:53) , ADDIE models have five phase that is analysis, design, development, implementation, and evaluation.

Data analysis technique

Data analysis technique to knowing the feasibility of learning media is descriptive statistic analysis. Descriptive statistic is one of statistic branch by summarize data so that data is easy to understand. Descriptive statistics are statistics that are used to analyze data by describing the data that has been collected as is without intending to make general conclusions (Sugiyono, 2016:207-208).

The formula to calculate the percentage of validation is as follows:

$$P = \frac{K}{N_k} \times 100\%$$

Where:

P = Percentage

K = Total Score

N_k = Total Maximum Score

The percentage obtained from the calculation will be interpret the result measurement of the validation questionnaire from the material expert and media expert which converted to be qualitative in table 3.4.

Table 1. Conversion of validation data percentage into qualitative (Arikunto, 2018:39)

Percentage	Interpretation
81% – 100%	Very valid
61% – 80%	Valid
41% – 60%	Quite valid

21% – 40%	Less valid
0% – 20%	Invalid

The formula to calculate the percentage of students responses is as follows:

$$P = \frac{K}{N_k} \times 100\%$$

Where:

P = Percentage

K = Total Score

N_k = Total Maximum Score

The percentage obtained from the calculation will be interpret the result measurement of the student’s responses which categorized in table 3.5.

Table 2. Conversion of student’s responses data percentage into qualitative (Arikunto, 2018:39)

Percentage	Interpretation
81% – 100%	Excelent
61% – 80%	Very good
41% – 60%	Good
21% – 40%	Bad
0% – 20%	Very bad

Result and Discussion

Result

The research and development was carried out in the 3rd grade of SMP Negeri 35 Medan. The output product of the research is Android-based Augmented Reality learning media for tree dimensional curved surface. The product is made in the form of an android application that is given to students to be used in the learning process both online and face-to-face.

This research and development was using the Research and Development (R&D) methods and ADDIE model. The product of the research is the augmented reality learning media for three dimensional curved surface.

The percentage of media expert I is 71.43% and media expert II is 92.86%. The percentage of total score from media expert I and II are 82.14%. The percentage of validation from material expert I is 71.43% and material expert II is 89.29%. The percentage of total score from material expert I and material expert II are 81.25%. The percentage of student responses is 85.88%. Total score is the total score of 30 respondents.

Discussion

This research produce the learning media that using the Augmented Reality technology in Android platform for the geometry specifcly three dimensional curved surface topic. In the development process, this research use five

phases, which are analysis, design, development, implementation and evaluation.

(a) Analysis phase is the step to find the information or condition from school in order to be able to collect enough information for formulating the goal of the development purpose. The results of this analysis phase showed that (i) the process of delivering learning material and interaction between students and teacher in the school still lacking because it only uses Google Classroom and Whatsapp as a place to give assignments that must be completed by students, (iii) students feel difficult to understand the material from books because the books can not show the shape of the real object, and (iv) teacher also want to improve the quality of learning by using the learning media.

(b) Design phase is the step to make the plan of the development. The result of design phase are goal formulation, flowchart in appendix 4, menu structure as shown in table 4.1 and objects design as explained in the collecting design objects section (4.1.2.4).

(c) Development phase is the step to developing the learning media by using the unity and vuforia software as development support and validation the media until it is suitable to use. The development of media using Augmented Reality technology that can bring students to learn in a digital world but like real. AR learning media was developed so that students can more easily construct their knowledge with 3D object, animations, proof video, and approachment that have been displayed in the learning media. The AR learning media has been tested before published and has been tested by the validator. Based on the result of validation process, the validity percentage score from material experts was 81.25% which means that the material used in the AR learning media was very valid. Furthermore, the validity percentage score from media experts was 82.4% which means that the AR learning media was very valid.

(d) The implementation phase is a step for the learning media to be trialed by allowing the students to use the AR learning media. Based on the result of students responses, the total percentage was 85.88% which means that the AR learning media was excellent category.

(e) Evaluation phase is the step to evaluate the result of implementation by analyze the result from student response in implementation phase.

According to the responses of 30 students in the 3rd grade of SMP Negeri 35 Medan, it was obtained that the total score was 1,855 while the total expected score was 2,160. So that the percentage of students responses total score is:

$$\begin{aligned} \text{total score percentage} &= \frac{\text{total score}}{\text{total maximum score}} \times 100\% \\ &= \frac{1,855}{2,160} \times 100\% \\ &= 85.88\% \end{aligned}$$

which means that the AR learning media belongs to the excellent media category.

Closing

The development of Android-based Augmented Reality learning media for three dimensional curved surface have been done by implementing the ADDIE model. The development process has five phases that are analysis, design, development, implementation and evaluation. In analysis phase, the researcher find out the information or condition from school in order to be able to collect enough information to formulating the goal of the development purpose. Then continued by the design phase, to get the goal formulation, making the flowchart, menu structure and objects design. After finished the design, then development phase. In development phase, the researcher developing the AR learning media by using Blender 3D, Sketchup, Vuforia, Unity and Visual Studio software. The software are used to built the application of AR learning media. After finished to built the AR learning media, then validated by validator. The developed AR learning media in this study was validated by the media and material experts. The result of this validation stage show that the learning material used in the developed AR learning media belongs to very valid category (82.42%), while the AR learning media itself belongs to very valid category (81.25%). After the AR learning media already validate, it would be implementing to the students to get the students responses. And at last, the researcher will get the evaluation from the result of students responses about the AR learning media.

The analysis of students responses for the Android-based Augmented Reality learning media for three dimensional curved surface show that the AR learning media belongs to excellent category (85.88%).

Based on the result of this research, the important thing to consider that the researcher suggest is to develop the other material by using the technology Augmented Reality and

reducing file size of application. And also hope the next researcher to input the AR learning media into Google Playstore for easier installing.

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