Artikel Annisa

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Development of Learning Media Using Ethnomathematics-Based Augmented Reality on Cube and Block Material

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Abstract

The use of technology in Indonesian education is still quite far behind. Therefore, researchers conducted research aimed at developing android-based learning media using ethnomathematics-based Augmented Reality on cube and block material that is suitable for use and knowing student learning outcomes. This type of research is Research and Development using the ADDIE development model which includes 5 steps, namely Analysis, Design, Development, Implementation, and Evaluation. Research instruments in the form of media validation questionnaires, material validation questionnaires, and learning outcomes tests. Media development using Blender 2.90.1 and Unity Engine 2018 4.36 software. Data analysis was carried out by normality, homogeneity, t-test, and learning due diligence. The results of this study can be concluded that (1) the percentage of validation of media experts is 91.5%, and material experts are 93%. (2) data from the field shows that the learning outcomes of students who obtain android-based learning media using ethnomathematics-based Augmented Reality are better than students who use lecture learning methods (conventional learning).

Keywords: Development, Augmented Reality, Ethnomathematics

Pengembangan Media Pembelajaran Menggunakan *Augmented Reality* Berbasis Etnomatematika pada Materi Kubus dan Balok

Abstrak

Pemanfaatan teknologi dalam pendidikan Indonesia masih terbilang cukup jauh tertinggal. Oleh karenanya peneliti melakukan penelitian yang bertujuan untuk mengembangkan media pembelajaran berbasis android menggunakan Augmented Reality berbasis etnomatematika pada materi kubus dan balok yang layak digunakan dan mengetahui hasil belajar siswa. Jenis penelitian ini adalah Research and Development dengan menggunakan model pengembangan ADDIE yang meliputi 5 langkah-langkah, yaitu *Analysis*, *Design*, *Development*, *Implementation*, dan *Evaluation*. Instrumen penelitian berupa angket validasi media, angket validasi materi, dan tes hasil belajar. Pengembangan media

menggunakan software *Blender 2.90.1* dan *Unity Engine 2018 4.36*. Analisis data dilakukan dengan uji normalitas, homogenenitas, uji t dan uji ketuntasan belajar. Hasil dari penelitian ini dapat disimpulkan bahwa (1) presentase validasi ahli media sebesar 91,5%, ahli materi 93% . (2) data dari lapangan menunjukan bahwa hasil belajar siswa yang memperoleh media pembelajaran berbasis android menggunakan *Augmented Reality* berbasis etnomatmatika lebih baik di banding dengan siswa yang menggunakan pembelajaran dengan metode ceramah (pembelajaran konvensional).

Kata kunci: Pengembangan, *Augmented Reality*, Etnomatematika

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INTRODUCTION

Mathematics is a basic science that underlies the development of other sciences, basically, mathematics is the queen of science. Ismail et al (Muhlisrarini, 2014) Giving a definition of the nature of mathematics as a science that discusses numbers and their calculations, discusses numerical problems, regarding quantities and magnitudes, studies the relationship of patterns, forms, and structures, means of thinking, a collection of systems, structures, and tools. (Muhlisrarini, 2014) In his book also says mathematics is a tool to solve problems by translating problems into mathematical symbols. But in fact, learning mathematics is a complaint for students, students consider that mathematics is difficult and scary. One of the mathematical materials that is considered difficult for students is geometry, especially on the Cube and Beam material.

But there are still many students who have difficulty solving math problems. As conveyed by (Fahlevi et al., 2020) To find out the understanding of the material taught can be seen when students finish working on a problem. (Nursalam, 2016) said some of the difficulties that students often experience include: 1) Students learn without knowing and what goals to achieve; 2) Lack of motivation to learn; 3) Study with bare hands; 4) Consider learning the same as memorization; 5) Interpret learning to acquire knowledge only; 6) Learning without concentration of mind; 7) Learning without a plan and doing learning of incidental origin desires. One of the materials that students still find difficult is the cube and block material. According to research from (Afrilianto &; Rohaeti, 2018)

Students' difficulties include (a) Difficulty mastering the concept of cubes and blocks consisting of difficulty mentioning and showing the elements of cubes and blocks in pictures, difficulty distinguishing the concepts of sides in flat shapes and side planes in spatial buildings, and difficulty in giving understanding cubes and blocks. (b) Difficulty finding the formula for the surface area of cubes and blocks. (c) Difficulty using the surface area formula of cubes and blocks.

According to the results of observations made by researchers at SMP Walisongo 1 Semarang showed that the mathematics learning process was less active and less interesting, this was due to the lack of supporting media in the learning process. Another obstacle is caused by the lack of school facilities such as the unavailability of LCD Projectors in each class that supports teachers to facilitate the delivery of material. The use of learning media should get the attention of teachers in learning activities. According to (Saputro et al., 2014) Learning media turns out to follow the development of existing technology, ranging from print technology, audio visual, computers to combined technology between print technology and computers. One of the benefits that can be taken from the existence of this technology is to use it as an effective, creative and educational learning medium. So that educational application media can continue to be developed, one of which is technology Augmented Reality (AR). (Suharso & Muhaimin, 2016) shows that the use of learning applications using AR technology can facilitate the task of teachers in presenting material, shorten the duration of time needed and can create a more interactive learning atmosphere. In addition, it was also revealed that the advantage of this application is that it has high interactivity, namely with the existence of AR virtual objects that can interact directly with users. According to (Buchori et al., 2017) Android learning media that can be selected according to (Saputro et al., 2014) defines AR technology or can also be referred to as the integrity of digital elements that are added to the real world directly (real world data) and follow environmental conditions that exist in the real world and can be applied to mobile devices.

The importance of using learning media is supported by the statement (Pranasiwi, 2015) that the demands of the times require children to know technology early and appropriately to increase children's interest in learning. Not only learning media, the learning process should be emphasized on the relationship between mathematical concepts and student experience. The math problem presented must be real, meaning that

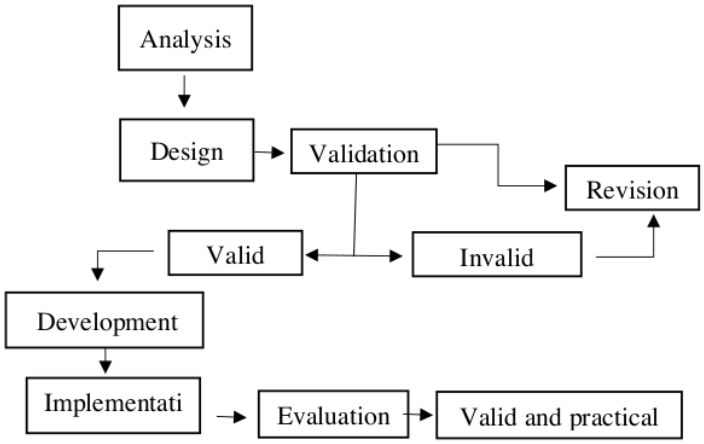
the problem situation must be experiential real for the student (Wijaya, 2012). According to (Treffers, 2012) The context or real problem is used as a starting point for learning mathematics. Context doesn't have to be a real-world problem, but it can be in the form of a game, use of props, or any other situation as long as it's meaningful and imaginable in the student's mind. Through the use of context, students are actively involved in exploring a problem. The ethnomathematical context used in this study is the Great Mosque of Demak, Central Java.

The use of context is needed by students in constructing knowledge based on contextual problems given at the beginning of learning. Culture can be used as a context in the learning process and in solving problems contextually because culture is closely related to everyday life (Orey & Rosa, 2008). Contextual problems based on cultural context as a source and reference for learning mathematics are relevant forms of ethnomathematics (Sintiya et al., 2021). This is in line with the research submitted by (Lubis et al., 2018) that education and culture are two inevitable essential elements of everyday life, because culture is a complete and inclusive entity applicable to society and education is the fundamental need of everyone in society. One of the relevant studies in research (Fauzi et al., 2021) said that the development of android-based learning media with Augemented Reality features using an ethnomathematical approach to building flat side space material is practically used in learning by looking at the percentage value of student responses of 89.06%; and based on field result trials, the average learning outcomes in experimental classes using android-based learning media with Augemented Reality features using an ethnomathematical approach are better than the average learning outcomes in control classes using conventional learning.

Based on this background, this study aims to: (a) To find out whether android-based learning media using ethnomathematics-based Augmented Reality on cube and block material is valid for use in mathematics learning (b) To find out whether Android-based learning media using ethnomathematics-based Augmented Reality on cube and block material is effective when viewed from student learning outcomes.

RESEARCH METHODS

This research is a Research and Development research using the ADDIE development model. The stages in the ADDIE model are: (1) Analysis (Analysis), in this stage 3 stages of analysis are carried out, namely student needs analysis, material analysis, curriculum analysis. (2) Design (Design), in this stage media design is carried out using ethnomathematics-based Augmented Reality, (3) Development (Development), in this stage product development and product improvement are carried out based on the results of data analysis from the assessment of media experts and material experts, (4) Implementation (Implementation), at this stage the product is tested in learning activities, (5) Evaluation (Evaluation), at this stage it is carried out Pre-Test and post-test. Products are used by class VIII with maetri Cube and Beam. The samples used in this study were class VIII B as an experimental class and class VIII A as a control class.



The instruments used include LAS, media expert validation questionnaires, expert validation questionnaires and tests. Validity to determine the eligibility / validity of media with judment experts through media experts and material experts. To determine whether the resulting product is effective in improving student learning outcomes using test instruments that were previously tested in trial classes and then analyzed using tests of validity, reliability, difficulty, and discriminating power. Questions that meet the criteria in the

validity, reliability, difficulty and differentiating power tests are used for pre-test and post-test. The effectiveness indicators used in this study are based on the indicators conveyed by Lintang et al., (2017), namely: (1) learning completeness ≥ 75%, (2) the learning outcomes of the experimental class are better than the control class, (3) there is an increase in the ability of students who use these learning devices.

RESULTS AND DISCUSSION

In this research and development produces a learning media product using Augmented Reality ethnomathematics-based which was carried out at SMP Walisongo 1 Semarang and developed with the ADDIE development model consisting of 5 stages, namely: First stage Analysis, in this stage, an analysis of the needs of students was carried out which obtained data that the learning media used in schools were less interesting, only in the form of textbooks and summaries of material sent by teachers. In an effort to improve student learning outcomes, it is necessary to use interesting learning media for students so that students more easily understand the cube and block material, not just listening to explanations from the teacher. Before making learning media using Augmented Reality Based on ethnomathematics, an analysis of the material and curriculum used in schools is also carried out, the material to be studied is cube and block material, and the curriculum used is curriculum-13 (K-13).

The second stage is design, at this stage researchers make Special Mathematics LAS which is done by adapting the package book held by students and designing an android application, making expert validation sheets for product assessment, evaluation questions, grids, answer keys and question scoring rubrics and designing learning media using Augmented Reality Ethnomathematics-based such as designing media displays and preparing learning devices to be used. The media display is presented in figure 1.

Figure 1. Menu display on the application

Figure 2. Augmented Reality Display

Figure 1 is the main display and several menus that will make it easier for students to learn cube and block material. Figure 2 is an Augmented Reality (AR) display that will

keep students motivated to learn easily. By using AR students can see a real picture of building the flat side space of cubes and blocks, students can also see the volume and webs of the building. Through ethnomathematics-based AR media learning is also provided in the AR application of the Great Mosque of Demak Central Java, the mosque can be enlarged and reduced and can be rotated 360 degrees. Students will be more enthusiastic to learn cube and block material through the ethnomathematical context of the Great Mosque of Demak, Central Java.

Third stage Development, after completion of product manufacturing, then the product will be validated by media experts and material experts. The data obtained is then analyzed, and from the analysis it is obtained that the product is declared feasible / valid. Results are shown in Table 1.

Table 1. Media Expert Validity Results

No	Validators	Score	Percentage	Category
1	Validator 1	90	90%	Excellent
2	Validator 2	93	93%	Excellent
	Sum	183		
	Average	91,5	91,5%	Excellent

Based on Table 1, the results of material expert validity data have an average of 91.5 with a percentage of 91.5% having Very Good criteria. Thus, it shows that the learning media to build a flat side space using ethnomathematics-based Augmented Reality developed has valid categories based on media experts. Furthermore, the results of material expert validation are shown in Table 2 below.

Table 2. Material Expert Validity Results

No	Validators	Score	Percentage	Category
1	Validator 1	76	91%	Excellent
2	Validator 2	73	95%	Excellent
	Sum	149		
	Average	93%	93%	Excellent

After conducting expert validation, the development of android-based learning media using Augmented Reality on the flat side room building material was then revised according to validators' criticisms and suggestions before conducting product trials. Based on the results of the discussion from expert validation, it can be concluded that android-based learning media using Augmented Reality on flat side space building material is valid and worthy of dissemination.

The fourth stage of implementation, after obtaining data from validators and analyzing which then concludes that the product is valid / suitable for use, the next stage is

the implementation of products used in experimental class learning. Before carrying out the learning, researchers conducted an initial analysis using pretest data and final data using a post test and then carried out a normality test, homogeneity test and right-party t test to find out whether the learning outcomes of the experimental class and the control class were the same. The data test process uses manual and Microsoft excel. The normality test results of the pretest and postest data are shown in Table 3.

Table 3. Test Analysis of Normality and Homogeneity of Initial Data

Description	Normality		Homogeneity
	Experiment	Control	
Initial Data	0,1555	0,0928	1,1435
Final Data	0,0615	0,0685	1,1922

Based on Table 3, information related to values for the normality test and homogeneity test is obtained. The normality test of the initial data of the experimental class was obtained by both classes with a normal distribution, namely obtained by the experimental class of 0.1555 0.159, $L_{hitung} < L_{tabel}$ and the control class of 0.092 0.159, < the homogeneity test of the two classes was obtained $L_{hitung} <$ by 1.1435 1.840 $F_{hitung} <$ so that both classes were homogeneous.$F_{tabel} <$ For the final data of the normality test, $L_{hitung} <$ the experimental class was obtained at 0.0615 0.159 and the control class at 0.0685 $L_{tabel} < L_{hitung} <$ 0.159 $L_{tabel} <$ so that both classes were normally distributed. In the homogeneity test, $F_{hitung} <$ 1.1922 $F_{tabel} <$ is obtained 1.840 so that both classes are said to be homogeneous.

It is known that both classes of initial data and final data are normally distributed and homogeneous. Then a t-test will be carried out to find out whether the learning outcomes of experimental class students who have used android-based learning media with Augemented Reality features using ethnomathematics-based are better than conventional learning in the control class. The results of the Right Party t-test are presented in table 4.

Table 6. Right Party t Test Analysis Results

Aspects	t_{hitung}	t_{tabel}
Learning Outcomes	6,5212	1,676

Based on table 4, information related to values = 6.5212 and = 1.676 is obtained. Because in this > it can be concluded that the average experimental class that uses Android-based learning media with $t_{hitung} t_{tabel} t_{hitung} t_{tabel}$ Augmented Reality features with an

ethnomathematical approach to flat side space building material is better than the control class with conventional learning.

Furthermore, the N-Gain test was carried out to calculate the magnitude of the increase in learning outcomes in students using the learning outcomes of initial data and final data (post-test) for the experimental class and control class. For the n-gain test results in the experimental class of 0.53 which has medium criteria, while for the control class of 0.41 which is also included in the criteria. Then the completeness of learning is tested to determine the completeness of students classically. The results of the learning due diligence are presented in Table 7.

Table 7. Results of Classical Learning Due Diligence Analysis

Class	t_{hitung}	t_{tabel}
Experiment	2,425	1,6955
Control	-2,931	1,6955

Based on Table 7 for experimental classes with n = 31 and a significant level of 5% obtained and . This means that it is thus accepted, while the t-test calculation for the control class with n = 31 and a significant level of 5% is obtained and . This means that it is rejected. Based on these calculations, it can be concluded that in the experimental class the proportion of student learning completeness has been achieved than the control class with the proportion of student learning completeness has not been achieved.$t_{hitung} = 2{,}425 t_{tabel} = 1{,}6955 t_{hitung} > t_{tabel} H_0 t_{hitung} = -2{,}931 t_{tabel} = 1{,}6955 t_{hitung} < t_{tabel} H_0$

This research is in line with the results of research from (Sari et al., 2012) who said that by applying AR technology innovation in learning, it will create a new atmosphere that is effective and provides an overview of the real-world environment in the learning system. The same is said by (Suharso & Muhaimin, 2016) that there is a significant difference in results before and after using learning-based media Augmented Reality MagicBook. Next (Buchori et al., 2017) in his research said that the cognitive learning outcomes of the group of students with the treatment of MAR learning strategies (Mobile Augmented Reality) superior to the group of students with non-MAR direct strategy treatment (Mobile Augmented Reality).

Based on the results and discussion, then overall "Development of learning media using Augmented Reality Based on cube and block material" is feasible to be used in learning activities according to media experts and material experts, and from learning outcomes. In addition, learning media also uses Augmented Reality Ethnomathematics-based on cube and block material is better than learning outcomes with conventional learning.

CONCLUSION

Based on the results of research and discussion, it can be concluded that (a) This research produces learning media products using ethnomathematics-based Augmented Reality on cube and block materials declared valid or suitable for use with a percentage of 91.5% media experts and 95% material experts (b) learning media using Augmented Reality Based on ethnomathematics on cube and block material is declared effective in improving student learning outcomes, the proportion of learning completeness is achieved so that the learning media is effectively used in mathematics learning and student evaluation based on the results of the N-Gain calculation of 0.53 with the medium category. So that learning media using ethnomathematics-based Augmented Reality on cube and block material can be said to be feasible to be used to improve student learning outcomes.

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