Implementation of the Magic Book Math Media Based on Augmented Reality in UPGRIS Senior High School

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Implementation of the magic book math media based on augmented reality in UPGRIS Senior High School

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Abstract

This study aims to implement the Magic Book Math media based on Augmented Reality in UPGRIS Senior High School. The research model used the ADDIE learning design model. This model, as the name implies, consists of five main phases, namely (A) analysis, (D) design, (D) development, (I) implementation, and (E) valuation. The stages of analysis, design and development have been conducted in previous studies resulting in the magic book math media based on augmented reality, which was a valid product and worthy of use. In this study, the stages carried out were the implementation and evaluation stages. Due to data collection during the Covid-19 pandemic, data collection and learning processes were carried out online using the Zoom platform. Questionnaire student responses used Google Form. The results showed that implementing learning using the Magic Book Math media based on Augmented Reality in UPGRIS Senior High School met the learning objectives. This was indicated by the difference in learning achievement between the control and experimental classes, where the average value of the experimental class was x1 = 85.83, and the control class average was x2 = 64.43. The percentage of student responses about the feasibility of Magic Book Math based on Augmented Reality (AR) was 87.00%.

Keywords: *Magic Book Math, Augmented Reality, Implementation*

1. Introduction

One indicator is that Augmented Reality has not been used to support student understanding yet, especially spatial abilities. The high school mathematics textbooks product is expected to display augmented reality in that textbooks to make students more interested in learning mathematics. In the education world, many textbooks that circulating in the market, but not in accordance with the demands of the times, for example, is a textbook in high school mathematics learning, so far the textbooks available are only in the printed version and have not been associated with the application of renewable technology, from this reality makes teachers must be able to package and make textbooks that are interesting for students. High school schools in Semarang city and its surroundings, both

public and private, have not provided augmented reality-based readers that can display 3D objects on every textbook page. Therefore it is necessary to make an augmented reality-based high school mathematics textbook that is able to improve students' ability to understand material mathematics in measurable terms.

Based on interviews with several high school mathematics teachers in Semarang city both public and private produced fact that nearly 100% of high school schools in Semarang city still use mathematics textbooks that have not been touched by renewable technologies such as augmented reality, virtual reality, other mathematical software applications, this becomes significant findings for the development of textbooks that are able to accommodate these problems.

Based on the observation conducted before the research conducted, the mathematics learning process is less active and attractive. This is due to the absence of instructional media used by teachers so that students become bored quickly. Teaching and learning interactions in the classroom are inseparable from the influence of the media used by the teacher in delivering teaching material. The existence of technology, especially smartphones that are now increasingly developed, must be addressed wisely. The phenomenon of the high number of smartphone users is undoubtedly a challenge and opportunity in the education world. The challenge is the abuse of negative things. Besides being a challenge, smartphones bring real opportunities to develop useful technologies in the education field. One of the benefits that can be taken from the existence of this technology is to use it as creative and educative learning media. So the educational application media can continue to be developed, one of which is the technology of Augmented Reality (AR).

Based on the background above, researchers developed an Android-based learning media using Augmented Reality (AR). This development has been implemented and has produced the magic book math media based on augmented reality-a right-good product and suitable for use. Then this media product is implemented in UPGRIS Senior High School.

2. Literature Review

Android Smartphone

In following the latest learning, students are expected to use their smartphones for learning, one of which is Android. Android is an operating system for Linux-based mobile devices that includes an operating system, middleware, and applications (Murtiyawati & Glenn, 2013:2). Kirthika et al. (2015:260), in the journal Android Operating System: A Review, says that

Android is a software platform and operating system for mobile devices, based on the Linux kernel, and developed by Google and later the Open Handset Alliance (OHA). According to Ichwan (2011:15), OHA includes 34 hardware, software and telecommunications companies, including Google, HTC, Intel, Motorola, Qualcomm, T-Mobile, and Nvidia.

Android in learning becomes an operating system for the first Linux-based mobile devices that provides an OPENSOURCE (open) platform. This makes it easy for developers to create their applications. Many applications can be made for Android, one of which can be used as a learning medium. Therefore, researchers want to utilize Android as effective learning media.

According to Zuliana & Irwan P (2013: 2), the strengths of Android are 1) Complete (complete platform), developers can take a comprehensive approach when developing the Android platform. Android is a safe operating system and provides many tools for building software and making opportunities for application developers. 2) Android is an open (open source platform), Linux-based Android which is open source or open-source, so anyone can easily develop it. 3) Free Platform, Android is a free platform for developers. There are no fees for paying licenses or royalty fees. Android software as a complete, open, free platform and other information can be downloaded for free by visiting the website http://developer.android.com. 4) The popular operating system, Android phones are certainly different from the iPhone Operating System (IOS) which is limited to gadgets from Apple, so Android has many manufacturers, with their mainstay gadgets at quite affordable prices.

While Android Weaknesses are 1) Android is always connected to the internet. This Android system smartphone requires an active internet connection. 2) The number of advertisements displayed above or below the application. Although there is no effect on the application being used, this ad is very annoying. 3) Does not save battery power.

The application of Augmented Reality technology is now quite extensive, including in the field of education. Billinghurst (2002) argues that the use of augmented reality technology in the world of education is still being developed until now because it is not like computing technology in general. The augmented reality interface can integrate users, virtual objects, and real environments. In its application to the school environment, there needs to be a collaboration between teachers or tutors and researchers in the field to know the compatibility of the application of augmented reality media with the curriculum in the school.

Magic Book Math Media

Magic book math is a textbook specifically for high school students that is based on

Augmented Reality, which is able to display the augmented reality that is interesting to students. This opinion is in line with the conclusion of Kaufman (2000) that as advances in the development of pedagogical concepts, applications, technology, and hardware cost reduction, the use of small-scale augmented reality technology for educational institutions has become very possible in this decade (assuming a careful level of sustainable development). However, the potential of this technology requires careful attention so that it can truly be utilized to improve educational success.

Azuma (1997) also revealed the reasons for the use of augmented reality technology in the world of education, namely; (1) supporting interaction between real and virtual environments, (2) the use of interfaces that seem real for object manipulation, (3) learning outcomes for a smooth transition between environments real and virtual objects.

Previous Relevant Research Results

The relevant studies related to the research that researchers will conduct are a research by Buchori, A., et al. 2017. Mobile Augmented Reality Media Design with Waterfall Models for Learning Geometry in College. The result reveals that the students were very interested in using mobile augmented reality in studying the geometry course material. Another similar research on the Development of Mobile Learning in Geometry courses in terms of the Students' Critical Thinking Ability conducted by Prasetyowati, D., et al. (2016). Hughes Research Laboratories, Malibu explains that augmented reality can improve students' ability with added reality spatial., Azuma Research, (Ronald T. 1997), a Survey of Augmented Reality. Research conducted by Permadi, Dendi, and Ahmad Rafi (2015), Developing a Conceptual Model of User Engagement for Mobile-based Augmented Reality Games also showing good result. While, (Hammo, 2015) Investigates the readiness of college students for ICT and Mobile Learning: A Case Study from King Saud University, shows that more than 60% of KSU students use ICT and Mobile learning in daily life on campus. Zheng, R., Zhang. D. and Yang, G. 2015. Seam the Real with the Virtual: a Review of Augmented Reality. It shows that by combining virtual and augmented reality makes learning as if seeing the real world in a fun way.

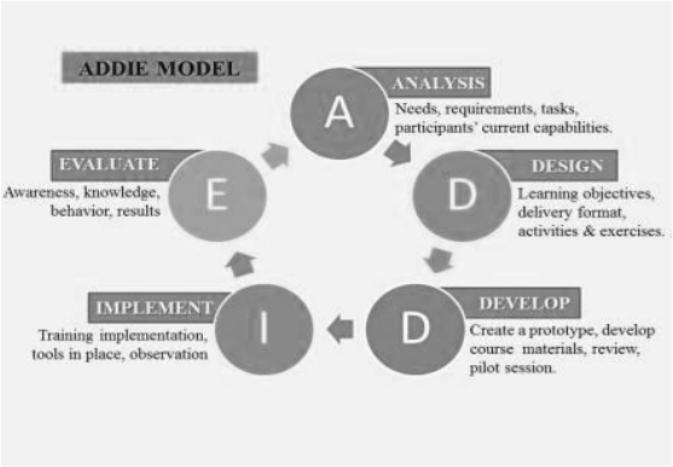
3. Research Methodology

This research method applied was a research and development. It is a research method used to produce certain products, and test the effectiveness of the products (Sugiyono, 2010: 407). The research model used was the ADDIE learning design model. This

model, as the name implies consists of five main phases or stages, namely (A) analysis, (D) design, (D) e-development, (I) implementation, and (E) valuation. The five phases or stages in the ADDIE model need to be done systematically and systematically (Personal, 2010: 125). Research Procedure with ADDIE model can be seen in figure 1 below.

Figure 1

Development Model ADDIE



The stages of analysis, design and development have been carried out in previous studies resulting in magic book math media based on augmented reality which was a valid product and worthy of use. In this study, the stages carried out were the implementation and evaluation stages. Due to data collection was conducted during the Covid-19 pandemic, data collection and learning processes were carried out online using the Zoom platform. Questionnaire student responses used Google Form.

The main purpose of the implementation stage, which is the step of realizing design and development, is to guide students to achieve learning goals, ensure solutions to address learning outcomes gaps faced by students, and ensure that at the end of the learning program, students need to have competency knowledge, skills, and attitudes needed (Personal, 2010:134). In the implementation stage, the researcher applied Android-based learning media using Augmented Reality on the flat side space material.

The final step of the ADDIE model is evaluating learning programs and evaluating learning outcomes. As in the analysis step, the evaluation process is carried out by clarifying the competence of knowledge, skills, and attitudes. This evaluation is known as formative evaluation. In addition, it can also be done by comparing the learning

outcomes that have been achieved by students with the learning objectives that have been formulated previously (Pribadi, 2010: 135).

In this research and development, the researcher evaluated the learning program, in which include evaluation of the quality of teaching materials based on the questionnaire results on the evaluation of teaching materials given to media experts, material experts, field experts and students who participated in the trial. This evaluation can be used as input for the revision of the teaching material. The evaluation also include evaluation on the impact of using teaching materials on the problem-solving abilities of students who work on post-test questions. This evaluation is used as a material consideration in Android-based learning media using Augmented Reality in teaching and learning activities in the classroom.

4. Findings and Discussions

At the implementation stage, researchers conducted the learning program by applying the design or specification of the magic book math learning program based on augmented reality. The main purpose of the implementation stage which was a step of realizing design and development was to guide students to achieve learning goals, ensure a solution to address learning outcomes gaps faced by students, and ensure that at the end of the learning program used math magic books based on augmented reality, students have knowledge, skills, and attitudes competency as required in the teaching plan.

In the implementation stage, researchers applied the magic book math learning media based on Augmented Reality in UPGRIS Senior High School. The implementation stage in UPGRIS Senior High School was by taking class X-1 as the experimental class and class X-2 as the control class. Due to data collection during the Covid-19 pandemic, data collection and learning processes were carried out online using the Zoom platform. Questionnaire for teacher responses and student responses used Google Form. Post-test data analysis was carried out to determine whether the experimental class and the control class had differences between conventional learning and learning using Augmented Reality (AR) based Magic Book Math media. Furthermore, researchers analyzed the post-test data that had been carried out in class X-1 and class X-2. The steps used to analyze the post-test data are as follows.

a. Normality Test

To calculate the normality of the initial data, it was carried out using the Liliefors test with a significant level of 5%. The hypotheses and criteria in the normality test are as follows.

Ho: L0 <L table, then the population is normally distributed.

Ha: L0> L table, then the population is not normally distributed.

The following results are obtained.

Table 1

Normality Test

Class	N	L0	Ltable	Decision
Experiment (X -1)	15	0,154	0,219	Normally Distributed
Control (X -2)	12	0,147	0,242	Normally Distributed

From the table it is clear that 0,154 < 0,219 and 0,147 < 0,242. So L0 <L table in the control class and experimental class with a significant level of 5% with n1 = 15 and n2 = 12 so that Ho is accepted. This means that samples from the experimental class and control class come from samples that are normally distributed.

b. Homogeneity Test

A homogeneity test is used to test the similarity of the two variances. From calculations with MS. Excel obtained Fcount = 1.36, with alpha = 0.05 and dk numerator (25 - 1 = 14), dk denominator (12 - 1 = 11), so F (0.05) (14,11) = 2,74. The test criteria accept Ho if Fcount <Ftable. Because Fcount <Ftable, namely 1,36 <2,74, Ho is accepted, so it can be concluded that the variance between groups is homogeneous (same).

c. T-Test

The effectiveness of the Magic Book Math media based on Augmented Reality (AR) was tested using an experimental design, namely Post-test Only Control Design. In this design, there are two groups, namely the experimental group and the control group. This experimental design was used to compare student achievement between the experimental and control groups hoping that the experimental group's achievement was better than the control group. The hypotheses used in this study are as follows.

Ho = Math learning outcomes using Magic Book Math Media based on Augmented Reality (AR) has no difference with conventional learning models.

Ha = Results of learning mathematics using Magic Book Math Media based on Augmented Reality (AR) is better than conventional learning models.

To find out which learning is better, the t-test (right side) is used with the following formula:

$$t = \frac{\left(\overline{X}_1 - \overline{X}_2\right)}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$dengan \quad s^2 = \frac{(n_1 - 1)s^2_1 + (n_2 - 1)s^2_2}{n_1 + n_2 - 2}$$

Based on calculations with MS. Excel obtained an average for the experimental class, namely x1 = 85.83 and the average for the control class, namely x2 = 64.43 with n1 = 15, n2 = 12 and s = 10,503 so that t-count = 5.36. The result of t count is compared with t table. From the t distribution list with probability 0.95 and dk = 15, then t 0.95 is 1.75. From the calculation obtained t-count of 5.36 and ttable of 1.75. Because t-count> t-table is 5.36> 1.75, then Ho is rejected.

Based on the above calculations, because Ho is rejected, it can be concluded that the results of learning mathematics using the Magic Book Math media based on Augmented Reality (AR) are better than conventional learning models. This proves a difference in learning achievement because the teacher uses two different treatments between the control class and the experimental class with the experimental class mean score, namely x1 = 85.83 and the control class average, namely x2 = 64.43.

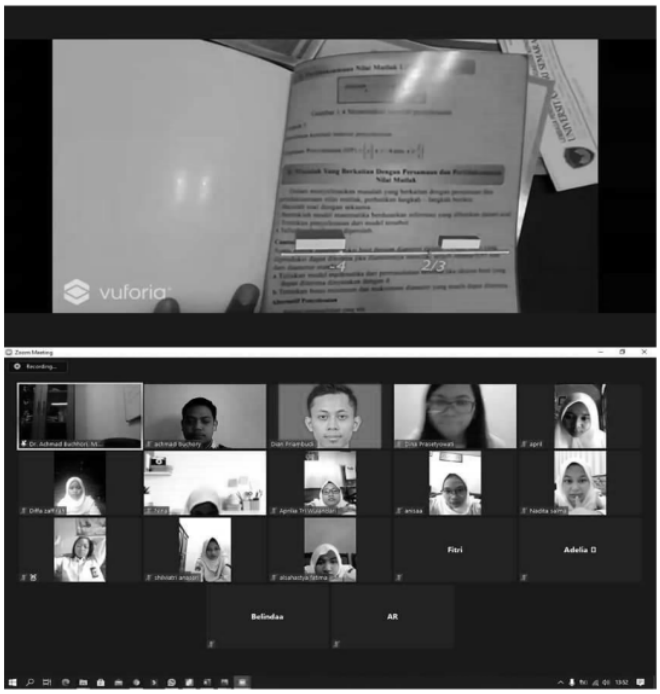
The extended test documentation in UPGRIS Senior High School can be seen in the following figure.

Figure 1

Implementation in UPGRIS Senior High School

Figure 2

Magic Book Math Display



d. Students' Responses Result

Students respond to the Magic Book Math Media based on Augmented Reality (AR) by filling out a questionnaire given by the researchers via the google form link for students to fill out. The questionnaire link is given to students after students have finished using the Magic Book Math Media based on Augmented Reality (AR. This is done so that researchers know how well the Magic Book Math Media based on Augmented Reality (AR) is used for students. The questionnaire filled out by students has five scales with the following criteria.

Score 5: Strongly Agree (SA)
Score 4: Agree (A)
Score 3: Less Disagree (LD)
Score 2: Disagree (D)
Score 1: Strongly Disagree (SD)

The assessment criteria are 10 questions. The analysis of students' responses result in each question are presented in the following table.

Table 2
The Student Response Questionnaire Result

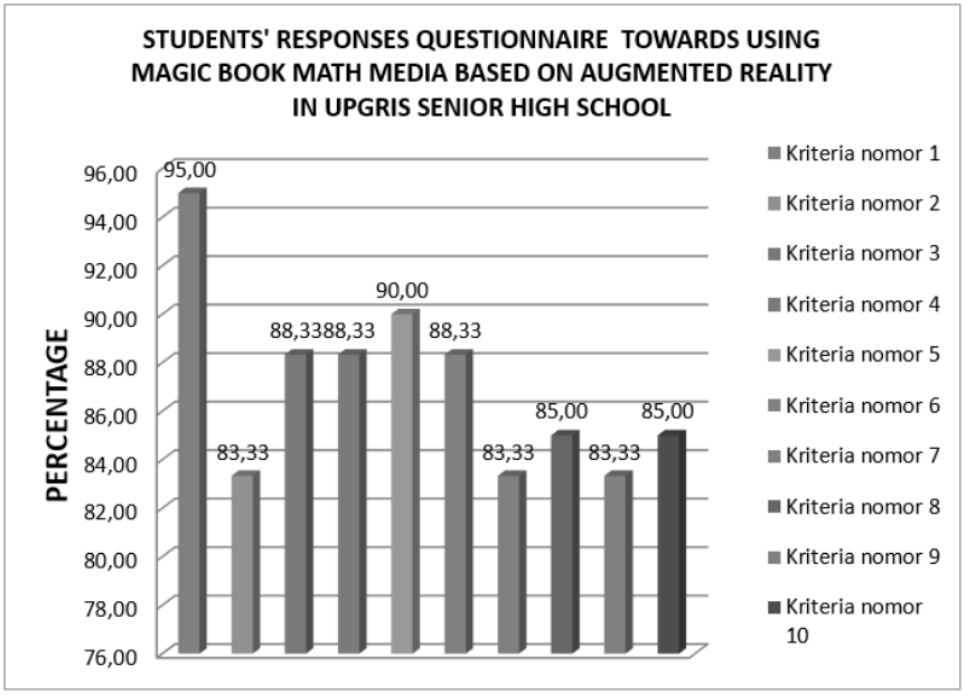
NO	CRITERIA	AVERAGE	PERCENTAGE
1	I am very interested in using this math magic book product	4,75	95,00
2	I can understand math material with Augmented Reality	4,17	83,33
3	I feel interested in using the math magic book in understanding math material	4,42	88,33
4	I can see augmented reality with fun and fun	4,42	88,33
5	I can relate this augmented reality-based math material with the concept of the material	4,50	90,00
6	I try to solve problems related to mathematics even though it is difficult	4,42	88,33
7	I can apply the math formulas well and it suits the problem	4,17	83,33
8	I can determine a suitable formula to solve math problems	4,25	85,00
9	I can solve the math questions in order	4,17	83,33
10	I am sure there is no difficulty in operating this magic book math product as a supplement to school materials	4,25	85,00
	AVERAGE	**4,35**	**87,00**

From the above calculations, the average percentage of the feasibility of the Magic Book Math based on Augmented Reality (AR) is 87.00% by students. After being converted to a scale conversion table, the Magic Book Math media based on Augmented Reality (AR) is in the range of 81% - 100%. So that puts the position on the very good criteria.

The percentage score for each student response criterion can also be seen in a bar chart in the following figure.

Figure 3

Students' Responses Questionnaire Bar Graph



5. Conclusions

After carrying out this implementation, it was found out the level of effectiveness of the learning program with the math magic book media based on Augmented Reality in Mathematics learning. The results of the research obtained that students like the learning program using the media magic book math based on Augmented Reality. The second result is that the learning program using the media magic book math based on Augmented Reality is beneficial for students, teachers and schools. The students showed that they are able to apply the knowledge, skills and attitudes that have been learned using augmented reality-based magic book math media which is evidenced by the value of the classically complete post-test results.

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