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DEVELOPMENT OF PHYSICS LEARNING MEDIA USING ANDROID BASED AUGMENTED REALITY IN STATIC ELECTRICAL MATERIALS FOR HIGH SCHOOL STUDENTS

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Abstract

This study aimed to develop physics learning media using Android-based Augmented Reality on static electricity topic in the form of an application called PARE (Physics AR Education). This application focuses on visualizing static electricity topic. The method used in this study is Research-and-Development. This study was conducted in three schools including SMAN 12 Tangerang, SMAN 90 Jakarta, dan SMAN 63 Jakarta each in two-class respondents. Validation tests were conducted by material and media experts. Media assessment shows that all the 15 statements received an average score of 4,49 hence categorized as very good. The material assessment shows that all the 12 statements received an average score of 4,07 hence categorized as good. The whole percentage of expert assessment reached 85,6%. Students' trial tests were conducted twice including small-scale and large-scale trial tests. The small-scale trial test was conducted towards 13 students and received an average score of 4,39 hence categorized as very good. Meanwhile, the large-scale trial test towards 201 students received an average score of 4,01 hence categorized as good. The whole percentage of the trial test reached 84%. Overall, media effectivity could be seen based on pretest and posttest that were conducted in SMA Negeri 12 Tangerang, SMAN 90 Jakarta, and SMAN 63 Jakarta with a total of 201 students and showed that the percentage reached 96,87% which categorized as very good.

***Keywords**: Learning Media; Augmented Reality; Android.*

Abstrak

Penelitian ini bertujuan untuk menghasilkan media pembelajaran fisika menggunakan Augmented Reality berbasis Android pada materi listrik statis dalam bentuk aplikasi yang dinamakan PARE (Physics AR Education). Aplikasi PARE difokuskan kepada visualisasi materi listrik statis. Metode penelitian yang digunakan adalah Research and Development. Penelitian ini dilakukan di tiga sekolah yaitu SMAN 12 Tangerang, SMAN 90 Jakarta, dan SMAN 63 Jakarta dengan responden sebanyak dua kelas di setiap sekolah. Uji validasi dilakukan oleh ahli materi dan ahli media. Penilaian media terdiri dari 15 pernyataan mendapatkan skor rata-rata 4,49 dengan kategori sangat baik. Penilaian materi terdiri dari 12 pernyataan mendapatkan skor rata-rata 4,07 dengan kategori baik. Jumlah persentase keseluruhan penilaian ahli sebesar 85,6%. Pada uji coba siswa dilakukan dua kali, yaitu uji coba skala kecil dan uji coba skala besar. Uji coba skala kecil dilakukan dengan total responden 13 siswa didapatkan skor rata-rata 4,39 dengan kategori sangat baik, sedangkan uji coba skala besar dengan total reponden 201 siswa didapatkan skor rata-rata 4,01 dengan kategori baik. Jumlah persentase keseluruhan penilaian ahli sebesar 84%. Untuk keseluruhan efektivitas media dilihat dari hasil pre-test dan post test yang dilakukan di SMA Negeri 12 Tangerang, SMAN 90 Jakarta, dan SMAN 63 Jakarta dengan jumlah total siswa sebanyak 201 siswa mendapatkan persentase sebesar 96,87% dengan kategori sangat baik.

***Kata kunci**: Media Pembelajaran; Augmented Reality; Android.*

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BACKGROUND

Education is an activity to civilize young people or make these young people live cultured according to the standards accepted by society. Education gives students the possibility to gain opportunities, hopes, and knowledge in order to live better. The opportunity and hope is very dependent on the quality of education that is obtained. Education can also be strong to make changes so that a condition for the better. Quality education certainly involves students to actively learn and direct the formation of the values needed by students in life (Sani, 2014). Based on the National Education System Law No. 20 of 2003 namely the development of the potential of students to become human beings who believe and fear God Almighty, noble, healthy,

knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Priyambodo & Situmorang, 2017) .

The learning process must be oriented towards providing and presenting direct experience by directing students to interact with a variety of learning sources and relevant study objects. Therefore it is very important for teachers to have creativity and innovation to convey learning to students so as to increase student interest in learning (Priyambodo & Situmorang, 2017).

In learning, physics presents natural phenomena in the form of real and abstract phenomena and includes small objects. Therefore, many problems occur in the learning process. In the learning process, sometimes there are obstacles, one of which is when the teacher has to visualize abstract phenomena to students, the dimensions are too small or too large which causes difficulties in making practice / direct observation such as in static electricity. This causes the majority of students to find it difficult to understand.

The learning process in Indonesia has been developing from time to time, starting from just using the blackboard as a learning medium and switching to more modern media following the current technological developments. The development of this learning media is expected to be more helpful in achieving the predetermined educational goals. This learning media is one of the important things that must be used by the teacher because it will support the ongoing learning activities.

In this static electricity material requires emphasis in visualization, some phenomena in static electricity material cannot be seen directly or in plain sight but the existing media does not support the learning process, so students need media to be able to visualize static electricity material. If using media it is expected that students can better understand the concept of the material. The learning media needed on the atomic core material is in the form of 3-dimensional images that utilize mobile technology so students can use it anytime and anywhere.

The visualization problem itself can be caused by assisted learning media which only refers to 2-dimensional media in the form of images or videos that are displayed on the projector screen. These problems make static electricity difficult to visualize. The progress of communication and information technology to date has changed the lifestyle and way of the community in obtaining and utilizing information and knowledge. The progress of communication and information technology as it is happening today has changed the paradigm of learning and learning. The old paradigm which considers teachers as the only source of information in the learning process no longer applies today (Personal, 2017). This media visualization solution can use 3-dimensional media created using Augmented Reality (AR) technology. Augmented Reality (AR) is an environment that incorporates 3-dimensional virtual objects into a real environment. AR allows users to interact in real time. The use of AR has now widened to various aspects of our lives and is projected to experience a very significant development. This is because the use of AR very interesting and makes it easy to use it in doing things (Rifa'i et al, 2014). Based on this, the final goal of this research is to create learning media using Android-based Augmented Reality technology on static electricity.

By using AR media, it is expected that students can better understand the concepts of physics that cannot be seen directly, but by visualizing in 3-dimensional form using a smartphone. Media in the form of this application can change 2-dimensional images into 3-dimensions and can input values of a quantity to calculate the required units. In addition students can find out developments of present technology.

METHOD

This study uses research and development (R&D) with the Borg & Gall development model. This development research model is a descriptive model. This research model explains the steps of research to develop a product.

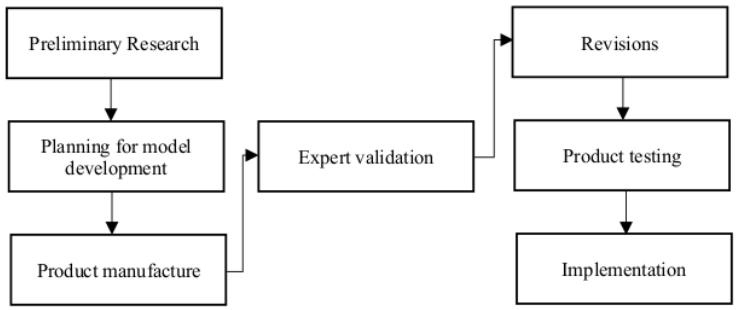

Figure 1. Chart of Model Development Steps (Source: Personal, 2017)

In Astuti (2016) procedures as research steps in the development of instructional media using Augmented Reality with the Borg & Gall development model:

1. Preliminary research

At this stage, data collection needs to be done to determine what is needed by students in learning physics, especially with regard to the media used.

2. Planning for model development

After obtaining the results of the needs analysis, then planning the development of media according to the needs of students. This media development planning is in the form of three-dimensional image design, module design, and instrument preparation.

3. Product manufacture

Making a product in the form of an application is carried out approximately one month until it can be used or tested on students.

4. Expert validation

Before being tested on students, the media that have been made are first validated to experts. Experts who rated this media were media experts and material experts as well as teachers at the research school.

5. Revisions

Expert validation of the media gets suggestions for improvement so that the developed media can be better. This revision follows the advice of material experts and media experts what needs to be replaced or added.

6. Product Testing

After completing the revision, the media is ready to be tested on students. This trial was carried out in two stages, namely a small-scale trial of 13 students conducted at SMA Negeri 63 Jakarta and a large-scale trial of 201 students conducted at three schools, namely SMA Negeri 90 Jakarta, SMA Negeri 63 Jakarta, and SMA Negeri 12 Tangerang. Then a pre-test and a post-test were conducted to determine the effectiveness of the media developed on student learning outcomes conducted at 12 Public High Schools in Tangerang.

7. Implementation

The developed media will then be published by uploading it to the Play Store so that it can be downloaded for free. Then this media will also be introduced to other physics teachers and will certainly be used by the writer as a prospective educator in learning physics, as well as adding discussion material to the application so students can use it for more physics material. The method includes research designs or research designs, targets and research targets (population and sample), data collection techniques, research models, and analysis techniques and hypotheses (if any). The method is written in Indonesian with Times New Roman font size 11 and space 1. Each paragraph is given a new line as much as one inch with the text format flat left and right.

RESULTS AND DISCUSSION

Expert Validation

The feasibility of the model is based on the results obtained after validating experts, namely media experts and material experts. Media expert validation is carried out to assess media appearance and media operation while material expert validation is carried out to assess the content of material contained in the media.

Table 1. Material Scoring

Num	Experts	Average Score	Percentage
1	Expert 1	3.83	76.6%
2	Expert 2	3.33	66.6%
3	Expert 3	4.33	86.6%
4	Expert 4	3.17	63.4%
5	Expert 5	4.83	96.6%
6	Expert 6	4.92	98.4%
Average Score		4.07	
Average Percentage		81.4%	

Table 2. Media Scoring

Num	Experts	Average Score	Percentage
1	Expert 1	4.73	94.6%
2	Expert 2	4.33	86.6%
3	Expert 3	4.33	86.6%
4	Expert 4	3.87	76%
5	Expert 5	4.73	94.6%
6	Expert 6	4.93	98.6%
Average Score		449	
Average Percentage		89.8%	

Material expert test and media expert judge based on three aspects namely learning design, software engineering, and visual communication design. The learning design aspect is the aspect assessed by the material expert regarding the material available on the developed media, while the software engineering and visual communication design aspect is the aspect assessed by the media expert regarding the operation and design of the media display.

Based on these three aspects, the average value of the learning design aspects is 4.02; software engineering aspects 4.52; and visual communication design aspects 4.44 the following graphs are obtained:

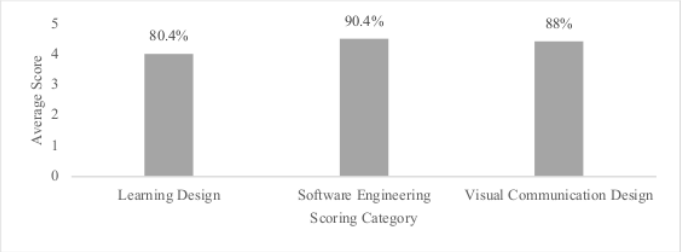

Figure 2. Graph of Expert Expertise

Based on the charts, the assessment is divided into three categories namely learning design, software engineering and visual communication design. The assessment of software engineering gets the highest percentage results, namely 90.4%, while the percentage of learning design results is 80.4%, and visual communication design is 88%. Media assessment consists of 15 statements, getting an average score of 4.49 and a percentage of 89.8% with a very good category. While the material assessment consisted of 12 statements, received an average score of 4.07 and a percentage of 81.4% in the good category. Then the aspects of the overall assessment of experts got a percentage of 86.26% with a very good category, so it can be said that the developed media model is suitable for use in physics learning.

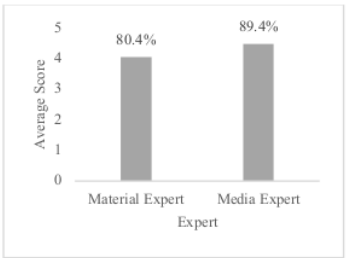

Figure 3. Overall Expert Test Chart

Based on the graph, the percentage of material experts was 80.4% and media experts were 89.4%. The total number of expert ratings got a percentage of 85.6%, so the model developed can be said to be suitable for use by high school students in learning physics.

Final Media Products

The final result of the AR media is in the form of static electricity submateries, namely electric charge, coloumb law, electric potential energy, and capacitors. In each submitter there is a summary of the material, 3-dimensional AR images that can be simulated in the amount, and the quiz in the form of multiple-choice questions can be seen the score. The learning module in the form of 2-dimensional images that will be scanned can be uploaded on the application.

Figure 4. Initial Display of Application

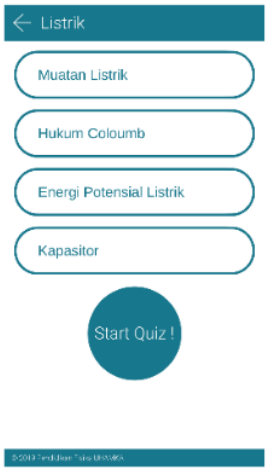

Figure 5. Display of Sub-material

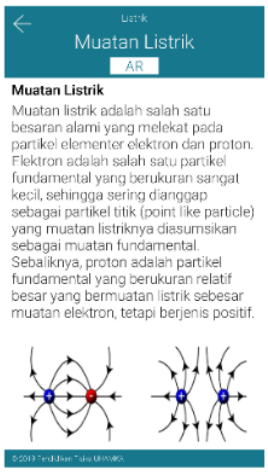

Figure 6. Display Material Summary

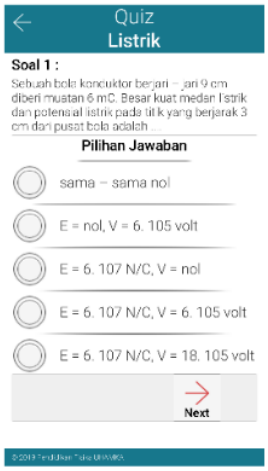

Figure 7. Quiz Display

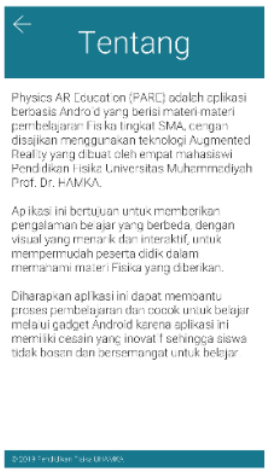

Figure 8. Display Application Information

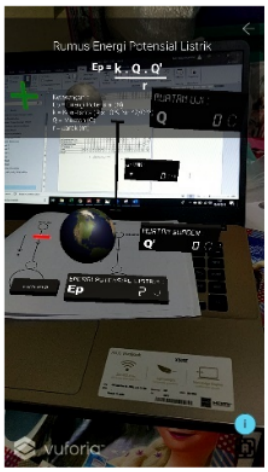

Figure 9. Augmented Reality Display

Product Testing

Trials to students were conducted twice, namely small-scale trials and large-scale trials. In this trial the aspects assessed are the use of learning media in schools, the readability and appearance of applications, the ease of use of applications, as well as the benefits of ease in learning physics. Based on small-scale trials conducted with a total of 13 student respondents obtained an average score of 4.39 and a percentage of 87.8% with a very good category.

Table 3. Score of Student Testing

Num	Trial	Average Score	Percentage
1	Small Scale	4.39	87.8%
2	Large Scale	4.01	80.2%
Average Score		4.20	
Average Percentage		84%	

Then a large-scale trial was conducted with a total of 201 students getting an average score of 4.01 and a percentage of 80.2% in either category. From this data graphs can be made as follows:

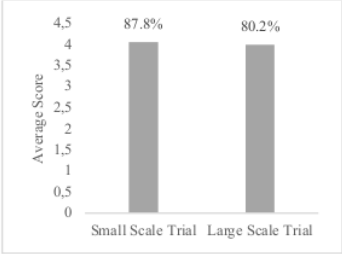

Figure 10. Student Try Out Graph

Based on the graph, the percentage of small scale trial results is greater than the large scale trials which is 87.8%, while the large scale trials get a percentage of 80.2%. The percentage of trials amounted to 84%, so it can be said that the developed media model is effectively used as a physics learning media in class XII on static electricity.

Pre-test and Post Test

In taking the pre-test data, students do not use the AR application but only with media books and videos. Then the post test data is obtained after students use the application. The pre-test and post-test are 10 multiple choice questions. The following table 4 pre-test and post-test results:

Tabel 4. Pre-test and Post-Test Results

Num	Test	Average Score	Percentage
1	Pre-test	53.75	53.75%
2	Post Test	86.87	86.87%
Average Score		70.31	
Average Percentage		70.31%	

Pre-test and Post-Test are given to one class in SMA Negeri 12 Tangerang with a total of 32 students. Obtained an average pre-test value of 53.75 with a percentage of 53.75% and an average post-test value of 86.87 with a percentage of 86.87%.

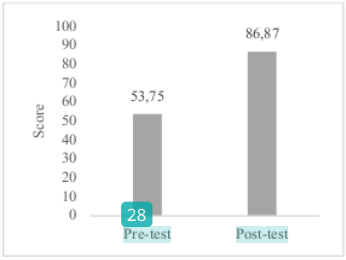

Figure 11. Pre-test and Post-Test Results Graph

Based on the graph, student learning outcomes improve after using the media seen from the post test scores which are higher than the pre-test scores. The effectiveness of the developed media is 96.87% with a very good category.

The value of media effectiveness is obtained from the pre-test and post-test results, namely:

$$\text{Effectiveness} = \frac{Jthe\ number\ of\ students\ who\ have\ completed}{Total\ number\ of\ students} \times 100\%$$

$$\text{Effectiveness} = \frac{31}{32} \times 100\% = 96{,}87\%$$

The value of the effectiveness of this media is obtained from the number of students with a complete score divided by the total number of students then multiplied by 100%. Then the level of effectiveness of the media obtained a percentage of 96.87% success.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the analysis and discussion of assessments that have been made related to learning media applications that have been developed both from the validator and student assessments, it can be concluded that the learning media developed is in the form of an application using Augmented Reality technology on Android gadgets called PARE (Physics AR Education). advantages not many researchers have developed this technology in the field of education, especially physics on static electricity, and this application can visualize the concepts of physics easily. While the disadvantage of this application is that it can only be used on Android gadgets and does not yet complete all the required physics material. The application of PARE (Physics AR Education) is feasible and effective to be used by students in learning physics, especially in static electricity viewed from the results of the assessment of material experts and media experts as well as trials to students and the results of pre-tests and post tests that have been carried out, namely the results Student learning increases after using the PARE application in learning physics.

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