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Abstract. Some contents of physics provide abstract concepts (e.g. electricity) so they are demanding to be visualized and students are challenging to understand. However, the recent development in technology namely augmented reality can be used as a learning media to depict the some abstract concepts in physics. This study aimed to examine the implementation of learning media-based augmented reality that was developed in electricity topics to enhance students' conceptual understanding. The research method used in this study was pre-experiment with one group pretest-posttest design. The participant of this study was 30 students in the first year of one public vocational high school in Garut. Students' conceptual understanding was snapped using an instrument test (26 item questions) developed in multiple choices. In addition, average gain and normalized gain were used to analyze the enhancing of students' conceptual understanding. The result of this study portrayed that improvement of conceptual understanding was in medium category. This case was illustrated by average gain (29.0) and normalized gain (0.56). According to result findings of this study can be inferred that learning media-based augmented reality developed in electricity topics could enhance students' conceptual understanding.

1. Introduction

Physics is one branch of science that underlies the development of advanced technology and the concept of living in harmony with nature. The rapid development of information technology and communication today is triggered by the findings in the field of material physics through the discovery of electronic devices capable of loading a lot of information with very small size. Various magnetic and electronic material-based technology products that we usually encounter in everyday life such as computers, the internet, lasers, GPS (Global Positioning System), fiber optic broadband networks, and etc. They are real technology products from basic physical research activities in the last 50 years. The spectacular leap rate in modern information and communication technology is inseparable from the incessant research in

the field of Material Physics. In other words, technology is a driving force in the changing behavior of people from industrial societies into knowledge and information-based societies.

In the world of education, the development of information technology was felt to have a positive impact because with the development of information technology, the world of education began to show significant changes. Many things are perceived differently and changed compared with the way that developed earlier. The development of ICTs allows the creation of various multimedia in learning that can facilitate and generate students' motivation in learning the concept of physics.

Physical material itself is composed by concrete and abstract concepts. Abstract physical materials such as electrical, magnetic and modern physics are difficult to visualize, causing students to have difficulty in studying abstract physical concepts. This is what makes students think that physics becomes difficult and boring. Therefore, to be able to develop students' understanding of the concept of physics learning, especially on the concepts of physics that are abstracts needs the help of information technology. Information technology in education is applied in the form of multimedia software (software), which provides facilities to students to learn a material.

One of the learning media that is seen to help and facilitate to facilitate students in studying abstract physical materials is Augmented reality. Augmented Reality is an effort to combine the real and virtual worlds created through the computer so that the boundary between the two is very thin. In simple terms Augmented Reality can be defined as a real environment with added virtual objects. Several previous studies have examined how augmented reality applications developed in various forms such as in the form of games, the application of augmented reality learning in the form of games can increase student learning interest [1], besides making augmented reality in view of its marker can divided into two marker forms in image based and location based [2], several studies have also attempted to implement augmented reality in the form of books [3, 4] and besides the view of hardware used augmented reality can use desktop or mobile [5].

In addition, several studies have also tried to apply augmented reality apps into classroom learning. Some studies show that the application of augmented reality in learning can have a positive impact in learning such as improving students' concept understanding after applying virtual lab augmented reality on the subject of kinetic gas theory [6] Application of AR technology can improve laboratory capability and student attitude toward physics [7], can improve learning motivation in computer learning [8] and can facilitate in studying abstract concepts [9]. some studies have also tried to compare the effects of augmented reality in comparison with other technologies. augmented reality is more effective than applying web based application learning, especially in improving learning effectiveness and flow student experience [10], augmented reality also improves student learning outcomes in comparison with 2D simulation media [11] and if compared to interactive simulation technology (IS), technology AR technology can overcome the affective aspects of learning (SSI) [12] in addition to comparing with several research technologies also compare augmented reality with traditional learning when compared with traditional learning was augmented reality is more effective in improving students 'learning outcomes and students' learning motivation on the subject of optics [13], further improving student learning outcomes on vector concepts [14] and mobile augmented reality. The appeal of traditional learning [15].

2. Method

The method used in this research was pre experiment method with one-group pretest posttest design. In this design, pre-test was first administered to the subjects, followed by a treatment of using learning media-based augmented reality.Then,post-test was administered to measure the effect of learning media-based augmented reality on students' conceptual understanding improvement on electricity.

The population of participant in this research are all students of the first year of 2017-2018 academic programmes in one public vocational high school consisting of four classes. From the population, researchers took sample for the study. Sampling was carried out by purposive sampling technique that is sample determination technique with certain consideration. The sampel of this research was 30 students consisting of 27 female students and 3 male students ranging in age from 15 to 16 years who

participate in this study. The location of the research was conducted in one public vocational high school located in the city of Garut. Students' conceptual understanding is identified using instrument multiple choices test (26 item questions) on the concept of electricity. The improvement of students' conceptual understanding determines with the N-gain score <g> from Hake [16]. The pretest and posttest data were tested statistically using the students test (t-test) using Microsoft Excel and SPSS Program 16.

3. Result and discussion

To see the effect of augmented reality learning media on students 'conceptual understanding, it is done by pre-test and post-test with the aim to see students' early ability, student's final ability and improvement. The initial ability is obtained from the pre-test administered before treatment while the final ability is obtained through the post-test given after the treatment. Increased understanding of student concepts is obtained by calculating the normalized gain. The statistics of students' conceptual understanding before (pre-test), after (post-test), and N-gain can be seen in table 1.

Table 1. Descriptive statistical data of students' conceptual understanding score in electricity.

Statistics	Value		N-Gain
	Pretest	Posttest	
Average	49.50	78.50	0.56
Variance	84.53	36.94	
At lest	31.00	65.00	
Maximum	65.00	92.00	
Standar deviation	9.19	6.08	
Median	50.00	77.00	

Table 1 shows that there is a difference between pretest to posttest results and the value of N-gain indicates how much influence using learning media-based augmented reality on Students' conceptual understanding improvement on electricity topic. The average improvement score (gain) of students' conceptual understanding was 29.0 there is an increase from 49.50 to 78.50. Based on the calculation the average score <g> of students' conceptual understanding is 0.56 which is categorized as medium.

The normality of the data were checked as the consideration to choose the appropriate statistic method. The normality results are shown in the Table 2. Table 2 shows the result of normality test using spss. there are two types of calculation which are Kolmogorov-Smirnov and Saphiro-Wilk. The first type is used if there are a lot of data (>50), while the second one used for the small size data. As sees from Table 2, the score distribution of pretest dan posttest displays a normal distribution (sig.>0.05).

Table 2. The result of normality test of students' conceptual understanding score in electricity.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pretest	.121	30	.200	.959	30	.286
Posttest	.140	30	.135	.967	30	.457

Table 3. The result of student test (t-test) and Levene test of students' conceptual understanding score in electricity.

	Levene's Test		t-test				
	F	Sig.	T	df	Sig. (2-tailed)	Mean	Std.
Equal variances assumed	6.691	.012	14.41	58	.000	29.0	2.01
Equal variances not assumed			14.41	50.28	.000	29.0	2.01

Table 3 above shows the significant effect of media based augmented reality on students' conceptual understanding. As seen from Table 3, the different between mean score of pretest and posttest is significant (sig.(2-tailed)<0.05). This statistical test shows that augmented reality learning media can improve the understanding of physics concepts of students, especially abstract physics concepts such as electrical concepts. this is caused because augmented reality is a technology that combines the real world and the virtual world [17]. So the concept of abstract physics in the real world can be visualized into the virtual world.

4. Conclusion

Based on the data obtained then the gain average is 29.00. while N-Gain data showed an increase of 0.56. From the data can be concluded that the application of learning media Augmented reality on the learning of physics can improve the understanding of physics concepts of students on the subject of electrical language.

Acknowledgments

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Submission ID: 2321023598
File name: conceptual_understanding_of_electricity_using_-_Tri_Hartini.pdf (699.64K)
Word count: 2535
Character count: 14175

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