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Research Article

Effect of the Use of Virtual Reality (VR)-nased Geometry Virtual Lab Media with the Van Hiele Theory Approach to Student Learning Achievement at IVET University Semarang

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Abstract.
The existence of technology, especially smartphones, which are now increasingly developing, must be addressed wisely. One technology that can be used as a learning medium is the Virtual Geometry Lab. This research aims to examine the effect of using virtual reality (VR)-based geometry lab media using the Van Hiele theory approach on student learning achievement at IVET University Semarang. This research is a continuation of the results of previous research which produced a valid Geometry Virtual Lab product. This research is an expansion test of the Virtual Geometry Lab Product at IVET University Semarang. This is a development research using the ADDIE stage model which has reached the implementation stage. The research design used is posttest only control design. Data were analyzed using descriptive statistics with simple regression analysis and independent sample t test using SPSS software. The research results show that using virtual lab media influences the learning achievement of IVET Semarang students by 80.3%, while 19.7% of learning achievement is influenced by other variables outside of the independent variables in this research. Confirmed by the t test, the average learning achievement of the experimental class was 82.35, while the average of the control class was 68.79. This means that the learning achievement of IVET Semarang experimental class students is better than the IVET Semarang control class.

Keywords: virtual geometry lab, learning achievement, influence

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1. Introduction

The existence of technology, especially smartphones, which are now increasingly developing, must be addressed wisely. With increasingly rapid and sophisticated technological developments in the current era, the need for learning materials is increasingly in demand among many groups. Increasingly advanced technological developments must be balanced with the availability of a school environment that can support the use of educational media in the learning process. Learning media is one of the developments

of technology, it cannot be denied that technology greatly influences the quality of education. Here the role of media can help students visualize the virtual world as a real world without the limitations of space and time so that the material is easier to understand. One technology that can be used as a teaching tool is the Virtual Geometry Lab.

Virtual reality is a technology that allows users to experience actual interactions in a virtual environment, even though these interactions are basically simulated by a computer. In Indonesian, virtual reality is known as virtual reality. The use of virtual reality involves students in the learning process, so its use is deemed appropriate to increase student interest in the learning process. In using VR, it is assisted by the Virtual Reality Glasses tool which allows users to change the virtual environment into a real environment [1]. Virtual laboratories are one way for schools or universities to get laboratories for all types of subjects. Teachers can use sophisticated technology to present a series of experimental processes that will produce authentic results like in a physical laboratory [2]. Visual laboratories also facilitate teachers to tinker with laboratory equipment that has similar functions as in the real world, virtual laboratories offer users, especially educators and students, a learning experience that may not be practical in a physical classroom [3].

Currently in Indonesia there are those who have created virtual laboratories for science classes, which shows that mobile virtual reality can improve students' analytical skills when studying physics material [4], besides that virtual reality which is packaged in the form of a game takes advantage of this and can improve motivation and academic achievement of students in learning biology [5], other research shows that virtual laboratories based on virtual reality can increase the knowledge of kindergarten students in Bali in studying various types of fish [6], in research it is also found that science students based on augmented reality and virtual reality can improve students' spatial skills [7], Augmented reality mobile media is used very effectively in learning geometry at an advanced level, because it shows augmented reality which increases students' achievement motivation and is easy to use on all cellphones [8].

One lesson that can overcome this geometry problem is learning using van Hiele's learning theory because in learning using van Hiele's learning theory, students can discover geometric concepts for themselves by using teaching aids [9]. It is hoped that with this learning students will truly understand the concept of geometry, not only memorize it but also be able to apply it in solving problems so that it can improve students' geometry learning outcomes. The van Hiele Level Theory or van Hiele Level Theory was developed by two mathematics educators from the Netherlands, namely

Hiele-Geldof and her husband Pierre Marie van Hiele in the 1950s. This theory has been used to explain why many students have difficulty with higher cognitive processes, especially evidence in high school geometry learning. In the theory they put forward, they argue that in studying geometry, students experience the development of thinking abilities through the level of visualization, level of analysis, level of abstraction, level of formal deduction, and level of rigor. This level is also called the metamathematical level [10].

This research is a continuation of the results of previous research which produced a valid Geometry Virtual Lab product. After the Virtual Geometry Lab product has been validated with excellent results, the product is then tested on a limited basis. Based on limited trials in the first year in 2022, it shows that lecturers and students in mathematics education study programs are greatly helped by the virtual media geometry lab to increase students' cognitive and spatial abilities in learning geometry [11]. This research is an expansion test of the Virtual Geometry Lab Product at IVET University Semarang. Based on this background, the researcher aims to test whether there is an influence of using Virtual Reality (VR) Based Geometry Lab Media Using the Van Hiele Theory Approach on Student Learning Achievement at IVET University Semarang.

2. Method

The method used in research is research and development. Research and development (Research and Development) is a research method used to produce certain products such as designs, models, learning media prototypes, and test the effectiveness of these products [12]. In this research, the ADDIE model development research design model was used. This model, as the name suggests, consists of five main phases or stages, namely (A) analysis, (D) design, (D) development, (I) implementation, and (E) evaluation. The five phases or stages in the ADDIE model need to be carried out systemically and systematically [13]. In previous research [11] the analysis, design and development stages were carried out. In this research, the implementation phase will be carried out. The research design used in this research is posttest only control design.

The expanded test was carried out at IVET University Semarang by taking fourth semester students in class 4A as the experimental class and class 4B as the control class. Data were analyzed using descriptive statistics with simple regression analysis and independent sample t test. using SPSS software. Post test data analysis was carried out to find out whether the experimental class and control class had differences between

conventional learning and learning using Android-based learning media using Virtual Reality.

3. Result and Discussion

The learning process using Virtual Reality-based Geometry Lab media at IVET University Semarang has been carried out simultaneously with the following steps:

1. Choosing an experimental class by random sampling, namely semester IV at IVET University Semarang to be subjected to face-to-face learning
2. The virtual geometry lab application includes 2 chapters which have been revised by the team based on input from experts, student and lecturer respondents in the first year including material on parallels, area and volume of flat shapes which are packaged in the form of Android and computer applications.
3. Students are required to use and install this virtual geometry lab application in classroom learning
4. Assessment is carried out at the end of each Android application-based learning material
5. Then students and lecturers responded to the questionnaire regarding the learning process using the virtual geometry lab.

The expanded test was carried out at IVET University Semarang by taking fourth semester students in class 4A as the experimental class and class 4B as the control class. Post test data analysis was carried out to find out whether the experimental class and control class had differences between conventional learning and learning using Android-based learning media using Virtual Reality. Next, the researchers analyzed the post test data that had been carried out on class 4A and 4B students. The steps used to analyze post test data are as follows.

3.1. Normality Test

In this research, the normality test was carried out using the Test of Normality test with the help of the SPSS program. The hypothesis to be tested is as follows.

H_0 : Samples in the experimental class and control class were normally distributed

H_1 : Samples in the experimental class and control class were not normally distributed

By criteria

H_0 accepted if the value is Significant > 5%

H_0 rejected if the value is Significant < 5%

From the SPSS output results, the following results were obtained.

Table 1: Tests of Normality.

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Nilai	Eksperimen	.181	27	.200*	.920	27	.374
	Kontrol	.168	25	.200*	.936	25	.512
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

From the Shapiro-Wilk Test of Normality table above, the significant value for the experimental class is obtained 0.374 = 37.4 % and the significant value of the control class is 0.512 =51.2 %. Because 37.4 % > 5 % and 51.2 % > 5 % then based on the criteria H_0 is accepted. This means that the samples in the experimental class and control class are normally distributed.

3.2. Homogeneity Test

In this research, the homogeneity test was carried out using the Test of Homogeneity of Variance test with the help of the SPSS program. The hypothesis to be tested is as follows.

H_0 : The variance of the experimental class and control class populations is the same (homogeneous)

H_1 : The variance of the experimental class and control class populations is not the same (not homogeneous)

By criteria

H_0 accepted if the value is Significant > 5%

H_0 rejected if the value is Significant < 5%

From the SPSS output results, the following results were obtained.

Table 2: Test of Homogeneity of Variances.

Nilai			
Levene Statistic	df1	df2	Sig.
.357	1	52	.395

From the Test of Homogeneity of Variances table above, the significant value is 0.395 = 39.5%. Because 39.5% > 5%, based on the criteria, H0 is accepted. This means that the variance of the experimental class and control class populations is the same (homogeneous). Normality tests and homogeneity tests are prerequisites for carrying out further tests [14]. Because the requirements for the normality test and homogeneity test have been met, you can proceed to the T test and regression test

3.3. T Test

The effectiveness of the Virtual Reality (VR) based Geometry Lab media 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 is used to compare student learning achievement between the experimental group and the control group with the hope that the experimental group's achievement will be better than the control group.

In this research, to find out which learning is better, the t test (Independent Sample Test) was used with the help of the SPSS program. The hypotheses used in this research are as follows.

H_0 = The results of learning mathematics using Virtual Reality Lab Geometry media are no different from conventional learning models.

H_1 = Mathematics learning outcomes in Virtual Reality Lab Geometry media based on Virtual Reality are better than conventional learning models.

By criteria

H_0 accepted if the value is Significant > 5%

H_0 rejected if the value is Significant < 5%

From the SPSS output results, the following results were obtained.

From the Independent Samples Test table in the t-test for Equality of Means table above, the significant value is 0.000 = 0%. Because 0% < 5%, then H0 is rejected. This means that we accept H1, which means that the results of learning mathematics from the Virtual Lab Geometry media based on Virtual Reality (VR) are better than conventional learning models.

To determine which class between the experimental class and the control class has a higher average value, Group Statistics analysis is used which can be seen in the table below.

Table 3: Independent Samples Test.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Nilai	Equal variances assumed	.468	.395	6.245	52	.000	18.691	2.430	19.332	29.951
	Equal variances not assumed			6.793	57.106	.000	18.691	2.428	19.523	29.751

Table 4: Group Statistics.

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Nilai	Eksperimen	27	82.35	6.902	1.113
	Kontrol	25	68.79	6.810	1.361

By looking at the average learning achievement in the mean column, the Group Statistics table shows that the experimental class average is 82.35 while the control class average is 68.79. These results show that the learning outcomes of the experimental class are better than the control class.

3.4. Regresion Test

In this research, the influence test was carried out using a simple linear regression test with the help of the SPSS program. This test aims to determine the effect of using Virtual Reality (VR)-based Geometry Lab media on student learning achievement. From the SPSS output results, the following results were obtained.

Table 5: Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38.341	12.447		3.080	.005
	Media Virtual Lab	1.633	.169	.896	9.681	.000
a. Dependent Variable: Prestasi Belajar						

From the coefficients table above, constant values and simple regression coefficient values for the independent variables are obtained. From this value, a simple regression value can be found which is expressed in the following equation.

$$Y = 38.341 + (1.633)\,X$$

From this equation, the results of the simple regression equation mean that:

1. A constant of 38,341, if the Media Virtual Lab variable is assumed to be constant, then learning achievement will increase by 38,341.
2. The regression coefficient value for the Media Virtual Lab variable in the regression equation shows a positive value of 1,633, which means that if the Media Virtual Lab variable increases by 1%, then learning achievement will increase by 1,633%.
3. From the results of regression coefficient testing, it is concluded that the use of Virtual Lab Media has a positive effect on learning achievement at IVET University Semarang.

To find out how much influence the independent variable (Media Virtual Lab) has on the dependent variable (learning achievement) can be seen in the R square value contained in the SPSS output as follows.

TABLE 6: Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896[a]	.803	.794	5.515

a. Predictors: (Constant), Media Virtual Lab

From the Model Summary table above, it is found that the R Square value is 0.803 = 80.3%. This value means that the influence of virtual lab media on learning achievement is 80.3%, while 19.7% of learning achievement is influenced by other variables outside of the independent variables in this research. This is in line with research [15] which states that students are able to apply the knowledge, skills and attitudes they have learned using augmented reality-based magic book math media. This is proven by the post test results which are classically completed.

4. Conclusion

The conclusion obtained from this research is that there is an influence of the use of Geometry Lab Media Based on Virtual Reality (VR) with the Van Hiele Theory Approach

on the Learning Achievement of IVET Students at Semarang University of 80.3% while 19.7% of learning achievement is influenced by other variables outside of the independent variables in the research This. Confirmed by the t test, the average learning achievement of the experimental class was 82.35, while the average of the control class was 68.79. This means that the learning achievement of IVET Semarang experimental class students is better than the IVET Semarang control class.

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