The Effect of Virtual Laboratories on Student Learning Outcomes and Self-efficacy

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Abstract. Research aims to understand the influence of virtual laboratory on student learning outcomes and self-efficacy and to see the correlation between self-efficacy and student learning outcomes. The kind of research is quasi experiment with the design research two group pretest-postest. The results showed that post test average value of the experimental class 66.5 with a standard deviation of 16.39 and the control class an average value of 56.25 with a standard deviation of 13.65, both normal and homogeneous data and statistical hypothesis analysis showed that the significance was 0.04 < 0.05 then there is a difference in the average of the two classes, meaning that there is an effect of conventional practicum and virtual laboratory on student learning outcomes. Self-efficacy having string correlation with student learning outcomes which is interpreted 0,76 value, its means the higher self-efficacy also the result of the higher student learning.

Keywords: virtual laboratory, student learning outcomes self-efficacy

1 Introduction

The 21st century, the technological revolution had a major positive impact on various fields including education.[1] The technology available today is basically a form of education. Development in the field of education will be directly proportional to future technological advances. The impact of education is determined by the teacher and how teachers can work to make education better through learning.

Supporting learning is very important to do to realize a better education, so important facilities are needed, namely, learning media. Learning media is a tool that can be used by teachers to achieve learning objectives, on the other hand the media can also be used to convey information, get feedback, increase motivation, and increase student concentration, thereby improving learning outcomes.[2] One way to improve student learning outcomes is laboratory activities. Laboratory activities are also influenced by psychological aspects, The psychological aspect that is closely related to learning outcomes is self-efficacy. The school laboratory is still under development, the tools and practicum materials are not complete, the study time is also lacking so that it is not possible to have a practicum in school. Virtual

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laboratory is one solution to overcome the problems experienced by teachers. Virtual laboratory is a digital form of laboratory facilities and processes that can be simulated digitally.[3] Virtual laboratory provides a series of laboratory equipment, algorithms, and other equipment to simulate activities in the laboratory.

Self-efficacy is a person's belief in one's abilities that one is able to do something or overcome a situation that one will succeed in doing. As Bandura suggests that self-efficacy is people's beliefs about their ability to generate levels of performance and master situations that affect their lives, then self-efficacy will also determine how people feel, think, motivate themselves and behave. Self-efficacy is a person's belief about his own ability to carry out certain behaviors or achieve certain goals.[4]

The research objectives are 1. To find out whether there is an influence of laboratory virtual media on students' self-efficacy on Simple Harmonic Vibration material, it is tested using percentage descriptive analysis. 2. To find out whether there is an effect of laboratory virtual media on student learning outcomes on the Simple Harmonic Vibration material, it is tested using the t-test. 3. To find out whether there is a relationship between self-efficacy and student learning outcomes in the Simple Harmonic Vibration material, it is tested using the Regressive Correlation Test.

2. Method

This type of research is a quasi-experimental research which aims to find out something in this case the learning outcomes imposed on the subject, namely students. The research design used is by using pretest and posttest. Before the different treatments were carried out, a pretest was held to determine the initial ability of the two classes. Then a different treatment was carried out and then a posttest was carried out to determine student learning outcomes.

The instrument used to collect data on student learning outcomes is a test of student learning outcomes on the subject of Simple Harmonic Vibration, which consists of 20 questions in the form of multiple choice. Before conducting the research, the tests that have been prepared are tested for validity by two validators to take valid questions that will be used in the pretest and posttest. The validator is asked to determine each item in the valid or invalid category. The instrument of learning outcomes is a validity test by using a reliability test, discriminatory power and the level of difficulty of each question.

The indicators in the self-efficacy variable are: Interest in facing difficult tasks and fighting spirit in facing tasks; The strength and weakness of students' beliefs about their abilities; Confidence in one's ability to all situations

Data to measure students' self-efficacy can be obtained through a questionnaire compiled by the researcher based on indicators using a Likert scale. Answers on the Likert scale with positive statements are followed by 4 (four) possible answers, each of which is distributed with SS (Strongly Agree) with a score of 4, ST (Agree) with a score of 3, TS (Disagree) with a score of 2, and STS (Strongly Disagree)) score 1. Negative statement followed by 4 (emoat) possible answers, each symbolized by SS (Strongly Agree) score 1, ST (Agree) score 2, TS (Disagree) score 3, and STS (Strongly Disagree) the score is 4. The data analysis technique used was normality, homogeneity and hypothesis testing. The relationship between self-efficacy and student learning outcomes analyzed using simple linear regression is an analysis to measure the magnitude of the influence between one dependent variable and predict the

dependent variable using the independent variable. In this study the dependent variable is self-efficacy and the independent is student learning outcomes.

3. Results

The data analyzed were student learning outcomes and self-efficacy questionnaires. After the research was carried out, it was obtained that student scores/values related to learning outcomes and self-efficacy were obtained where the results of student scores/values data will be analyzed with the following description.

Data Description

Description of Students' Initial Ability (Pretest)

Pretest was given to each student in the control class and the experiment was carried out at the first meeting. Pretest was given to determine the average equality of the experimental and control classes. The pretest and posttest questions have been validated by experts and forecast validation so that there are 20 valid multiple choice questions. It is expected that after being given learning treatment through conventional practicum and virtual laboratory practicum there will be changes in student scores.

Table 1. The Average Results of the Second Class Pretest Score

Class	Ideal Score	N	X_{min}	X_{max}	X	SD
Control	100	20	20	60	40	13,17
Experiment	100	20	20	70	45	16,46
Total/Average	100	40	20	65	42,5	14,81

Based on Table 1, the data description for each table in the control class (conventional practicum) obtained the lowest score of 20 and the highest score of 60, the average value of 40 with a standard deviation of 13.17. While in the experimental class (conventional practicum + virtual laboratory) the lowest score was 20 and the highest score was 70, the average value was 45 with a standard deviation of 16.46.

Description of Students' Final Ability (Posttest)

The second meeting started the learning process using a series of lessons that had been prepared, namely the experimental class using conventional practicum and virtual laboratory while in the control class using only conventional practicum. The last meeting of each class was given a test to review student learning outcomes after the learning was carried out, whether there was an increase or not. The description of the student's final ability test is carried out by calculating the mean and standard deviation. The summary results are presented in table 2.

Table 2. The Average Results of the Second Class Posttest Score

Class	Ideal Score	N	X_{min}	X_{max}	X	SD
Control	100	20	35	80	57	13,99
Experiment	100	20	45	95	66	16,39
Total/Average	100	40	40	87,5	61,5	15,19

Based on Table 2, the data description for each table in the control class (conventional practicum) obtained the lowest score of 35 and the highest score of 80, the average value of 57 with a standard deviation of 13.99. While in the experimental class (conventional practicum + virtual laboratory) the lowest score was 45 and the highest score was 95, the average value was 66 with a standard deviation of 16.39. These data indicate that there is an effect of virtual laboratory on student learning outcomes in the experimental class.

Description of Student Self-efficacy

After the implementation of learning, students fill out a self-efficacy questionnaire, there are 30 questions that are filled out by students according to their own abilities. The description of students' self-efficacy tests is carried out by calculating the mean and standard deviation. The summary results are presented in table 3.

Table 3. The Average Value of Student Self-Efficacy

Class	N	Minimum	Maximum	Average	SD
Control	20	55	80	66,85	10,83
Experiment	20	70	92	78,65	8,08
Total/Average	40	40	87,5	61,5	15,19

Table 3 explains that the minimum self-efficacy score of students in the control class is 55 lower than students in the experimental class with a score of 70. The maximum self-efficacy score of students in the control class is 80 lower than students in the experimental class with a score of 92. The average score the control class is lower than the experimental class, but the standard deviation of the control class with a value of 10.83 is higher than the standard deviation of the experimental class with a score of 8.08.

Hypothesis Test

Testing the leaning outcomes hypothesis using paired sample test

Table 4. Hypothesis Test Result Learning Outcomes

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	X1 - X2	-10.250	20.741	4.638	-19.957	-.543	-2.210	19	.040

The statistical hypothesis shows that the significance <0.05 means that there is a difference in the average of the two classes, meaning that there is an effect of conventional practicum and virtual laboratory on student learning outcomes. Testing the learning outcomes hypothesis using a paired sample test through the SPSS 26 application.

The statistical hypothesis shows that the significance <0.05 means that there is a difference in the average of the two classes, meaning that there is an effect of conventional practicum and virtual laboratory on students' self-efficacy.

The results of the calculation of the relationship between self-efficacy and learning outcomes are described in table 5 below, the analysis was carried out using SPSS 26.

Table 5. Self-efficacy Hypothesis Test Result

Correlations			
		SE	LO
SE	Pearson Correlation	1	.796**
	Sig. (2-tailed)		.000
	N	20	20
Learning Outcome	Pearson Correlation	.796**	1
	Sig. (2-tailed)	.000	
	N	20	20
**. Correlation is significant at the 0.01 level (2-tailed).			

Self-efficacy on learning outcomes has a correlation with a value of 0.76 which is interpreted to have a strong degree of relationship and a positive relationship, which means that the higher the self-efficacy, the higher the student learning outcomes.

The results of the calculation of the relationship between self-efficacy and learning outcomes are described in table 6 below, the analysis was carried out using SPSS 26

Table 6. The Correlation between Self-efficacy and Student Learning Outcomes

Correlations			
		SE	Hasil Belajar
SE	Pearson Correlation	1	.796**
	Sig. (2-tailed)		.000
	N	20	20
Learning Outcome	Pearson Correlation	.796**	1
	Sig. (2-tailed)	.000	
	N	20	20
**. Correlation is significant at the 0.01 level (2-tailed).			

Self-efficacy on learning outcomes has a correlation with a value of 0.76 which is interpreted to have a strong degree of relationship and a positive relationship, which means that the higher the self-efficacy, the higher the student learning outcomes.

4. Discussion

This section will describe the research discussion in accordance with the description of the data, the results of the analysis requirements test, the results of the hypotheses of learning outcomes, self-efficacy and the correlation of self-efficacy with learning outcomes. The requirements test analysis was conducted to test the hypothesis or the effect of the virtual laboratory on the sample, but before the requirements test, both samples had to be tested for prerequisites to test whether the two samples were normally distributed and homogeneous or not. The analysis prerequisite test used the data normality test and the data homogeneity test. The pretest data between the control and experimental classes were normally distributed and homogeneous tested through SPSS 26 with a significance level > 0.05.

Hypothesis testing of the control class and experimental class students was carried out by testing the data with normal distribution and homogeneity first. The results of the posttest data normality test showed that the significance value was > 0.05 and indicated that the data were normally distributed and homogeneous so that it could be continued to test the hypothesis using the T test. The T test used was the paired T test because there were two classes to be tested for its influence, namely the experimental class and control. The statistical hypothesis shows that the significance <0.05 means that there is a difference in the average of the two classes, meaning that there is an effect of conventional practicum and virtual laboratory on student learning outcomes.

Self-efficacy is a person's belief about his ability to organize, perform a task, achieve a goal, produce something and implement actions to display certain skills.

The self-efficacy analysis in the experimental class is higher than the self-efficacy in the control class. Students who follow self-efficacy who are taught using conventional practicum and virtual laboratories are more confident in understanding the concept of Simple Harmonic Vibration, because learning is not just transferring knowledge from the teacher to students, but a process that is conditioned or pursued by the teacher, so that students are active with various ways to build their own knowledge so that their self-confidence also increases.

The results of the Paired Sample Test calculation obtained a significance of 0.02 <0.05, so there is a difference in the average of the two classes, which means that there is an effect of conventional practicum and virtual laboratory on students' self-efficacy.

The relationship between self-efficacy and student learning outcomes analyzed using simple linear regression is an analysis to measure the magnitude of the influence between one dependent variable and predict the dependent variable using the independent variable. In this study the dependent variable is self-efficacy and the independent is student learning outcomes.

Self-efficacy results on learning outcomes have a correlation with a value of 0.76 which is interpreted to have a strong degree of relationship and a positive relationship, which means that the higher the self-efficacy, the higher the student learning outcomes.

5 Conclusion

Student learning outcomes taught using conventional practicum and virtual laboratory on Simple Harmonic Vibration material in class X a higher average learning outcome than the control class, which is 66.5.

Self-efficacy of students who are taught using conventional practicum and virtual laboratory on Simple Harmonic Vibration material in class X has an average self-efficacy of 78.65.

The relationship between self-efficacy and learning outcomes has a correlation with a value of 0.76 which is interpreted to have a strong degree of relationship and a positive relationship, which means that the higher the self-efficacy, the higher the student learning outcomes.

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