OPEN ACCESS

Jurnal Riset Pendidikan MIPA, 5(2): 65-74, December 2021
ISSN 2549-0192 (e) | 2549-0184 (p)
https://new.jurnal.untad.ac.id/index.php/jrpm

The Influence of Virtual Laboratory Learning and Interest in Understanding Student's Physical Concepts of Mechanical Wave Materials

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Article History
Received 11 August 2021
Revised 15 September 2021
Accepted 01 November 2021

Keywords:
Virtual Laboratory, Interest in Learning, Concepts Understanding

Abstract

This study aims to examine differences in conceptual understanding between students who take part in virtual laboratory learning. Based on the results of the calculation of the N-gain score test, the average N-gain score for the experimental class using a virtual laboratory was 44.85%, which was in the less effective category. With a minimum N-gain score of 0% and 90%. Meanwhile, the average N-gain score in the control class using a real laboratory was 19.45%, which was included in the ineffective category. With a minimum N-gain score of -90% and a maximum of 90%. Data were analysed using a two-way ANOVA technique. The results showed that: (1) there were differences in conceptual understanding between students who were taught using a virtual laboratory and students who were taught through a real laboratory as indicated by the p-value (0.000) < α (0.05); (2) there are differences in conceptual understanding between students who have high learning interest and students who have low learning interest as indicated by the p-value (0.000) <α (0.05) and (3) there is no interaction between virtual laboratory learning.

doi: 10.22487/j25490192.2021.v5.i2.pp.65-74

Introduction

Physics is knowledge that is based on experimentation, where its development and application become the standard for experimental work. Learning physics in schools should ideally teach laboratory theory and practice that can be used to base further experimental investigations. Laboratory practices and experiments in learning are expected to be able to help students gain technical abilities. Physics experiments must be an important source of learning in mastering concepts and theories.

This condition requires that teachers teaching physics concepts must use scientific processes and attitudes. The scientific process in question is a way of gaining direct experience through observation and conducting experiments. The ability to do scientific work through experiments includes the ability to take measurements, test hypotheses, design experiments, retrieve and process data, interpret data, and be able to communicate experimental results.

The most important means of learning science is a laboratory. The laboratory is a very important part of teaching and learning activities. This is because students do not just listen to the teacher's explanation of the lessons that have been given, but must carry out their own activities to obtain more information about the concepts they are learning. With the laboratory, it is hoped that the science teaching process can be carried out as optimally as possible.

The simulations contained in virtual laboratories represent real laboratory experiments in the form as closely as possible or a computer simulation that allows the important functions of laboratory experiments using computers Hafsyah et al. (2012). The characteristics of the virtual laboratory program are that it contains laboratory tools that can function as real tools, is very easy to operate, and in this program, the activity is 100% in the user's hands (Saraswaty, 2014). An alternative to maximizing the role of conventional media and laboratories is to bring abstract concepts into the form of visualization assisted by computer technology (virtual laboratory). The laboratory in question is a form of laboratory where observations or measurements are made using computer software that has the same appearance and equipment as conventional laboratories. It is designed in such a way that the equipment used is in accordance with the actual conditions. Ahmed & Hasegawa (2014) virtual labs make it easy for learners to connect between theoretical and practical aspects without paper and pen.

Physics virtual laboratory experiments can help students to understand physics material and at the same time improve the abilities of students and teachers in the field of ICT.

Virtual laboratories provide meaningful virtual experiences so that students have the opportunity to repeat faulty experiments or deepen the intended experience. The interactive nature of the teaching method offers a clear and pleasant learning environment Tatli et al. (2013). Nurrokhmah & Sunarto (2013) said that virtual laboratories have interesting elements such as the display of practical animations as a tool for students to solve problems that can make learning more enjoyable and avoid boredom it can foster learning motivation. Learning using a virtual laboratory provides better classical completeness according to Yuniarti et al. (2012).

The existence of a virtual laboratory is expected to be a solution to the obstacles faced in conducting practicum in schools. Hermansyah et al. (2017) laboratory activities have psychological advantages such as enriching experiences with things that are objective, and realistic and eliminating verbalism, and the benefits of laboratory activities are increasing student interest and learning activities and providing a more precise and clear understanding.

Sandi et al. (2012) most educators agree that laboratory activity is an important component of science learning. The research findings show that there is a relationship between experience in the laboratory and the development of metacognitive skills, and can inform the development of curriculum based on research. While Noor & Wasfy (2008), defines virtual labs as modeling, simulation, and information technology to create an interactive learning environment that suits both researchers and learners. According to Ciepiela et al. (2010), the keyword of virtual labs is an experiment.

An alternative that supports the success of students in learning is the existence of student interest, where the interest can be interpreted as a liking, indulgence, or pleasure in something. Interest is very influential in achieving an achievement, therefore each student must understand his own interest so that they can make planning and decisions appropriately. A student will be successful in studying physics if there is a desire in the student to learn.

Interest will be formed if there is an effort from within him and there is also encouragement from outside both from the teacher, family, and environment to like and pay attention to physics lessons. Many research points state that there is an effect of interest in learning on learning outcomes, one of the results of this study Artana et al. (2014) states that interest in learning has an influence on learning outcomes in Science. Susanto (2013) Interest in learning is the main factor that determines the degree of student learning activity. It can be emphasized that the interest factor is a factor that significantly influences learning success.

The low interest in student learning, especially in learning science, will certainly have an impact on students' understanding of the subjects being studied, especially in science subjects (Ningsih, 2016). Understanding includes the ability to grasp the meaning of the material being studied. This indicates that if students' interest in learning is low, students will find it difficult to capture the subject matter delivered by the teacher. So understanding is the ability that students have to interpret and understand the material delivered by a person or teacher (Winkel, 2007).

A concept is an idea that is used or allows someone to group or classify an object. Wardhani (2008) says that a concept is an abstract idea that is used to organize a set of objects.

According to Gusniwati (2015), concept understanding is the ability to find abstract ideas in mathematics to classify objects that are usually stated in a term and then poured into examples and not examples, so that someone can understand a concept clearly. Meanwhile, conceptual understanding is the ability to behave, think and act shown by students in understanding definitions, understanding of special features, essence, and content of mathematics, and the ability to choose the right procedures in solving problems.

States that the use of virtual laboratory teaching methods has a better effect than interactive demonstrations using real laboratory equipment regarding conceptual understanding.

One of the important problems in learning physics is the low interest in learning of students. Physics practicum provides a natural opportunity for students to learn to do an experiment and analyze the data obtained in accordance with the objectives of the experiment being carried out. Implementation of practicum activities as expected will at least increase students' interest and understanding of concepts. Practical activities can also improve the level of understanding of students and provide opportunities for students to conduct experiments. Based on the above problems, the use of virtual laboratories is very important as a learning medium to support laboratory practicum activities.

Materials and Method

This type of research is a quasi-experiment. It is basically the same as pure experiments, the difference is in controlling variables. In this type of research, control or variable control cannot be done strictly, or in full. The research design used in this study is a quasi-experimental (quasi-experiment) because the research object was manipulated which consisted of two groups of students, namely the experimental class and the control class. The experimental class received virtual laboratory learning and the control class received real laboratory learning. The design form uses a 2 x 2 factorial form.

Table 1 Research design

Experimental Variables		Virtual Lab Learning (A1)	Real Lab Learning (A2)
Interest	High (B1)	A1B1	A2B1
	Low (B2)	A1B2	A2B2

Information

A1B1: Students' understanding of concepts in virtual laboratory learning with high learning interest

A1B2: Students' understanding of concepts in virtual laboratory learning with low learning interest.

A2B1: Students' understanding of concepts in real laboratory learning with high learning interest.

A2B2: Students' understanding of concepts in real laboratory learning with low learning interest

The populations of this study were all XI MIA students of SMA Negeri 2 Palu for the 2019/2020 academic year. The samples of this study were students of class XI MIA 3 as the experimental class and class XI MIA 4 as the control class.

Sampling in this study was purposive sampling, namely the technique of determining the sample with certain considerations from physics subject teachers in both classes at the school. The two classes chosen were considered academically homogeneous.

Types of data obtained in this study are (1) data from pretest results, (2) data on scores of interest in learning, and (3) data from posttest results (concepts understanding). The three research data came from students enrolled in the study sample.

Results and Discussion

The instrument used in this study was a concept understanding test consisting of 5 questions in the form of an essay test. Each item of test questions has been validated by expert validators. This study also used an instrument of interest in learning that has been validated by validators who are experts in their fields.

1. Description of pretest results in the experiment class and control class

The two research samples were given a pretest using a concept understanding test that had been tested for quality. The pretest given to students is identical to the conceptual understanding test used in the posttest both in terms of the number of questions and content. The pretest results are used to determine the condition of the initial ability of the research sample. The pretest results on the research sample are presented in Table 2.

Table 2 Data description of pretest results based on research samples

Class	N	Minimum Score	Maximum Score	Average	SD
Experiment	35	10	60	35.71	11.19
Control	35	10	55	31.57	11.09

Based on Table 2 it is described that the research sample in the experimental class amounted to 35 students, the minimum score in the experimental class was 10. The average pretest score in the experimental class was 35.71 with a standard deviation of 11.19. Whereas in the control class, the number of samples is 35 students, and the minimum score is 10. The average score of the pretest results in the control class is 31.57 with a standard deviation of 11.09.

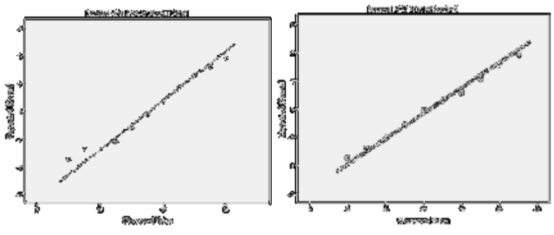
2. Data normality test of research sample pretest results

The data normality test used the Shapiro-Wilk test which was analyzed through the SPSS 24 program.The results of the normality test of the pretest data from the experimental class and the control class were presented in Table 3.

Table 3 Results of data normality test results of pretest research samples

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
experiment	0.133	35	0.119	0.960	35	0.231
control	0.156	35	0.030	0.966	35	0.343

Based on Table 3, information is obtained that the p-value of normality test results in the experimental class has a Sig value of (0.231) and the control class has a Sig value of (0.343). Both the variable prices for the experimental class and the control class are> 0.05. This can prove that the pretest results are normally distributed because it is in accordance with the acceptance level of significance> 0.05. Apart from statistical testing, data normality can also be seen from the normal QQ plot graph in the study sample. The normal graph of QQ The research sample plot is presented in Figure 1.



Ficture 1 Normal QQ plot on research samples

The Normal QQ Plot informs the normality level of the pretest result data. The straight line that stretches from the bottom left to the top right is the expected value, while the points scattered around the expected value are the results of the pretest (observer value). Based on Figure 1 shows that the pretest data plot against the standard normal quartile in both the experimental class and the control class there is a tendency to form a straight line, so it can be concluded that the data is normally distributed.

3. Homogeneity test of data on pretest results of research samples

The variance homogeneity test has the same degree as the normality test of the data as a prerequisite for using parametric statistical techniques. The results of the variance homogeneity test through the SPSS version 24 program are presented in Table 4.

Table 4. Data of homogeneity test on pretest results

Levena Statistic	df1	df2	Sig.
0.113	1	68	0.738

Based on the information from Table 4, the p-value is obtained (0.738). Based on this significance value, it can be seen that the p-value is> 0.05. So it can be concluded that the pretest result data in the experimental class and control class have homogeneous variances.

4. N-gain test

Based on the results of the calculation of the N-gain score test, shows that the average N-gain score for the experimental class using a virtual laboratory is 44.85%, including in the less effective category. With an N-gain score of at least 0% and 90%. Meanwhile, the average N-gain score for the control class using the real laboratory was 19.45%, in the ineffective category. With an N-gain score of at least -90% and a maximum of 90%.

Thus, it can be concluded that the use of virtual laboratories is less effective in improving the understanding of physics concepts in class XI Mia SMA Negeri 2 Palu. Meanwhile, the use of real laboratories is not effective for improving conceptual understanding in physics subjects on mechanical wave material in class XI Mia SMA Negeri 2 Palu. 5.

5. Different tests the average pretest results of the research sample

The pretest results showed a difference in the mean score of the experimental class (35.71) and control (31.57). However, it needs to be tested using statistical techniques to obtain inferences that also apply to the study population. The prerequisite test results show that the parametric statistical technique that can be used to test the difference in the mean pretest results is the independent sample t-test. Data from the pretest results with the independent sample t-test were analyzed through the SPSS version 24 program.

Based on information from Table 6, it is obtained a p-value of (0.125) with a level of acceptance> 0.05, it can be concluded that H_0 is accepted. This conclusion means that the mean score of the pretest results of the experimental class and the control class is not different.

6. Description of pretest results based on high learning interest

The scores of the students' pretest results in the experimental class and control class were grouped based on the categories of learning interest.

Table 5. Pretest result data based on learning interest

Class	N	Minimum Score	Maximum Score	Average	SD
High Learning Interest	38	10	60	35.39	11.29
Low Learning Interest	32	10	50	31.56	11.03

Based on Table 5, it is described students with high learning interest categories 38 students. The minimum and maximum scores for high learning interest are 10 and 60 respectively. The average pretest score for high learning interest is 35.39 with a standard deviation of 11.29.

7. Description of pretest results based on low learning interest

Based on Table 6, it is described students with low learning interest category 32 students. The minimum score for low learning interest is 10, while the maximum score is 50. The average pretest score for low learning interest is 31.56 with a standard deviation of 11.03.

8. Pretest results from data normality test based on learning interest

The pretest result data normality testing based on learning interest was carried out on the pretest results based on high learning interest and low learning interest. The results of pretest data normality testing based on interest in learning are presented in Table 6.

Table 6 Pretest results data normality test results based on learning interest

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	Df	Sig.
high	0.129	38	0.193	0.962	38	0.315
low	0.153	32	0.055	0.949	32	0.131

Based on Table 6, information was obtained that the two p-value results of the normality test in the experimental class (0.315) and the control class (0.131). Both the variable price of high interest and low interest are> 0.05. This can prove that the pretest results are normally distributed because it is in accordance with the acceptance level of significance> 0.05. In addition, the normality test of pretest results data can also be assessed through the normal QQ Plot graph. The normal graph of the QQ Plot of the pretest results based on learning interest is presented in Figure 2.

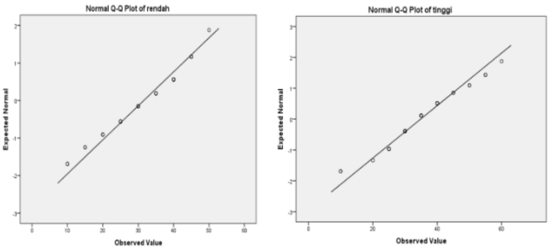


Figure 2. Normal QQ Plot Based on Learning Interest

Based on Figure 2 shows that the pretest result data plot against the standard normal quartile both in high learning interest and low learning interest there is a tendency to form a straight line, so it can be concluded that the data is normally distributed.

9. Homogeneity test of pretest results from data based on learning interest

The results of the variance homogeneity test through the SPSS version 24 program can be presented in Table 7.

Table 7. Data of homogeneity test results pretest results based on learning interest

Levena Statistic	df1	df2	Sig.
0.636	1	68	0.428

Based on the information from Table 7, the p-value is obtained (0.428). Based on this significance value, it can be seen that the p-value> 0.05. So it can be concluded that the pretest result data based on high learning interest and low learning interest have homogeneous variance.

10. Difference test of average pretest results based on learning interest

The results of the pretest analysis showed the difference in the average score of students based on their interest in learning. However, testing through statistical techniques is still needed to take inference the average difference in pretest results based on learning interest. The prerequisite test results show that the parametric statistical technique that can be used to test the difference in the mean pretest results is the independent sample t-test. Data from the pretest results with the independent sample t-test were analyzed through the statistical program. The results of the difference in the average pretest score based on learning interest are presented in Table 8.

Table 8. Test results based on learning interest

		Pretest Results	
		Equal variences assumed	Equal variences not assumed
Levene's Test for Equality of Variences	F	4,778	
	Sig.	0.032	
t-test for Equality of Means	t	15.371	15.919
	df	68	64.274
	Sig. (2-tailed)	0.000	0.000
	Mean Difference	7.595	7.595

Based on the results of the t-test through the statistical program, it was obtained a p-value of (0.000) with an acceptable level of <0.05, so it can be concluded that H0 is rejected. This conclusion means that the average pretest score on high and low learning interest has a difference.

11. Research sample post-test results

Description of Posttest Results Based on Research Samples Posttest data on the experimental class and control class. The description of the post-test data on the research sample is presented in Table 9.

Table 9. Description of post-test results based on research samples

Class	N	Minimum Score	Maximum Score	Average	SD
Experiment	35	40	90	61.14	14.95
Control	35	25	80	45.86	15.17

Based on Table 9 is obtained a description of the post-test result data in the form of the minimum score, maximum score, and average and standard deviation in the experimental class and the control class. The minimum scores in the experimental class and control class are 40 and 25. Likewise, the maximum scores in the experimental class and control class are 90 and 80. Although the average post-test scores of the two classes have shown differences in post-test results, inferential statistical techniques are still needed. to confirm the difference. The mean scores in the experimental class and control class were 61.14 and 45.86. While the measure of data deviation from the average score is shown in the standard deviation value. The standard deviation of the posttest score data in the experimental class and the control class was 14.95 and 15.17.

Description of posttest results based on learning interest.

Posttest result data based on learning interest consists of posttest result data with high learning interest and posttest results from data with low learning interest. Post-test score grouping based on the total score obtained by students on the interest in learning questionnaire with the average score of interest in learning. The distribution of post-test results data based on interest in learning.

Based on Table 10, also obtained a description of the results of concept understanding data in the form of minimum score, maximum score, average and standard deviation based on student learning interest. The minimum scores for high and low learning interests are 40 and 25. Likewise, the maximum scores for high and low learning interests are 90 and 60. As with the description of concept understanding data in the research sample, Table 4.10 also describes the average score. Students with high learning interest and low learning interest have shown a difference in the average understanding of concepts, but this information cannot be used as an inference before inferential statistical testing is carried out. The average scores for high and low interest in learning were 64.61 and 40.31. While the measure of data deviation from the average score is shown in the standard deviation value. The standard deviation of the posttest score data on high learning interest and low learning interest is 13.12 and 9.66. The histogram score of the posttest results on high learning interest and low learning interest is presented in Figure 3.

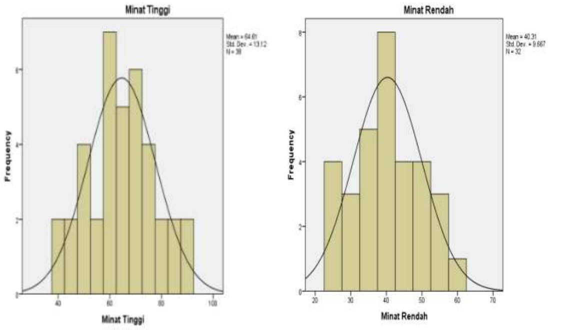


Figure 3 Posttest data histogram based on learning interest

Based on Figure 3, it is obtained a description that has different characteristics. The score of the posttest results with the highest frequency in high learning interest is smaller than the average score for low learning interest, which is greater than the average score.

The research hypotheses tested in this study were the effect of virtual laboratory learning and real laboratory learning on concept understanding, the effect of learning interest on concept understanding, and the influence of the interaction of virtual laboratory learning, real laboratory, and learning interest on conceptual understanding. Furthermore, the decision-making on the research hypothesis is carried out by comparing the probability value (p-value) of the source of variance and the significance level used in this study (α = 0.05). In Table 10, two-way ANOVA results are presented through the statistical program as follows:

Table 10 Two-way Anova results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17642.500a	27	653.426	14.637	0.000
Intercept	142908.893	1	142908.93	3201.159	0.000
Class	728.571	1	728.571	16.320	0.000
Interest	12800.809	16	800.051	17.21	0.000
Class * Interests	308.058	10	30.806	.690	0.728
Total	219875.000	70			

Based on Table 10, the results of testing the research hypothesis can be described as follows:

1) Effects of virtual laboratory learning and real laboratory learning on concept understanding

The research hypothesis about the effect of treatment states that there are differences in students' understanding of concepts in the experimental class and the control class. Decision-making on the research hypothesis can be seen by comparing the p-value with α. The source of class variation has a p-value (0.000) <α (0.05), so H_0 is rejected. The average student learning outcomes in the experimental class (61.14) were higher than the control class (45.86). This means that the effect of virtual laboratory learning is more significant than the real laboratory learning model on conceptual understanding.

2) The effect of interest in learning on concept understanding

The research hypothesis about the influence of treatment on learning states that there are differences in conceptual understanding between students who have high learning interests and students who have low learning interests. This research hypothesis is acceptable because the p-value of the source of variance in interest in learning (0.000) <α (0.05) meets the criteria for rejection of H_0. The average learning outcomes of students who have a high interest in learning (64.61) are greater than students who have a low interest in learning (40.31). This means that the effect of high learning interest is more significant than low learning interest on understanding concepts.

3) The influence of the interaction of virtual laboratory learning, real laboratory, and learning interest on conceptual understanding.

The research hypothesis about the effect of interaction states that there is a virtual laboratory learning interaction, real laboratory and learning interest towards students' conceptual understanding, p-value sources of class interaction variance, and learning interest (0.728)> α (0.05), so H_0 is accepted. Thus the hypothesis of this study indicates that there is no influence of the interaction between virtual laboratory learning, real laboratory, and learning interest on conceptual understanding.

1. The influence of virtual laboratory learning on conceptual understanding.

The results of testing the first hypothesis show that the H0 rejection criteria are met so that it can be generalized that there are differences in conceptual understanding between students taught using virtual laboratories and students taught through real laboratories.

Learning with virtual laboratories can stimulate students' enthusiasm to learn, this can be seen during the learning process, namely when conducting experiments with wave on a string 2.04 simulation software, students are very enthusiastic and want to know what happens if the frequency scale changes - and can also stimulate students' curiosity about the experiment by changing the wave pattern. Unlike the case with learning in real laboratories, students only do practicum according to the instructions on the student worksheets and cannot change the wave pattern as in a virtual laboratory.

The average learning outcome in the experimental class was 61.14 greater than the control class, namely 45.86. This indicates in general that learning with a virtual laboratory is able to minimize students' difficulties with the concept of mechanical waves.

The difference in understanding the concept of physics between classes with virtual laboratory learning and classes with real laboratory learning is influenced by the level of understanding of students in mastering the concept itself.

The treatment given to classes with virtual laboratory learning is able to lead students to have competencies that affect their understanding of the concept. As it is understood that learning with virtual laboratories can help students to understand physics material, especially on the subject of mechanical waves and at the same time be able to improve the abilities of students and teachers in the field of ICT.

This study is in line with the results of research conducted by Bajpai & Kumar (2015) in his research that the concept of student learning through virtual laboratories is a better way than real laboratories. This study also suggests the use of virtual laboratories in physics teaching, especially for concept teaching.

Research conducted by Nugroho et al. (2012) states that guided inquiry learning through virtual laboratories and real laboratories has a significant effect on cognitive learning achievement. with the average result of cognitive achievement in virtual laboratories being 77.2 while the real laboratory is 65.1. So it can be concluded that virtual laboratories are better than real laboratories.

The results of this study are also in line with research conducted by Athaillah et al. (2017) in that the results show that learning using virtual laboratories can improve students' conceptual understanding. This can be seen from the acquisition of the percentage of the N-Gain category that the experimental class is higher than the control class. The increase in students' conceptual understanding in the experimental class in terms of understanding indicators, shows that the extrapolation indicator has the highest increase, reaching 84% for the experimental class, and the control class by 65%.

2. The influence of learning interests on students' conceptual understanding.

Interest in learning is a desire for a willingness accompanied by deliberate attention and activeness which ultimately creates a sense of joy in behavior change, both in the form of knowledge, attitudes, and skills Donni (2015), Learning interest is also an intrinsic factor that can affect the understanding of concepts and student learning outcomes. As in this study, it was found that there were differences in conceptual understanding between students who had high learning interests and low learning interests. This generalization is supported by the results of testing the research hypothesis, namely the p-value of the source of variance in learning interest (0.000) <(0.05) so that the criteria for rejection of the hypothesis H0 are met. The average post-test results that have high learning interest and low learning interest are 64.61 and 40.31.

The results of measuring student learning interest are a result of previous learning experiences. This condition of interest in learning then affects student participation in the next learning process. Thus learning interest is able to influence students' conceptual understanding as in the results of hypothesis testing in this study students with high learning interest have a higher understanding of concepts than students who have low learning interest.

This research is in line with research conducted the results of hypothesis testing obtained a sig value. = 0.023 <0.05 and F count = 5.427> F table = 2.231 which shows that there is a significant influence between the science learning outcomes of students who have high interest and students who have low interest. This is supported by the average acquisition of the group of students taught with discussion media of 77.00, while the average group of students taught using conventional media is 72.88. This shows that the value of learning outcomes with high interest is better than the learning outcomes of students who have low interest.

3. The effect of the interaction of virtual laboratory learning, real laboratory, and learning interest on conceptual understanding.

The results of the two-way ANOVA test allow researchers to see the main effect and the interaction effect. The main influence that can be seen in this study is the effect of virtual laboratory learning and interest in students' understanding of concepts discussed in the previous section. The effect of the interaction between the two variables in this study can be seen in the probability value of class interaction variance and interest.

The absence of an interaction effect between the two variables is supported by the unfulfilled criteria for rejecting H_0 so the research hypothesis is not accepted. The amount of p-value for the source of class variance and interest (0.728)> α (0.05) then H0 is accepted.

The results of the study which states that there is no interaction effect between the two variables can be explained that the characteristics of differences in concept understanding between students with high learning interest and low learning interest are the same. These characteristics are of course the same as the marginal characteristics of differences in student interest in learning. If seen, the average marginal rate of students with high learning interest (64.61) is better than those with low learning interest (40.31). Because there is no interaction, this also applies to the group of students in the experimental class, meaning that in the experimental class, the average understanding of the concept of students with high learning interest is more than students with low learning interest. Likewise, if it is only paid attention to the control class.

This study is in line with the results of research conducted by Rahman (2014) which states that there is no interaction between the STAD-type cooperative learning model through the use of interaction diagrams and learning interest toward student learning outcomes as indicated by p-value (0.30422) > α (0.05), which means that students who have high learning interest have better learning outcomes than students who have low learning interest both with the STAD type cooperative learning model through the use of interaction diagrams without the use of interaction diagrams. = 0.422> 0.05 and F count = 0.653 <F table = 2.231 which shows that there is an insignificant interaction effect between learning methods and students' interest in learning science learning outcomes.

Conclusions

Based on the results of research and data analysis, it can be concluded that: (1) there is an effect of concept understanding among students who take virtual laboratory learning (2) there is a difference in conceptual understanding between students who have high learning interest and students who have low learning interest, but in the hypothesis third (3) there is no interaction between virtual laboratory learning and learning interest towards students' conceptual understanding. This can be seen in the statistical test used where for the final test questions the Sig value was obtained. <0.05, which means that Ho is rejected so that there is a significant difference between students who are given virtual laboratory learning and students who are given real laboratory learning research hypothesis is not accepted.

Acknowledgment

The authors would like to thank the school and the people who have supported this research.

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