

Application of the Virtual Laboratory Assisted Inquiry Learning Model for Understanding the Concept of Light Theory and Optical Instruments for Class VIII Students of SMPN 24 Bekasi.

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Abstract

Light material and optical equipment are materials that have conceptual and procedural characteristics so that they require practical activities, but this practicum is still rarely carried out due to the limitations of laboratory equipment and materials, the availability of school facilities and infrastructure that are not adequate. In the learning process the teacher uses learning media, namely power points and learning videos that are delivered using the lecture method. This study aims to determine the effect of the application of the guided inquiry learning model assisted by the Virtual Laboratory on the understanding of the concept of light material and optical instruments for class VIII SMPN 24 Bekasi. To identify these problems, researchers using a quasi-experimental method (quasi-experimental), with a nonequivalent control group design. This study obtained the result that the guided inquiry learning model with the help of virtual laboratory media had an effect on increasing the ability to understand the concept of light and optical instruments. This is indicated by a significant increase in students' ability to understand science concepts, oral communication, collaboration, and problem-solving after following the guided inquiry learning process with the help of virtual laboratory media with an average of 8.49 in the experimental class while in the control class 7.91..

Keywords: Guided Inquiry; Virtual Laboratory; Light Materials and Optical Instruments

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INTRODUCTION

Natural Sciences (IPA) studies natural phenomena in the form of facts, concepts, and laws, which are confirmed through a series of studies. Science learning is a process of teaching students to understand the nature of science (process, product and application), so as to form curiosity, determination, perseverance and awareness of social existence as well as the Application of the Virtual Laboratory Assisted Guided Inquiry Learning Model for Understanding the Concept of Light Material and Optical Instruments for Students Class VIII SMPN 24 Bekasi towards a positive attitude. Science learning is expected to help students to understand natural phenomena. Based on its characteristics, science learning can be viewed from two sides, namely science learning as a product of the work of scientists and science learning as a process as scientists work to produce knowledge. Science learning by providing direct experience can foster cognitive thinking skills (cognitive thinking skills), psychomotor skills (psychomotor skills) and social skills (social skills). In science learning, students are expected to be active as much as possible, either through observation, experimentation, or discussion to find answers to various phenomena that occur in the natural environment so that science learning can be more meaningful and all students understand the concepts of the material that has been taught. (Ida Fitriyati, Arif Hidayat, and Munzil, 2017, p.27). Science learning by providing direct experience can foster cognitive thinking skills (cognitive thinking skills), psychomotor skills (psychomotor skills) and social skills (social skills). In science learning, students are expected to be active as much as possible, either through observation, experimentation, or discussion to find answers to various phenomena that occur in the natural environment so that science learning can be more meaningful and all students understand the concepts of the material that has been taught. (Ida Fitriyati, Arif Hidayat, and Munzil, 2017, p.27). Science learning by providing direct experience can foster cognitive thinking skills (cognitive thinking skills), psychomotor skills (psychomotor skills) and social skills (social skills). In science learning, students are expected to be active as much as possible, either through observation, experimentation, or discussion to find answers to various phenomena that occur in the natural environment so that science learning can be

more meaningful and all students understand the concepts of the material that has been taught. (Ida Fitriyati, Arif Hidayat, and Munzil, 2017, p.27).

Learning media is a factor that supports the success of the learning process in schools because it can help the process of delivering information from teachers to students and vice versa. (Ahern, TC, 2016, p. 332-345. Learning media is a tool in the learning process to stimulate thoughts, feelings, attention, and learning abilities or skills so that they can encourage the learning process. (Tafanao, Talizaro, 2018.)

Increasingly sophisticated technology helps and affects students' access to information. With the development of technology, students really take advantage of and receive various news. The learning process uses various technology-based learning media, one of which is a personal computer. Using computers alone can make students work easier and faster, and bring interesting results, because students can interact with images, sounds, videos, and other interesting things. With advances in technology, practicum activities can be complemented by virtual practicums. The place to develop and find laboratory-based learning methods has been very developed. One of them is the use of virtual laboratories in science class. Virtual laboratory is a series of laboratory equipment in the form of software (application). Virtual Laboratory can be used as an alternative to focus students' attention on teaching and learning activities and to train students to do real practicum. Practical activities can be done virtually. (Rusman, 2012, p.19).

Based on interviews with science teachers at SMPN 24 Bekasi, the school divided the class of students into 9 classes where each class contained 38 students. In this interview, it was found that there were problems with Light Material and Optical Instruments, where there were still many students who did not understand the concepts in the material because the material was relatively dense and the learning time was limited. In addition, the science teacher at SMPN 24 Bekasi also conveyed information about learning media that are often used in the learning process, namely power points and learning videos delivered by teachers using the lecture method. Meanwhile,

By utilizing the development of virtual laboratories, practicum activities can shift from demonstrations to virtual laboratory activities. If

real tools are available in quantities according to the number of students, then practical activities using real tools can be carried out with a virtual laboratory equipped as practical activities. However, if real tools are not available in appropriate quantities, real tools can be used for demonstrations and virtual laboratories can be used as an alternative to practical activities. Virtual laboratory as a computer-based learning media will make it easier and help science teachers at SMPN 24 in the student learning process in receiving material for understanding the concept of light and optical instruments which will make it easier for students to understand the material provided by the teacher.

Virtual Laboratory describing a situation in a real laboratory process, can be interpreted as a learning model, as a result of updating theoretical knowledge into practical knowledge by doing practicum. Virtual Laboratory helps students carry out practicums and investigate phenomena that cannot be tried in real practicums, due to the lack of availability of laboratory equipment and materials. Virtual Laboratory can also help in describing various abstract concepts so as to deepen the description of student participants. Experiments of hazardous materials can be carried out with the Virtual Laboratory. Virtual Laboratory can be used repeatedly, anywhere, and anytime according to the needs of the student learning process. (Abou Faour, M and Ayoubi, Z, 2018, pp. 54-68).

Virtual laboratory which can be used, which was developed by the Ministry of Education and Culture (Kemendikbud) can be accessed via a PC or android, so that if there are no students who support one of the learning processes it does not burden students. Virtual laboratory has several advantages, namely it can complement student learning resources which is a form of integrated use of ICT in learning. Virtual laboratory is not a substitute, but is part of a real laboratory to complement and improve the existing one. Disadvantages, has modeling and simulation functions, which can clarify the concept. (Ade Yuspa, 2017, p.18).

In addition to the virtual laboratory application for learning houses from the Ministry of Education and Culture, there is also a software-based application developed to assist students in the learning process, namely the Physic Virtual Lab. This application has features for simulation of physics laboratory learning. Can be accessed via each student's smartphone.

In order to develop the skills that students expect at this time, a learning model based on scientific investigation is needed, and students are first given guidance by the teacher before carrying out the scientific investigation. One example of a learning model that can make this happen is the laboratory-assisted guided inquiry learning model. Guided inquiry assisted by a laboratory can add to the basic skills students need. As a result, students can actively participate and carry out scientific activities correctly. (MIS Putra, Widodo, and B. Jatmiko, 2016, p. 84).

The inquiry learning model is a learning model that prioritizes student activities in the learning process. In science learning, the use of similar learning methods will have a significant impact on the positive psychological development of students, because through this learning model students have enough opportunities to seek and find for themselves what they need, especially in abstract learning. One of the inquiry learning models used in this research is an example of guided inquiry learning. Guided inquiry is one example of learning. The teacher gives an example of a certain topic first. Students can solve problems early, then the teacher guides students on the problem. A student must do his best, and play the role of a scientist, conduct experiments and be able to carry out the inquiry process, and describe it through the stages it has gone through. The reason for using this guided inquiry learning model is that it can overcome student problems, such as lack of conceptual understanding, scientific process skills and lack of critical thinking skills. Therefore, students are required to improve the deficiencies in the learning process with the help of the teacher. learning process. (Dyah purwaningtyas, Wayan Dasna, and Fariati, 2016, p. 569-570). students are required to improve the deficiencies in the learning process with the help of the teacher. learning process. (Dyah purwaningtyas, Wayan Dasna, and Fariati, 2016, p. 569-570). students are required to improve the deficiencies in the learning process with the help of the teacher. learning process. (Dyah purwaningtyas, Wayan Dasna, and Fariati, 2016, p. 569-570).

Based on the existing problems, the researchers are interested in examining these problems into a study with the title "The Application of Virtual Laboratory Assisted Inquiry Learning Model on Understanding the Concept of Light Material and Optical

Instruments for Class VIII Students of SMPN 24 Bekasi".

METHOD

This research was conducted at SMPN 24 Bekasi on March 30, 2021 to April 13, 2021. The subjects of this research were grade VIII students of SMPN 24 Bekasi.

The method in this study used a quasi-experimental method (quasi-experimental), with a non-equivalent control group design with a sampling technique using random sampling technique. This quasi-experimental method was used to determine the effect of a guided inquiry model assisted by a virtual laboratory on understanding the concept of light and optical instruments.

The research design consisted of two groups of objects, namely the experimental class and the control class. The Experiment class is taught using a Virtual Laboratory with a guided inquiry model while the control class is taught without using a guided inquiry model assisted by a Virtual Laboratory only with a conventional learning model.

There are two kinds of data on two test and non-test instruments, so there are also two different data analysis techniques. The data generated in the test instrument will be analyzed to measure the significance level of improving learning outcomes and to test hypotheses. The data generated from the questionnaire sheet will be analyzed to determine the implementation of the learning model. (Siti Julianti, 2014, p. 39)

In this study, research documentation in the form of photos, student learning outcomes and lesson plans. Photos can provide information about school conditions, classroom situations and students carrying out the learning process. This observation is used to obtain data by making direct observations about activities in the form of science learning methods, infrastructure, and supporting factors in research. In this study, a response questionnaire was used to determine the student's response to the learning process on light materials and optical instruments using a guided inquiry model assisted by a virtual laboratory, this questionnaire was given after completing the learning process. Meanwhile, the tests in this study were conducted before and after the researchers treated the experimental class and the control class. Both classes will be given the

same question, in the form of multiple choice questions. The test formats given are pre-test and post-test. In this study, the test was used to measure the understanding of the concept of the control class and the experimental class before and after treatment.

Before the test questions were distributed for research, the test questions were first tested on people who were not respondents, then the test questions were tested on students in grades 9I and 9F. After getting the data from the test results obtained, then the test result data is analyzed by means of item analysis to determine the validity, reliability, discriminating power, and level of difficulty of a question so that it can then be known which questions are suitable for use in research, and then can be distributed to students. sample to be able to know the learning outcomes of control and experimental class students before and after treatment.

Data analysis of validity items to determine the accuracy of the question. The formula used to test the validity is the point biserial (rpbi) technique. (Ulfatul Hasanah, 2015, p. 46)

After testing the validity and generating which questions are valid and which are not, then the valid questions will be tested for reliability to show whether the instrument used is reliable, the method used to show the reliability of the instrument is the Spearman Brown (Split Half). (Febrianawati Yusup, 2018, p. 21)

After testing the reliability of the questions, then the test questions were tested for the level of difficulty to determine the variation in the level of difficulty in a test. A good question if the test questions have various levels of difficulty, with the formula for finding the difficulty index (proportion) is $P = \frac{B}{JS}$. (Ulfatul Hasanah, 2015, p. 49).

After getting the results of the difficulty level of each question, the discriminatory power of the questions is calculated to find out whether the question is good, sufficient, or dropped. This discriminatory power can identify students who are smart and students who are less intelligent. (Mujiyanto, 2017, pp. 192-213).

After all the questions have been analyzed, it can be seen which questions are feasible or not. Decent and good questions will be selected and then distributed for research questions *pretest* and *posttest*.

After the research and all data were collected, the data analysis technique stage was carried out, there were two kinds of data on two different instruments, namely test and non-test instruments, so there were also two different data analysis techniques. The data generated in the test instrument will be analyzed to measure the significance level of improving learning outcomes and to test hypotheses. The data generated from the questionnaire sheet will be analyzed to measure the implementation of the guided inquiry learning model assisted by a virtual laboratory.

The test carried out on the test instrument is a normality test to find out whether the data obtained comes from a population that is normally distributed or not. One of the requirements for the Parametric test is data with a normal distribution. One of the conditions for the Parametric test is that the resulting data is normally distributed. (Lucky Herawati, 2016, p. 3). This normality test uses the Shapiro Wilk test.

After knowing the data is normally distributed, then test for homogeneity. Homogeneity test is used to determine the effect between the dependent variable and the independent variable. The calculation of the uniformity test in this study used a simultasn test (F test). (Hendry and Roy Setiawan, 2017, p. 3)

After getting the resulting data, then doing a hypothesis test to answer the problem formulation, between the two models used, namely the guided inquiry model assisted by a virtual laboratory and which conventional learning model is more effective in the learning process. (Ilham, Sonny, and Joyce, 2019, p. 59)

To determine whether there is an effect of the guided inquiry learning model assisted by a virtual laboratory on improving student learning outcomes, the paired sample t-test is used. (Chriestie and John, 2018, p. 44)

For non-test instrument analysis techniques, the teacher's teaching and learning activity implementation sheet, student learning implementation sheet, and student response questionnaire sheets were filled out by observers and respondents. Where the observer for the teacher and student implementation sheet is the science teacher, while the respondents for the student response questionnaire are experimental class students. This non-test instrument was distributed after the learning process was used to determine whether this research was carried out

well or not and to know the extent to which this research was successful.

The results of observing the implementation of the learning model and student responses were analyzed using the following formula: (Siti Asiyah and Gde Agus, 2019)

$$\text{Percentage} = \frac{\text{sum of score}}{\text{sum of maximum}} \times 100\%$$

RESULTS AND DISCUSSION

Result

The learning tools used in this research are the lesson plan (RPP), syllabus, and worksheets. The instruments used in this study were observation sheets on the implementation of teacher and student learning, student response observation sheets, and two sets of multiple choice questions. After the learning tools and research instruments have been validated and declared suitable for use, then before conducting research on the multiple choice questions, they are first tested to determine the validity, reliability, distinguishing power, and level of difficulty of the questions to students who are not respondents and have studied light materials and optical instruments. Experimental subjects used by researchers.

Guided inquiry is a learning model that can increase student learning outcomes by designing and creating their own science concepts to make the material longer stored in students' memories. While virtual laboratories are complex interactive multimedia objects with implicit and explicit educational goals and include new digital forms, education with virtual laboratories makes students more independent, improves thinking skills to the ability to express ideas. Students' ability in light and optical materials is seen based on the results of observations seen during the learning process.

The assessment of these aspects is to determine the increase in students' generic science abilities during learning. The experimental class students' learning outcomes on students' abilities in light and optical instruments during the pre-test control class average were 5.68 and 7.91 for the experimental class, while in the post-test for the control class the average results for class 5 .66 and for the experiment 8.49. Students' learning outcomes of light and optical instruments have increased both in the experimental class and the control class. The complete data from the pre-test and post-test results for the experimental and

control classes are presented in the appendix below. The results of the pre-test and post-test of students in both classes can be seen in the table 1:

Table 1 Average Pre-test and Post-test scores

Component	PreTest		PostTest	
	Experiment	Control	Experiment	Control
Many Students	38	38	38	38
Average	5.66	5.68	8.49	7.91
The highest score	8	8	10	10
Lowest Value	2.6	3.3	6	6

1. Normality Test Pre-test and Post-test

The normality test was conducted to determine whether the data were normally distributed or not. The data used for normality test are pre-test and post-test scores. The results of the normality test of the pre-test and post-test scores for the experimental class and control class are presented in the Appendix. The results of the normality test of the pre-test and post-test values between the two classes can be seen in the table below:

Table 2. Normality Test

Class	Kolmogorov Smirnov			Shapiro Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Learning outcomes	.126	38	.135	.953	38	.112
	.135	38	.051	.943	38	.078
	.137	38	.069	.955	38	.128
	.140	38	.059	.956	38	.136

The results of the normality test of the pre-test and post-test data showed that the pre-test and post-test data values for both the experimental class and the control class were normally distributed. From the results of the normality test, the significance value of the pre-test experimental class was 0.112, meaning that it was greater than 0.05, then for the post-test experimental value, a significance value of 0.07 was obtained, meaning that it was greater than 0.05, so the experimental class was declared normal. Then for the control class, the

significance value of the pre-test was 0.128 and the post-test was 0.136, meaning that it was greater than 0.05, so it was stated that the value was normally distributed.

2. Homogeneity Test

Homogeneity test is used to determine the analyzed data has a homogeneous variance or not. To see if this data is homogeneous, it can be seen in the table below:

Table 3. Homogeneity Test Results

Test of Homogeneity of Variances			
Student learning outcomes			
Levene Statistics	df1	df2	Sig.
.008	1	74	.931

Based on the data of pre-test and post-test scores, the results of the homogeneity test showed that the data of the pre-test and post-test values for the experimental class and the control class were declared homogeneous. From the results of the homogeneity test, a significance value of 0.957 was obtained, meaning that it was greater than 0.05 with a significant level of 5%, so the distribution of the pre-test and post-test values of the two samples was homogeneous.

3. Hypothesis Testing and Post-test Results

The hypothesis test of the post-test data aims to determine whether the students' ability to understand the concept of light and optical

instruments shown through the average post-test results of the experimental class is better than the post-test results of the control class. The results of the calculation of the difference between the two averages of post-test data using the t-test Independent sample t-test. The data on the results of the difference in the two averages of the post-test results for the

experimental class and the control class are presented in the Appendix. The results of the difference test between the two classes can be seen in the table 4:

Table 4. Independent Samples T-Test Hypothesis Testing

		Leven's Test		t-test for Equality of Means						
		F	Sig	t	df	Sig 2	Mean Difference	Std. Error Difference	95% Lower Upper	
Student learning outcomes	Equal variances assumed	.008	.931	2,593	74	0.11	.5816	.2243	.1347	10,285
	Equal variances not assumed			2,593	73.99	0.11	.5816	.2243	.1347	1.285

Based on the data in table 4, a significant value of 0.11 is obtained, meaning that it is greater than 0.05, so it can be concluded that

there is an average difference in student learning outcomes between understanding the concept of light and optical instruments.

Table 5. Paired Sample Test

		Paired Differences								
		mean	Std Deviation	Std. Error Mean	95% Confidence Interval of the Differences		T	df	Sig. (2-tailed)	
					Lower	Upper				
Pairs 1	Experimental PreTest-Experimental Posttest	-28.342	16,695	.2708	-33,830	-22.855	-10,465	37	.000	
Pair 2	PreTest Control PreTest Control	-22,342	15,045	.2441	-27.287	-177.397	-9,155	37	.000	

In the table 5, it will be known whether there is an influence of the Virtual Laboratory-assisted Guided Learning Model on the understanding of the concept of Light Material and Optical Instruments for Class VIII Students. The hypothesis of the post-test results data aims to determine whether the students' ability to understand the concept of light and optical instruments shown through the average post-test results of the experimental class is

better than the post-test results of the control class. The formulation of the research hypothesis, namely:

H0 = There is no average difference between the learning outcomes of the Pre-test and the Post-test, which means that there is no influence of the guided learning model with virtual laboratory materials on the understanding of the concepts of light and optical instruments for class VIII students.

H1 = There is an average difference between the pre-test and post-test learning outcomes, which means that there is an influence of the guided learning model with virtual laboratory rocks on the understanding of the concepts of light and optical instruments for class VIII students.

The decision-making guidelines in the paired sample t-test based on the significance value (sig) of the SPSS output results are as follows: (Singgih Santoso, 2014, p.265).

- 1) If the value of Sig. (2-tailed) < 0.05 then H0 is rejected and Ha is accepted
- 2) On the other hand, if Sig. (2-tailed) > 0.05, then H0 is accepted and Ha is rejected

Based on the "paired sample test" output table 5, it is known that the value of Sig. is 0.000 < 0.05 then H0 is rejected and Ha is accepted. So it can be concluded that there is an average difference between the pre-test and post-test learning outcomes, which means that there is an influence of the guided learning model with virtual laboratory rocks on the understanding of the concepts of light and optical instruments for class VIII students.

The use of guided inquiry methods assisted by virtual laboratories, on light materials and optical instruments, can support the improvement of understanding the concepts of these materials. Guided inquiry is a learning model that can improve students' conceptual understanding by designing and discovering the material concepts themselves, so that the material can be stored in students' memory longer. Virtual laboratory is a simulation of scientific experiments and uses software to assist the learning process in improving students' understanding of the material, has complete tools and materials for the experimental process, and can be used anywhere and anytime. Conceptual understanding is a condition so that students can learn the material and then use their knowledge to interpret the material presented in their own language.

Discussion

The ability to understand the concept of light and optical instruments that emphasizes the guided inquiry learning model assisted by the Virtual laboratory. Assessment of each aspect to determine the increase in students' understanding of the concept of light and optical instruments during learning. The ability to understand the concept of light and optical instruments was assessed using a multiple-choice test given to students during the post-test. Multiple choice tests are made based on indicators of understanding the concept of light and optical instruments that are adjusted to the level of student knowledge and the learning model used.

Based on the results of data analysis, the average understanding of the concept of light and optical instruments of students has increased both in the experimental class and in the control class (Table 5). The improvement of students' understanding of the concept of light and optical instruments can be seen from the results of the initial state that the average understanding of the concept of light and optical instruments in the experimental class before and after being taught using a guided inquiry learning model with the help of a virtual laboratory is 5.66 and 8.49. In control class, increasing understanding of the concept of light and optical instruments can be seen from the results of the students' initial abilities before and after being given learning by practicum, which are 5.68 and 7.91.

The differences in students' understanding of the concepts of light and optical instruments in the experimental class and control class were caused by differences in the learning model applied. The experimental class uses a guided inquiry learning model with the help of virtual laboratory media, the control class uses a conventional learning model and does not use virtual laboratory media assistance. Differences in student learning outcomes can be seen in the table 6

Table. 6. Learning Outcomes of Control Class and Experiment Class

Component	PreTest		PostTest	
	Experiment	Control	Experiment	Control
Many Students	38	38	38	38
Average	5.66	5.68	8.49	7.91
The highest score	8	8	10	10
Lowest Value	2.6	3.3	6	6

Virtual Laboratory is a complex interactive multimedia object with implicit and explicit learning objectives and includes a new digital form. Learning with *virtual laboratory* lead to more independent student participation, improve thinking skills to the ability to express their ideas. (Mahesti Kudiastuti, et al, 2016).

By using the guided inquiry learning model, the material provided by the teacher is not only given and accepted by students, but also strives for students to gain various experiences in order to "find themselves" concepts. The guided inquiry model is a form of teaching that requires students to process messages to acquire knowledge, skills, and values. In the inquiry model, students are designed to participate in inquiry. The inquiry learning model is a student-centered learning model. Through this kind of teaching, students can learn more actively. The main purpose of this model is to help students develop knowledge and skills by asking questions and getting answers based on their curiosity. Students may wonder why this happens, obtain and process data logically so that students get their own answers. (Urgent Putu Eka Nilakusmawati and Ni Made Asih, 2012, p.20)

Guided inquiry-based learning using virtual laboratory media can stimulate students' curiosity, because in practice students will be invited to discover various theories, laws and concepts for themselves. Related to this, finding their own concepts can further influence the learning outcomes of students' general scientific abilities, so that students can know firsthand how to find and understand the concepts of light and optical instruments. (Ziadatul Fatimah, et al, 2020)

Conventional learning in the control class by not using virtual laboratory media is different from the experimental class. In learning, students listen and take notes on important topics explained by the teacher. In the learning process students only listen and discuss, there are no practical activities like in the experimental class. Therefore, students do not have experience in finding concepts. This problem causes the difference in the average value of creative thinking in the control class is lower than the difference in the average value in the experimental class. This proves that guided inquiry learning provides students with a good learning experience in understanding concepts, so that students' written comprehension skills and problem solving learning effects are better.

Based on the description above, it can be seen that the indicators of understanding the concept of light and optical instruments indicate that the application of a guided inquiry model with the help of virtual laboratory media can improve students' understanding of the concepts of light and optics. The improvement of students' understanding of light concepts and optical instruments is indicated by an increase in the percentage of students' problem-solving abilities in various aspects.

From the description above, it can be concluded that guided inquiry learning as a learning model can lead to new understanding. The function of the virtual laboratory is to invite students to directly and actively conduct their own experiments in order to develop their ability to understand scientific concepts. The combination of guided inquiry learning and virtual laboratory media can improve students' written communication and problem solving skills. This is indicated by the fact that the average value of the experimental class is better than the control class.

CONCLUSION

The application of guided inquiry learning models and virtual laboratory media can improve students' written communication and problem solving skills. This is shown based on the output table "paired sample t-test" in the discussion resulted in a significance value of 0.000 where $0.000 < 0.05$. So that it can be seen that based on the decision guidelines in the paired sample t-test test, H_0 is rejected and H_a is accepted, where there is a difference in the average student learning outcomes of the control class and the experimental class, which means that there is an effect of the built-in inquiry learning model assisted by virtual laboratories on understanding the concept of material light and optical instruments for class VIII SMPN 24 Bekasi.

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