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THE INFLUENCE OF GUIDED INQUIRY LEARNING MODEL USING PhET MEDIA ON THE STUDENTS SCIENCE PROCESS SKILLS OF LIGHT WAVE MATERIALS

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Abstract

This study aims to look at the science process skills of students using guided inquiry learning models assisted by the PhET media on the science process skills (SPS) of light subject matter, students in class XI, second semester, of SMA Negeri 9 Medan Academic Years 2018/2019. The population is all students of class XI semester II. With the cluster random sampling technique, the class XI IPA 1 was selected as the experimental class and XI IPA 2 as the control class. Before the study was conducted, the average pretest value of the experimental class was 38.43 and the control class was 38.31. In testing the normality and homogeneity of the two classes, it is obtained that the data of both classes are normally distributed and homogeneous. Furthermore, in the experimental class guided inquiry learning was carried out using PhET media and conventional learning was carried out in other classes. After learning is given then in the two classes conducted posttest with the average results of the experimental class 83.33 and the control class 70.60. From the results of hypothesis testing, there was an increase in students' SPS due to the influence of the PhET guided inquiry learning model on student's SPS the of light wave principal.

Keywords: Learning Models, guided Inquiry, PhET media, Science Process Skills (SPS)

There are several aspects that we can evaluate from the concept of education contained in our National Education System Law. First, education is an activity that is carried out consciously and in a planned effort. Secondly, the planned education process is directed towards realizing an atmosphere of learning and learning process, this means education must not rule out the learning process. Third, the atmosphere of learning and learning is directed so that students can develop their potential, this means the educational process must be oriented to students (student active learning). Fourth, the end of the educational process is the ability of children to have spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation, and country (Sanjaya, 2013).

Physics itself is an experimental science that is used to find patterns and principles that connect natural phenomena. In studying physics, students must have the provision of science process skills. This is very important for every student as a provision to use the scientific method in developing science and is expected to acquire new knowledge or develop existing knowledge. (Derlina & Lia, 2016).

The interview was conducted by the researcher with one of the physics teachers named

Sarohatua Sarumpaet, S.Pd., M. Sc at the 9th High School in Medan. The teacher said that during the process of teaching and learning activities took place and in working on the physics questions given by the teacher, students still tended to be passive.The use of media in the learning process is still rarely done by the teacher. In addition, if seen the physics test scores achieved by students on average are still far below the Criteria Minimum completeness (KKM) is 75. They also rarely do lab work in physics laboratories. If students are practicing, they should be able to improve their science process skills. Students will get used to observing, asking, making hypotheses, predicting, discovering relationship patterns, communicating, designing, and conducting investigations as well as measuring and calculating. These problems cause the science process skills of class students are still relatively low.

Researchers also distributed questionnaires to 36 students in class XI of SMA Negeri 9, based on the questionnaire obtained information that 60.7% of students disliked physics and 39.3% of students liked physics. 74.8% of students consider physics difficult, 25.2% of students consider physics to be ordinary. 64.6% of students consider physics boring and 35.4% of other students consider learning physics normal.

Referring to this problem, there are several learning models that can be used to change physics learning that is teacher centered (conventional) to student centered which can improve students' science process skills. One is the inquiry learning model, such as guided inquiry. Guided inquiry learning is a strategy in which students are actively involved in learning about concepts or symptoms through observation, measurement, data collection, to draw conclusions. The main goal is to develop students' attitudes and skills that enable them to become independent problem solvers (Ngalimun, 2017).

The main objectives of Inquiry learning activities are: 1) maximum student involvement in the learning process. 2) the logical and systematic direction of activities on the learning objectives, and 3) Develop students' self-confidence about what is found in the inquiry process (Trianto, 2010). The application of the learning model can be more effective by utilizing the media. Physics learning is needed apperception in the form of real examples of physical phenomena, whether in the form of animation, demonstration or simulation. This is supported by the fact that physics animation significantly increases student's science prosess skills (SPS). The learning media used are assisted by PhET animation.

The use of media aims to attract students 'interest and arouse students' curiosity through observation of the material in the learning process. PhET media is best used because of interactive

images or animations that are displayed like games where students can learn by exploring. Besides attracting students in the learning process of PhET media also helps students' understanding of the material being discussed in the learning process.

Several studies that have been conducted previously regarding the application of guided inquiry models are the first research by Fithriani et al (2016), which shows that the use of PhET simulations through the guided inquiry approach to critical thinking skills is 76%. In addition, the second research on the influence of the scientific inquiry model using PhET media on SPS was conducted by Safarati (2017), which showed that students SPS who were taught with a scientific inquiry model using PhET media were better than students who were taught with direct instruction. The third research on the application of guided inquiry to SPS was conducted by Rasyidah et al (2018), The number of experimental class values is greater than the control class, with an average value of 42.6 for the experimental class, and 40.6 for the control class.

Based on these descriptions, the researchers of this study aimed to determine the existence of a significant influence by applying the guided inquiry learning model of the PhET media to the science process skills of the subject matter of light waves in class XI semester II of SMA Negeri 9 Medan T.P 2018/2019.

METHOD

This research is a quasi-experiment or Quasi Experiment and the design used in this study is Cluster Random Sampling. The population is all grade XI students of SMA Negeri 9 Medan in the 2018/2019 academic year consisting of 4 classes. From the population, 2 classes were chosen as the experimental class, namely class X IPA 1 and X IPA 2 as the control class, each of which amounted to 36 students. The experimental class was treated in the form of guided inquiry learning assisted by PhET media and a control class with conventional learning. After the material ends, both classes are given a posttest. The study design is presented in Table 1.

Table 1. Group pre-test-post-test design

Class	Pretest	Treatment	Postest
Experiment	T_1	X_1	T_2
Control	T_1	X_2	T_2

Information:

T_1 = Early Test (Pretest)

T_2 = End Test (Posttest)

X_1 = Guided inquiry learning with the help of PhET media

X_2 = Learning with conventional models (direct learning models).

In this research, the instrument used was an instrument in the form of SPS test in the form of an objective to measure the level of science process skills of students, and instruments of observation of student activity. Before the instrument is used, it is first validated by two experts in the field of physics.

The experimental research data were analyzed using the t test. Before testing the hypothesis, the prerequisite test analysis is the normality and homogeneity of the data. Normality test uses the Lilliefors test and the Homogeneity test uses the Barlett test with a significance level of 0.05 ($p < 0.05$).

RESULT AND DISCUSSION

Result Research

Pretest Data for Experiment Class and Control Class

The initial stage of research in both classes is given an initial ability test (pretest). Based on the research data obtained the average value of student pretest in the experimental class before being treated using a guided inquiry learning model with a PhET media of 38.43 with a standard deviation of 9.13 while in the control class the average value of 38.31 with a standard deviation 9.75.

Based on data obtained from the study and to see in more detail the results of the pretest in both classes can be seen in the following diagram:

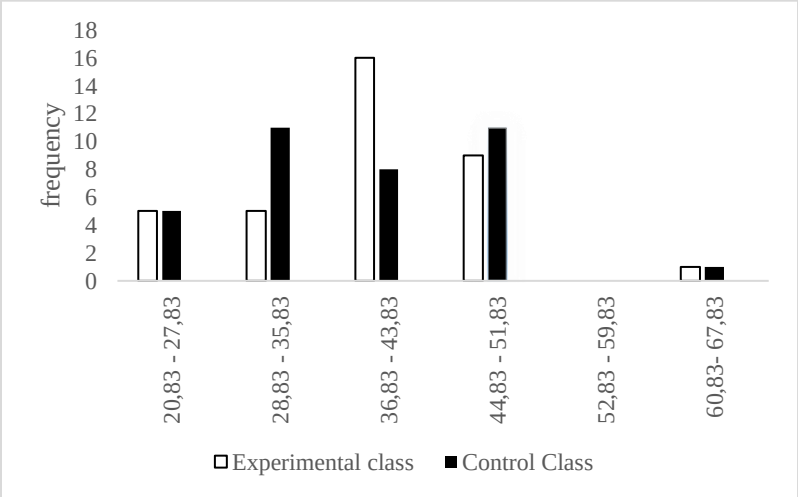

Figure 1. Pretest Data Bar Diagram of Experiment Class and Control Class

From the picture above it can be seen that the pretest values for the experimental class and the control class were carried out by the two-party t test. This means that the initial capabilities in both classes are the same.

Posttest Value Data Experiment class and control class.

Post test score data obtained from test scores given to each class of samples after being given different treatments. To see in more detail the results of the posttest in both classes can be seen in the following diagram:

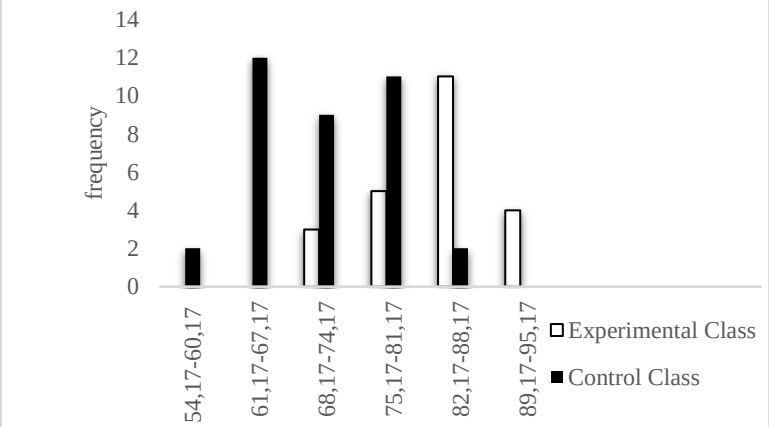

Figure 2. Post-Test Data Bar Contest of Experiment Class and Control Class

From the picture above the acquisition of posttest scores in the experimental class taught by the guided inquiry learning model with the PhET media is higher than the conventional learning model assisted by the PhET media. Based on the results of the study obtained an average posttest score of students in the experimental class of 83.33, while in the control class obtained an average of posttest students of 70.60. This shows that the implementation of conventional learning assisted by PhET media can improve students' science process skills better.

Student Science Process Skills Activity

During the learning process, observation of student activities is carried out four times after the pretest. Observation of this activity is only done in the experimental class that uses a guided inquiry learning model assisted by the PhET media. Observation of activities carried out by 2 observers (observers) who have been equipped with observation sheets. The activities observed include aspects of observing, making hypotheses, predictions, finding relationships and patterns, interpreting / interpreting, communicating, designing experiments, and measuring and calculating.

To see in detail the value of the development of student activities in the experimental class can be seen in the following bar diagram:

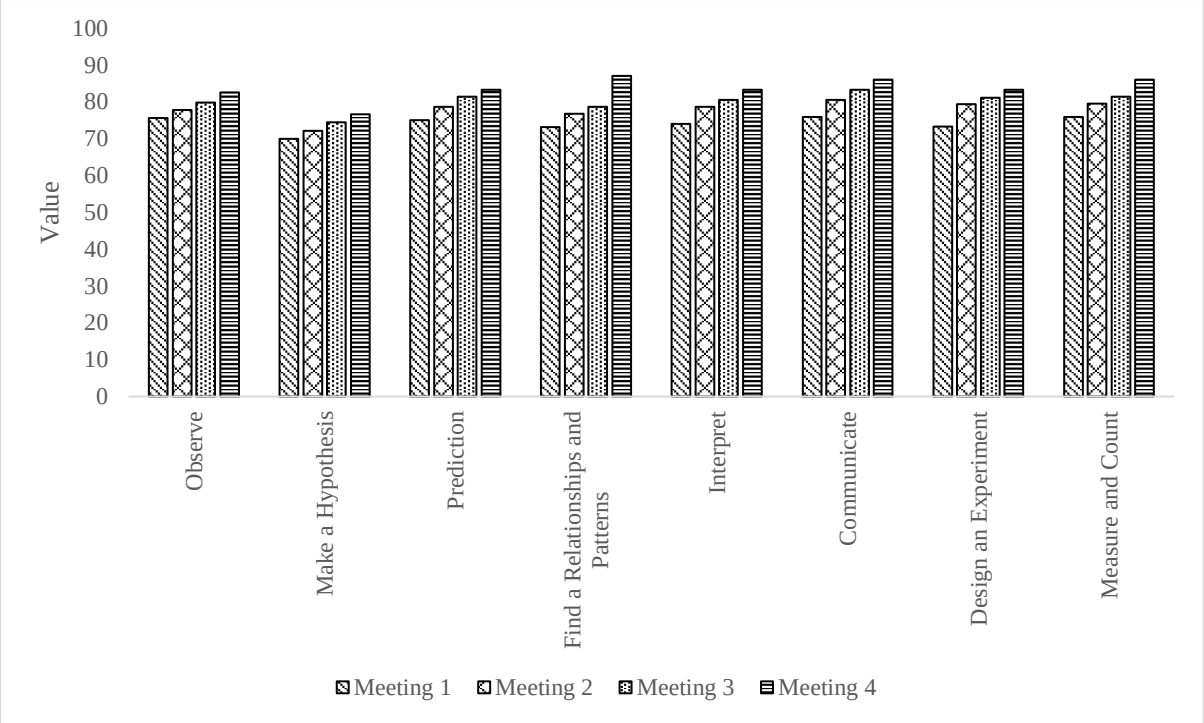

Figure 3. Improvement of the Science Process Skills indicator for each student

Discussion of Research Results

The study begins by giving a pretest to the two samples with the number of questions about 8 items in the form of essays in the experimental class and the control class. The average value of the pretest of the experimental class and the control class that is relatively the same shows that the initial ability of the two classes there is no significant difference, where the average pretest results of the experimental class obtain an average value of 38.43 and the average value of the control class 38.31. Based on the results of normality tests on the pretest of the experimental class and the control class, it was obtained that L_{count} = 0.12567 and L_{table} = 0.14767 From these tests it can be seen that $L_{count} < L_{table}$, so it can be concluded that the pretest value is normally distributed. Furthermore, based on the homogeneity test, it is obtained that F_{count} = 1.139 and F_{table} = 1.76, it can be seen that $F_{count} < F_{table}$, so it can be concluded that both data have the same or homogeneous variance. After the two data are declared normal and homogeneous, then the two data are tested using a two-party t test. This is done to see whether both classes have the same initial ability. Hypothesis test results using the two-party t test at a significant level α = 0.05 obtained $t_{count} < t_{table}$ (0.0576 <1.996) which means that the experimental class and the control class have the same initial ability.

After that, the two classes were given a different treatment, namely in the experimental class the guided inquiry learning model was implemented with the help of PhET media while the control class used conventional learning. After being given treatment in both classes were given a posttest

to see whether there were differences in students' process skills due to different learning treatments. The results of the experimental class posttest had an average value of 83.33 while the control class obtained an average value of 70.60. The results of normality tests in the experimental class posttest obtained L_{count} = 0.1384 and L_{table} = 0.14767, and in the posttest control class obtained L_{count} = 0.1269 and L_{table} = 0.14767. From these tests it can be seen $L_{count} < L_{table}$, so it can be concluded that the posttest values are normally distributed. Furthermore, based on the homogeneity test, it is obtained that F_{count} = 1.538 and F_{table} = 1.76, it can be seen that $F_{count} < F_{table}$, so it can be concluded that both data have the same or homogeneous variance. After the two data are declared normal and homogeneous, then the two data are tested using one party t test. This was done to see the effect of the learning model applied to improve students' science process skills in both classes. Hypothesis test results using one-party t test at a significant level α = 0.05 obtained $t_{count} > t_{table}$ (8.48> 1.668) which means there are differences in students' science process skills that indicate the influence of the guided inquiry model with the help of PhET media with conventional learning. This increase occurs because students are increasingly skilled in carrying out learning in accordance with the rules of guided inquiry learning.

The difference in science process skills is due to the influence of the PhET guided inquiry model on students' SPS. This shows that learning using guided inquiry models assisted by PhET media is better than conventional learning. This happens because the guided inquiry model assisted by the PhET media requires students to be more active in the learning phase. In addition, the guided inquiry learning model provides opportunities for students to explore to collect and analyze data to solve problems, so students are able to think critically, analytically, systematically, and logically in finding alternative solutions to problems. Students in this case are active and enthusiastic to work together with group friends in solving problems that have been given by researchers. Students are also interested and active when discussing and issuing different opinions when discussions are held between groups.

The guided inquiry learning model is also very beneficial because it gives equal opportunities to all students, both students who have low, medium and high ability to be able to find material through practicums without any difference. This is what causes the guided inquiry learning model to have better SPS than conventional learning.

In addition to the guided inquiry learning model, students' SPS are also supported by the use of PhET media. PhET media is a moving image or interactive animation created like a game where students can learn by exploring. These simulations emphasize the correspondence between real

phenomena and computer simulations and then present them in physical conceptual models that are easily understood by students (Perkins et al, 2006).

The use of PhET media can also provide interesting experiences to students during learning, educate students to have constructivism thinking patterns, make learning more interesting because students can learn and play at the simulation and visualize sound wave concepts. This is consistent with the results of research by Isti Khoiriyah., et. al. (2014) using the guided inquiry learning model assisted by the PhET media, the average learning outcomes of students using PhET Simulation 8.07 while students using Optics KIT 6.90. Improved student learning outcomes using PhET Simulation 3.05 and an average N-gain of 0.65, while students using Optics KIT 2.09 and an average N-gain of 0.43.

Likewise, with research conducted by Budiyono & Hartini (2016) Improved science process skills of students in the experimental class scored <g> of 0.78 or were in the high category while the control class obtained a value of <g> of 0.34 or were in the moderate category.

Based on observations of the learning activities of the experimental class students shown in Figure 3, the average activity from the first meeting to the third meeting experienced a good change with the understanding of each meeting, the science process skills of students using the guided inquiry learning model assisted by the PhET media increased. In the SPS 1 indicator, namely observing, an average calculation of 75.69 for the first meeting, 77.78 for the second meeting, 79.86 for the third meeting, and 82.64 for the fourth meeting. In the SPS 2 indicator which is to make a hypothesis, an average of 70 calculations was obtained for the first meeting, 72.22 for the second meeting, 74.44 for the third meeting, and 76.67 for the fourth meeting. In the SPS 3 indicator which is prediction, an average calculation of 75 for the first meeting is obtained, 78.70 for meeting II, 81.48 for meeting III, and 83.33 for meeting IV. In SPS 4 indicator, which is finding relationships and patterns, an average calculation of 73.15 for meeting I was obtained, 76.85 for meeting II, 78.70 for meeting III, and 87.03 for meeting IV. In SPS 5 indicator, namely interpreting / interpreting, the average calculation is 74.07 for meeting I, 78.70 for meeting II, 80.56 for meeting III, and 83.33 for meeting IV. In the SPS 6 indicator, namely communicating, an average calculation of 75.93 for meeting I was obtained, 80.56 for meeting II, 83.33 for meeting III and 86.11 for meeting IIV. In the SPS 7 indicator, which is designing an experiment, the average calculation is 73.33 for the first meeting, 79.44 for the second meeting, 81.11 for the third meeting and 83.33 for the fourth meeting. Finally, for SPS 8, namely measuring and calculating, an average calculation of 75.93 for meeting I, 79.63 for meeting II, 81.48 for meeting III and 86.11 for meeting IV was obtained.

This increase occurred due to students' habits in laboratory activities in accordance with the inquiry learning method. There are also some indicators whose improvement is not too prominent at the SPS 2 indicator stage in making hypotheses. Where at this stage students are advised to give their hypotheses about an experiment.

The application of the guided inquiry learning model can improve aspects of a student's SPS because teaching is accompanied by laboratory experiences. Experimental class students conduct scientific studies to solve given problems. Experimental class students are able to conduct experiments well starting from introducing, orienting, investigating, recognizing / identifying, collecting, creating / producing, giving / sharing, evaluating. The implementation of the guided inquiry learning model results in students being able to distinguish whether something is happening in accordance with science or not. The second stage of student orientation must use a reasoning mind to analyze the given problem. The third stage investigates, students must use logical or logical thinking when doing practicum, starting from making observations, asking questions, constructing hypotheses, designing experiments, conducting experiments, processing data, and drawing conclusions from experiments conducted. So, by thinking logically students are able to connect a series of opinions to arrive at a conclusion. Experimental class students in practicum try new things to investigate whether there are things that can be found if using other methods. Students are trained to carry out investigations that are applied to the guided inquiry model in the learning phase.

Weakness of guided inquiry learning models in research. First, experiencing difficulties in controlling students who have an impact on the learning process is less effective and uses time to control these students. The thing to do is provide motivation in advance to students in order to order students and learning can run well. Second, the use of time is less efficient, especially in the phase of conducting investigations through experiments. It is better to explain to students the practicum procedure that will be done. So that the time in learning activities with this model will be more effective and efficient. Third, some students are confused using the tools and materials used in the experiment. The thing to do is that the students are first taught to know the tools and practicum correctly so that when students conduct experiments they are not confused and already know the function of the tools and materials.

In the control class using conventional learning that is identical to the lecture method so students are more passive and teachers are more active. This is what sometimes makes students get bored quickly in learning and there is a one-way learning activity that results in less optimal control

class learning outcomes. So, the guided inquiry learning model has better benefits compared to conventional learning, so researchers suggest using the guided inquiry learning model in learning activities in schools in the hope of increasing the quality and quantity of students both in learning activities at school and in its application in life.

CONCLUSIONS

Based on data from research conducted at SMA Negeri 9 Medan, it can be concluded as follows:

1. The average value of SPS for students taught using the guided inquiry learning model assisted by the PhET media subject matter Light Waves by 83.33.
2. The average value of SPS for students taught using the conventional learning model of the subject of Light Waves is 70.60.
3. Student SPS activities in the learning process using the guided inquiry learning model assisted by the PhET media in four meetings have increased with an average value of meeting I being 73.85 (active). At meeting II 77.68 (active). At the III meeting 79.79 (active). At meeting IV 83.05 (active).
4. There is a significant influence of the guided inquiry learning model assisted by the PhET media, the subject of Light Waves, to the science process skills of students.

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REFERENCES

Budiyono, A. & Hartini. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Keterampilan Proses Sains SMA. *Jurnal Pemikiran Penelitian Pendidikan dan Sains,* Vol. 4 (2): 2579-8464.

Derlina & Lia. (2016). Efek Penggunaan Model Inquiry Training Berbantuan Media Visual dan Kreativitas Terhadap Keterampilan Proses Sains Siswa. *Cakrawala Pendidikan,* No 2.

Fithriani, S. L., Halim, A. & Khaldun, I. (2016). Penggunaan Media Simulasi PhET dengan Pendekatan Inkuiri Terbimbing untuk Meningkatkan Keterampilan Berpikir Kritis Siswa pada Pokok Bahasan Kalor di SMA Negeri 12 Banda Aceh. *Jurnal Pendidikan,* Vol 8 (1).

Khoiriyah, I., Rosidin, U & Suana, W. (2014). Perbandingan Hasil Belajar Menggunakan PhET Simulation dan KIT Optika melalui Inkuiri Terbimbing. *Jurnal UNEJ.*

Ngalimun. (2017). *Strategi dan Model Pembelajaran.* Yogyakarta: Aswaja Pressindo.

Perkins, K., Wendy, A., Micheal, D., Noah, F., Sam, S., and Carl, W. (2006). PhET: Interactive Simulation for Teaching and Learning Physics. *Jurnal of The Physics Teacher,* Vol 4.

Rasyidah, K., Supeno, & Maryani. (2018). Pengaruh *Guided Inquiry* Berbantuan *PhET Simulations* terhadap Hasil Belajar Siswa SMA pada Pokok Bahasan Usaha dan Energi. *Jurnal Pembelajaran Fisika*, Vol. 7 (2).

Safarati, Nanda. (2017). Pengaruh Model Scientific Inquiry Menggunakan Media PhET terhadap Keterampilan Proses Sains Ditinjau dari Keterampilan Berfikir Kritis. *Jurnal Pendidikan Fisika,* Vol. 6 (1): 2301-7651.

Sanjaya, W. (2013). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan.* Jakarta: Kencana.

Trianto. (2010). *Mendesain Model Pembelajaran Inovatif-Progressif.* Jakarta: Kencana.