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The Effectiveness of The Virtual Lab-Assisted Guided Discovery Learning Model on Students' Science Process Skills

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Abstract

This study aims to determine students' science process skills after using the guided discovery model assisted by the virtual PhET lab on vibration and wave materials and the effectiveness of applying the guided discovery learning model assisted by the virtual PhET lab. This research was conducted at a junior high school, SMPN 2 Siak. The research method used is quasi-experimental with a *posttest-only control group design*. The sample of this study is the experimental class and the control class. Each class has 33 students. The research data was obtained by using a science process skill test instrument. The results showed that the average process skills of the experimental class $\bar{x}$= 76.76 and the control class $\bar{x}$= 57.23. The results of the t-test using SPSS software were obtained with (sig) 0.000 < 0.05 . It was concluded that the guided discovery learning model assisted by the virtual lab PhET was more effectively used to improve students' process skills.

Keywords: guided discovery, PhET, science process skills, vibration and waves

INTRODUCTION

One of the essential aims of education is to teach about the nature of science and how to engage in experimentation. Science is knowledge that contains several materials or concepts that are interrelated and comprehensive. In other words, science does not consist of knowledge that is foreign to one another but is a collection of knowledge that is systematically arranged. Science can be viewed as a scientific process, product, and attitude—science is a product in the form of concepts, principles, theories, and laws. As a process, science is seen as a scientific method and an attitude, namely honest, open, objective, and critical. Therefore, understanding science requires various methods and approaches, such as an environmental approach, a process skills approach, a concept approach, and an integrated approach (Makhrus 2012).

Physics is a science subject. Physics is a lesson that requires understanding rather than memorizing and understanding concepts that are focused on the process of forming knowledge through the discovery and presentation of data mathematically and based on specific rules (Azhar 2008). According to Giancoli, physics is the most fundamental science because it deals with the behavior and structure of objects (Dudeliany 2014). In addition to making students master the targeted material, physics learning activities are also directed at developing valuable process skills in helping solve problems. Physics directs students in process skills to produce good cognitive and psychomotor outcomes. Physics learning in junior high school still shows the achievement of mastery of subject matter regardless of whether students understand the material being taught, resulting in the neglect of students' science process skills. Student learning outcomes can be improved if it is supported by the teacher's sensitivity in stimulating students' skills in overcoming existing weaknesses. Good products are produced from good process skills (Erina 2015).

One of the most frequently used thinking skills is science process skills. In addition, Rillero emphasized that individuals who cannot use science process skills will have difficulty in everyday life because these skills are used not only during education but also in daily life (Danis 2015). Developing science skills enables students to acquire the skills needed to solve everyday problems. However, in reality, students' science process skills are still low. The still weak Science Process Skills is reinforced by Anam's research which conducted research on thirty representative students from MI in Sumedang Regency in Madrasah Science Competency (KSM) activities. The results showed that average students' four types of process skills, namely observing, planning experiments, classifying, and making tables, were in the less proficient category and not proficient in concluding skills (Rahayu 2017).

Science process skills can be developed through various strategies, one of which is conducting practicum or experimentation through approaches or learning models used by teachers in the learning process (Charistia 2016). According to the Ministry of Education and Culture, indicators in science process skills include observing, classifying, interpreting, predicting, asking questions, formulating hypotheses, planning experiments, using tools and materials, applying concepts, and communicating (2017).

Based on observations made in one of the public junior high schools in Siak Regency, it can be seen that the practicum facilities in the physics science laboratory are inadequate, causing students to rarely do practicum, and the learning process still often uses conventional learning models. In conventional learning, students tend to listen a lot to the material presented by the teacher and take notes on what is written on the blackboard. This makes students' science process skills not develop because they are not actively involved in constructing their knowledge. To overcome this problem, the researchers tried to apply the guided discovery learning model assisted by PhET on the vibration and wave material for class VIII. The guided Discovery Learning learning model was developed by Jerome Seymour Bruner (Mayer 2004). Discovery learning is divided into free discovery and guided discovery (Suprihatiningrum 2013).

According to Bruner, in guided discovery learning, students are faced with situations where they are free to investigate and draw conclusions. The teacher acts as a guide, helping students to use the ideas, concepts, and skills they have learned before to gain new knowledge. In learning guided discovery learning, someone manipulates, creates structures, transforms information, and in the end, can find (Maulidar 2016). Guided discovery is a problem-solving process through systematic action consisting of problem finding, hypothesis formulation, data collection, hypothesis testing, and conclusions. This learning model aims to solve problems that tend to be students' individualistic learning attitudes. This learning model adheres to a constructivist view that emphasizes understanding the concept of learning through the active role of students (Saeful 2015). Physics Education Technology (PhET) is a simulation created by the University of Colorado which contains physics, biology, and chemistry learning simulations for the benefit of classroom learning or individual learning. According to Yuafi (Saputra 2020). Physics Education Technology (PhET) is an interactive physics simulation software available on sites that can be run online or offline. In PhET, theoretical and experimental simulations actively involve the user. Users can manipulate activities related to experiments. PhET was developed to help students understand visual concepts (Zulkilfi 2022).

The application of the guided discovery learning model assisted by the PhET virtual lab aims to determine the students' science process skills on vibration and wave material at SMPN 2 Siak and to determine the effectiveness of the PhET virtual lab-assisted guided discovery learning model on vibration and wave material.

METHODS

The research method used is a quasi-experimental design using a posttest-only control group design, as shown in FIGURE 1. This study used two sample groups, the experimental and the control groups.

Both groups will be given treatment and then given a post-test to analyze the description of students' science process skills.

Class	Treatment	Final Test
Experiment	X_1	O_1
Control	X_2	O_2

FIGURE 1. Posttest-only control group design (Ahmad Ibnu Rusydi 2018)

The research was conducted at SMPN 2 Siak in March 2022. The population in this study was all class VIII. The sample was determined by conducting a normality test and a homogeneity test in the population using the previous material test data. The samples taken in this study were the experimental class which used the Guided discovery learning model with the help of the PhET virtual lab, and the control class, which used the conventional model. Each class consisted of 33 students. The data collection method used is the post-test of science process skills in the form of objective questions. After getting the post-test data, the results of the data were analyzed descriptively. To determine the level of students' science process skills, the following criteria were used.

TABLE 1. Category of Student Science Process Skills Assessment

Value Criteria	Science Process Skills Criteria
85	Very good
70-85	Well
55-70	Enough
40-55	Not good
40	Very Not Good

Inferential analysis of the post-test results of students' science process skills begins with the prerequisite test of homogeneity test analysis and normality test. Then, it was followed by a t-test for hypothesis testing to determine the effectiveness of using the PhET-assisted guided discovery learning model on students' science process skills. It was determined based on the difference in the value of science process skills obtained between the experimental and control classes.

RESULTS AND DISCUSSION

Descriptive analysis was used to get an idea of the extent to which the science process skills of SMPN 2 Siak students, both for the experimental class that applied the guided discovery learning model and the control class that applied the conventional learning model after the treatment. The data on the post-test average score of the science process skills of the experimental class and control class students is shown in TABLE 2.

TABLE 2. The Results of the Average Science Process Skills of the Experimental Group and the Control Group

No	Aspect	*Post-test*	
		Control Group	Experimental Group
1	Observe	84.84	87.87
2	Grouping	90.90	93.93
3	Interpret	21.21	63.63
4	Predict	24.24	78.78
5	Formulating Hypotheses	75.75	87.87
6	Planning an Experiment	24.24	42.42
7	Using Tools and Materials	24.24	45.45
8	Applying the Concept	90.90	96.96
9	Communicating	78.78	93.93
Average		57.23	76.76
Standard Deviation		30.54	19.94
Category		Enough	Well

The average post-test score of science process skills based on TABLE 2 after the implementation of learning in the control group was 57.23 with sufficient category, while the average post-test score of science process skills in the experimental group was 76.76 with good category. Based on these results, there is a difference in the average score of students' science process skills between the two groups, namely 19.53. The experimental group obtained higher results than the control group. This illustrates that implementing science learning physics using guided discovery learning models assisted by virtual lab PhET on vibration and wave materials in the experimental group runs effectively, causing descriptive improvements. In line with the research conducted by Alatas and Hikma Sakina (2019) entitled "Guided discovery assisted by a virtual lab to improve science process skills and scientific attitudes" and following research conducted by Handayani (2017) that science process skills students increase after applying the model guided discovery learning. The results of the study can be concluded using the model Guided discovery learning assisted by virtual labs can improve science process skills and scientific attitudes of students in each group. The results of research conducted by Maulina and Kuistijono (2017) concluded that learning physics by conducting a PhET-based practicum is very effective and can improve students' science process skills. This is shown by the positive response from students and research conducted by Ngadinem (2019) entitled "Use Phet Simulation Media To Improve Science Process Skills".

The average data on science process skills are then categorized into the frequency distribution of students' science process skills so that the frequency distribution results will be obtained as shown in TABLE 3.

TABLE 3. Frequency Distribution of Science Process Skills Data

interval	Control Group		Experimental Group		Category
	Amount	Percentage (%)	Amount	Percentage (%)	
85	0	0	6	18.18	Very good
70-85	2	6.06	12	36.36	Well
55-70	23	69.69	15	45.45	Enough
40-55	8	24.24	0	0	Not good
40	0	0	0	0	Very Not Good

Based on TABLE 3, it can be seen that the experimental group was distributed in the very good, good, and sufficient categories. Meanwhile, for the control group, the data obtained were distributed in the good, sufficient, and poor categories. Where the data of the two dominant groups is distributed in the sufficient category, if the average data on students' science process skills are visualized into a bar chart, it will look like FIGURE 2.

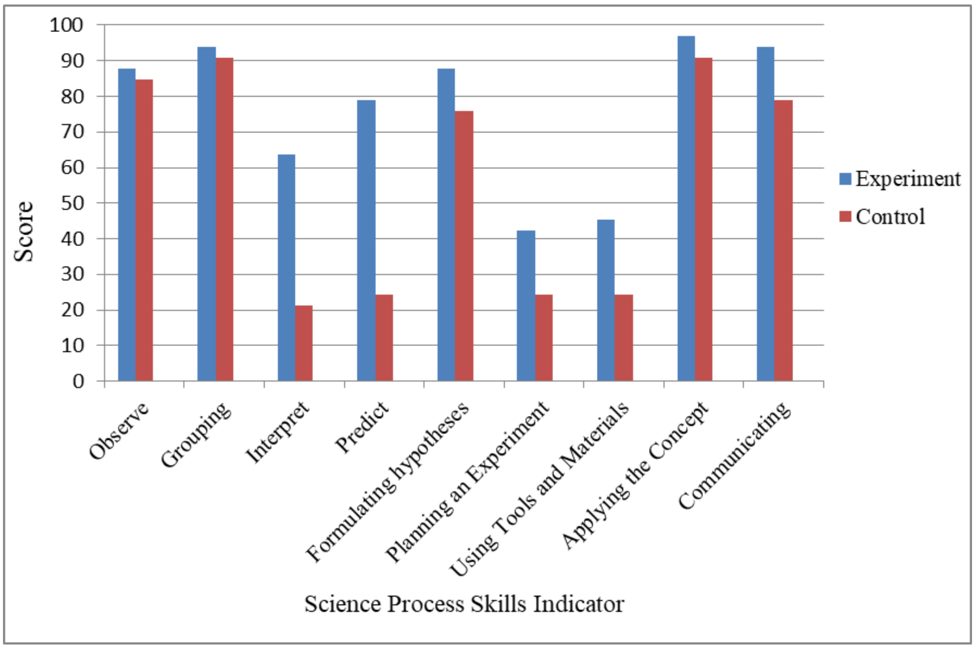

FIGURE 2. Comparison Graph of Science Process Skills Each indicator of Experiment and Control Group

The normality test for process skills data was carried out using the *Kolmogorov-Smirnov test. B*ased on the output obtained, the significance value of the experimental and control groups was 0.000. Because the significance value of the experimental and control groups is less than 0.05, it can be concluded that the data are not normally distributed. The homogeneity test for the process skills data was carried out by a *levence* test. Based on the output obtained, it was seen that the two classes had homogeneous variance with a significance value greater than 0.05.

Hypothesis testing in this study was carried out through testing using the *Mann-Whitney test*. Hypothesis testing aims to determine whether there are differences in students' science process skills between the experimental and control classes. Based on the output obtained a significance value (sig.2 –tailed) of 0.000 based on the provisions if (sig.) <0.05, then there is a significant difference in science process skills between the groups using the *guided discovery learning model* with the help of the PhET virtual lab and the group. Which uses conventional learning models on vibration material.

CONCLUSION

Based on the results of the research, data analysis, and discussion, it can be concluded that there was an increase and a positive impact on the science process skills of junior high school students after applying the guided discovery learning model assisted by the PhET virtual lab. Thus, the application of the guided discovery learning model assisted by the PhET virtual lab is effective for improving the science process skills of junior high school students.

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