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The Effect of POGIL Model Toward Science Process Skills and Physics Acquisition of Student

Elfrida Toyo, Sudi Dul Aji, and Chandra Sundaygara*
Universitas Kanjuruhan Malang, Malang, Indonesia
chandrakirana@unikama.ac.id

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Abstract: This research aims to determine the differences in the Process Oriented Guided Inquiry Learning (POGIL) model toward science process skills and physics acquisition of students. The method used in this study was a quasi-experimental research design with posttest-only involving 64 students as samples. The research sample was chosen based on a purposive sampling technique. Instruments for measuring science process skills in the way of process skills assessment sheets and physics concept acquisition in the form of multiple-choice tests. Data analysis used is two-way ANOVA. The results showed that there were differences in science process skills between students who learned using the POGIL model and students who learned using the direct instruction model with a value of F=10.207 (p>0.05). There were differences in the mastery of concepts between students learning using the POGIL model and students who learned using a direct instruction model with F=17.771 (p>0.05) There is an interaction between the POGIL model and science process skills towards mastery of concepts with a value of F= 5.660 (p>0.05).

Keywords: POGIL model, science process skills, concept acquisition

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INTRODUCTION

The development of technology is inseparable from developments in the field of science. Science is not only a collection of knowledge in the form of facts, concepts, laws, and theories but also a process of discovery. The nature of physics requires physics learning to be carried out through a constructivism process that facilitates students to practice science process skills, build their own cognitive abilities (especially physics concept) (Yunia, Sona, Dasna, & Susilo, 2016).

Physics learning in junior high school grade 7 on heat material generally still uses teacher-centered learning activities so that students only memorize concepts without understanding and prove empirically (Ningsih & Bambang, 2012). In general, Physics learning does not provide opportunities for students to practice various skills, such as high-level thinking skills and science process skills (Zamista & Kaniawati, 2016). Skills in the 21st century include 4Cs (Critical Thinking, Communication, Collaboration, Creativity) (Redhana, 2019). As a result of students only know physics concepts without knowing how students comprehend the process of the concept itself. This has an impact on the low level of science process skills and students' concept mastery (Cakir, 2008). The selection of the right learning model can be used as one solution to overcome problems in the learning process, especially in the aspects of science process skills and physics acquisition of students. Learning emphasizes the process of gaining knowledge (constructivism) and linking knowledge with real experiences in everyday life (Zamista & Kaniawati, 2016). One of the learning models based on the constructivism approach is the Process Oriented Guided Inquiry Learning (POGIL) model that has been developed (Moog, Creegan, Hanson, Spencer, & Straumanis, 2008).

The POGIL model emphasizes learning to work in teams, to develop conceptual understanding, and to develop science process skills, thinking skills, problem-solving skills, communication skills, management skills, and development skills. Positive social attitudes and self- assessment skills can develop metacognitive knowledge (Zamista & Kaniawati, 2016).

Science process skill is the ability to develop scientific methods, where students can find and develop facts and concepts to make learning more meaningful, contextual, and constructivist (Yunia et al., 2016). Science process skills students must be trained through the activities of observing, formulating problems, predicting, conducting experiments, interpreting, and formulating conclusions (Murni, 2018). Science learning should provide opportunities for students to develop their thinking skills, science process skills, and attitude development. POGIL learning emphasizes content and process through using learning teams, guided inquiry activities to develop understanding, questions to develop critical and analytical thinking, problem-solving, reporting, metacognition, and individual responsibility (Hanson, 2013). The results of the study showed that POGIL influences the understanding of science concepts, science process skills, and critical thinking skills (Rustam, Ramdani, & Setijani, 2017)

Concept acquisition is a very important thing and must be the focus of attention in the science learning process and takes precedence over memorization (Cakir, 2008). The learning process is not only conveying and explaining concepts or theories but also involving students to build their knowledge and skills (Jufri, 2013). The POGIL learning model provides an opportunity for students to develop mastery of concepts, namely, at the application stage, students are asked to apply the concepts. They got new problems, so they were able to develop students in processing information, communication, and students were more easily to understand and master the scientific meaning of both concepts, in theory, law, principles, and their application in everyday life.

Considering the need of the previous discussion, the purpose of this study was to determine the effect of the POGIL learning model on science process skills and physics acquisition of students.

METHODS

The design of this research was a quasi-experiment research design by applying the posttest-only to the control group. The population in this study were all seventh-grade students of SMPN 1 Lawang academic year 2018/2019, with the total number of students were 160 students. The sample in this study consisted of 2 classes, namely class VII-A as an experimental class taught by the POGIL learning model and class VII-B as a control class taught by the conventional model. The sampling technique uses purposive sampling.

The instrument used to obtain data consisted of instruments of science process skills and physics acquisition of students. The process skills assessment sheet is an instrument for measuring process skills. The instrument of physics acquisition in the form of multiple-choice tests, the development of question, was based on the bloom taxonomy, which has been adapted in cognitive aspects. Before using the physics acquisition test, the content was validated by two experts, and the construct validation was tested in the field.

In analyzing data, the researcher used inferential statistical analysis techniques. In the use of statistical parametre before carrying out a hypothesis test, an analysis prerequisite test is conducted (normality test and homogeneity test) (Sugiono, 2017). The normality and homogeneity test, which used was a one-sample Kolmogorov-Smirnov test at a significance level of α = 0.05. Hypothesis testing uses a two-way ANOVA technique. Hypothesis testing in this study was carried out by using SPSS for windows 16. With the criteria, if $F_{count} \geq F_{table}$ meant H_0 is accepted at the significance level of 0.05 or vice versa, to determine the effect of independent variables using the t-test at the 0 significance level 05 with criteria If the value of sig $\geq$ 0.05, then H_0 is accepted.

RESULTS AND DISCUSSION

Data on students' initial abilities were obtained from the average value of student tests on physics subjects in the previous material. The initial capability data was used to see the initial abilities of both classes and was used as data to test the study sample. Data on students' initial abilities can be seen in table 1.

Table 1 Data on students' initial abilities

Class	Students' Initial Abilities		
	Highs	Lowest	Average
Experiment	93	35	69,5
Control	90	35	68,5

Based on table 1, it can be seen that the value of the initial ability of students in the experimental class using POGIL having the same ability as the control class using a conventional model. Then a t-test was conducted to see whether the students' initial abilities in the experimental class and the control class were the same. From the results of the t-test, the sig value is 0.765 > 0.05, so it can be concluded that the initial ability of the experimental class and the control class is the same.

Science Process Skills

Science process skills obtained by students in the experimental class using process-oriented guided inquiry learning (POGIL) and control class using direct interaction learning. There were several indicators used in this study. They were hypothesis (HP), Implement the experiments (IE), processing data (PD), communication (CM), and conclusion (CS). Data on students' science process skills are measured after students get treatment. Resulting in experimental and class science process skills scores control presented in the following figure 1.

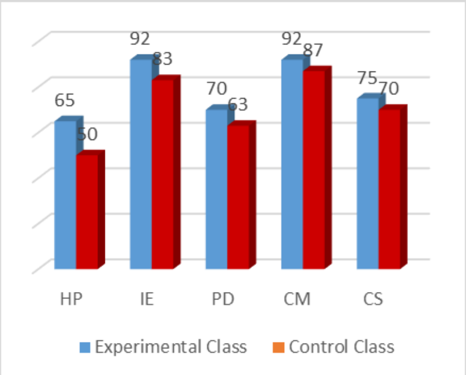

Figure 1 Histogram Comparison of the Value of Science Process Skills of Students

Based on Figure 1, it can be seen that the value of the experimental class with the treatment process-oriented guided inquiry learning model (POGIL) is higher than in the control class with the direct instruction model on the acquisition of science process skills.

Concept Acquisition

Physics acquisition consists of several indicators, namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). The result of the concept mastery score of the experimental and control class is presented in Figure 2 below.

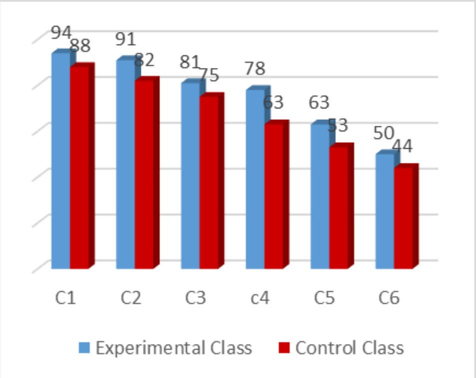

Figure 2 Histogram Comparison of Average Value of Physics Concepts Acquisition of students

Based on Figure 2, it is known that the acquisition of the concept mastery value of the experimental class students and the control class is not the same. The value of physics concepts mastery of experimental class students is higher than students in controls. While for the result of Anova can be seen in table 3.

Table 3 ANOVA Test Results

Source	F	Sig.
Corrected Model	10.207	.002
Corrected Model	17.771	.000

Dependent Variable: Science Process Skills and Physics Concepts Acquisition of students

Based on table 3, the results of ANOVA analysis using SPSS 16.0 for windows above show that: there are differences in science process skills between students who learned using the process-oriented guided inquiry learning (POGIL) and students who learn to use the direct interaction model. Because of the results of the ANOVA test analysis in the table above, at a significant level of 0.002 <0.05. Test criteria (α = 0.05). This means that if the sig value is <0.05 At a significant level (0.002 <0.05), it can be said that there is a difference in science process skills between students who learned physics using process-oriented guided inquiry learning (POGIL) model and students who learned physics using the direct interaction model. This finding is in line with the results of previous studies, namely research done by Ningsih & Bambang (2012) the finding shows that the application of process-oriented guided inquiry learning models have a positive influence, among others, can improve students' critical thinking skills, improve science process skills, cognitive abilities, improve aspects of hypotheses, analyze and conclude. Process-oriented guided inquiry learning (POGIL)can encourage students to export complex knowledge in depth (Barthlow, 2011). It can be concluded that the use of process-oriented guided inquiry learning (POGIL) models has a positive effect on science process skills in heat and displacement material. These positive effects include: 1) develop science process skills; 2) Make students actively participate in learning; 3) Develop communication and performance skills in groups.

There is a difference in the aspect of concept mastery between students studying physics using the POGIL model and students who learned using the direct instruction model. It is proved by the ANOVA test results at a significant level of 0,000 <0.05. Test criteria (α = 0.05). This means that if the sig value is <0.05 at a significant level <0.05 (0.000 <0.05), then there is a difference in science process skills between students who learned physics using the POGIL model and students who learned physics using the direct instruction model. According to Hanson, the POGIL model makes students easily understand learning material because it is taught through group collaboration in conducting experiments so as to provide opportunities for students to think in solving problems found in the learning process (Zamista & Kaniawati, 2016). Whereas in the direct instruction, students have little opportunity to be actively involved, it is difficult for students to develop science process skills and their concept mastery (Ningsih & Bambang, 2012).

The use of the POGIL model can be applied to science subjects because in this learning process, students are emphasized to construct their own cognitive abilities, provide facilities for students to be skilled in conducting experiments to improve science process skills and develop creativity in thinking. Thus, the concepts will be easy to understand, then proven through experiments or practicums to build their science process skills and give the opportunity to assess their performance and think about how to improve their shortcomings. POGIL model learning activities focus on core concepts and science processes that encourage and develop a deep understanding of learning material (Haryati, 2018).

Based on some of these studies, it can be concluded that the use of the POGIL model can improve the mastery of students' physics concepts in heat matter and their displacement. In this case, the POGIL model emphasizes the formation of concepts independently by students with teacher guidance so that a deep impression of the concepts learned. The result of the test of the Interaction Between Learning Models and Science Process Skills towards Concepts acquisition can be seen in table 4.

Table 4 Tests result of the Interaction Between Learning Models and Science Process Skills towards Concepts acquisition.

Test of Between-Subject Effects		
Source	**F**	**Sig.**
Skills	26.357	.001
Mastery of the Concept	513.674	.000
Skills * Mastery Concept	5.660	.041

Based on table 4, the results of ANOVA analysis using SPSS 16.0 for windows above indicate that: There is an interaction between the POGIL model and science process skills towards physics concepts acquisition of students. Because of the results of ANOVA test analysis in the table above, obtained F_{count}=5.660 with F_{table}=3.15 at a significant level of 0.05. Test criteria where $F_{count} > F_{table}$ (5,660 > 3,15), then there is an interaction between learning models and science process skills towards physics concepts acquisition of students. An interaction occurs when the effect of one factor influences another in influencing something. The results of data analysis with two-way ANOVA showed that there was an interaction between the use of the POGIL model and science process skills about physics subjects in heat matter and their movements towards physics concepts acquisition of students. The difference in the mastery of the concept occurs if it is based on the science process skills of students about physics subjects, where students who have high science process skills have higher physics concepts acquisition than students who have low science process skills in physics learning. The results showed that POGIL influences physics concepts acquisition of students (Rustam et al., 2017). The use of the POGIL strategy increased overall student performance on examinations, improved higher-level thinking skills, and provided an interactive class setting (Soltis, Verlinden, Kruger, Carrol, & Trumbo, 2015).

From these findings, two things affect the mastery of physics concepts, namely learning models and science process skills in physics subjects interacting. In harmony, it was stated in a study conducted by Villagonzalo (2014) that the performance of students taught using the POGIL model was better than the performance of students taught using conventionally ones, also in understanding concepts and developing science process skills. POGIL emphasized on learning content and processes relating to understanding and science process skills (Rustam et al., 2017). Activities in POGIL focus on fostering a deep understanding of material and science process skills and developing high-level thinking skills.

Based on some of the above studies, it can be concluded that there is an interaction of POGIL with science process skills about physics subjects in heat matter and their movement towards physics concepts acquisition of students. Where in the POGIL learning model aims to improve the development of science process skills in teamwork, so students can build and understand the concept well (Widyaningsih, Haryono, & Sulistiyo, 2012). Students who have high science process skills have higher physics concept acquisition compared to students who have low science process skills. Increasing the ability of science processes will affect the cognitive abilities of students (Zamista & Kaniawati, 2016).

CONCLUSION

It can be concluded that there are differences in science process skills and mastery of physics concepts of students who learn to use the POGIL and students who learn to use the direct instruction, and there is an interaction between the POGIL model and science process skills towards physics concepts acquisition of students. For further research, it can conduct a study with the oriented guided inquiry learning (POGIL) process model on other variables such as learning achievement.

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