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THE EFFECT OF PROCESS ORIENTED GUIDED INQUIRY LEARNING MODEL ON STUDENT LEARNING OUTCOMES IN CLASS XI MATERIALS

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ABSTRACT

This research was motivated by the difficulties students face in understanding the material on cells. Specifically, 70% of the students' learning outcomes in cell material did not meet the Minimum Completeness Criteria, indicating a need for improvement in the learning process. To address this, innovative learning models were implemented. The study utilized a quasi-experimental design with a pretest and posttest control group design. The research sample was selected using purposive sampling techniques, resulting in two classes: Class XI MIPA 5 (Experimental Class) where the POGIL learning model was applied, and Class XI MIPA 6 (Control Class) where the conventional learning model was used. Data collection involved administering a test consisting of 20 multiple-choice questions. The mean scores for the control class were 37.91 and 67.63. Data analysis was conducted using the Paired Sample t-Test with SPSS Version 21 software. The results of the hypothesis testing revealed that the POGIL learning model had a significant effect on student learning outcomes in cell material for Class XI MIPA SMA N 12 Medan T.P. 2022/2023. The N-gain value for the experimental class was 0.71, falling within the high category, while the control class had an N-gain value of 0.46, categorizing it as medium. This indicates that the POGIL learning model had a greater impact on student learning outcomes in cell material for Class XI MIPA SMA N 12 Medan T.P. 2022/2023.

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INTRODUCTION

The ability of a teacher to manage the learning process has an impact on the success of learning activities, and good learning outcomes reflect students' mastery of the material (Dionisius et al, 2019). Through interviews with biology teachers at SMA N 12 Medan, it is known that the topic of cells is considered challenging for students to understand. Students face difficulties in comprehending cell material due to its abstract nature, the use of complex terms in organ identification, and the intricate sequence of cell organelle mechanisms. This finding is further supported by students' opinions obtained through interviews, where they express that the abundance of cell organelles with distinct tasks and functions contributes to the complexity of understanding cell material. Additionally, student learning outcomes in the cell topic indicate that 70% of students do not meet the Minimum Completeness Criteria. This aligns with the research conducted by Saputra et al (2021), which demonstrates that students often misconstrue biology concepts, particularly in the context of cell material. These challenges arise from the abstract nature of the material, the utilization of intricate terminology, and the requirement for students to grasp concepts ranging from microscopic to macroscopic levels.

Based on observations of biology lessons at SMA N 12 Medan, it is evident that the lecture method is predominantly utilized by teachers. The learning process involves students passively listening to the teacher's explanations, with their attention directed solely towards the teacher. Therefore, it is necessary to take action to address the issue of student learning outcomes in cell material during biology lessons. One approach that can be implemented is the application of an innovative learning model that emphasizes the development of concepts through active learning. The Process Oriented Guided Inquiry Learning (POGIL) model is an example of such a model. Şen et al (2015) define POGIL as a learning model that encourages students to actively express their own ideas. POGIL combines cooperative learning and guided inquiry, enabling students to engage in a learning process that enhances their independent learning skills. By integrating cooperative learning and guided inquiry, POGIL provides opportunities for students to actively participate in group discussions and enhance their understanding (Maulidiawati & Soeprodjo, 2014; Ningsih, et al, 2014).

Previous research on the application of the POGIL model to the excretory system material has shown its positive impact on student learning outcomes, resulting in an increase in learning outcomes in the high category. Based on the aforementioned details, the researcher is motivated to conduct a study on the application of the Process Oriented Guided Inquiry Learning model to Class XI Cell Material at SMA N 12 Medan.

METHOD

The research was conducted at SMA Negeri 12 Medan, located at Jalan Cempaka No. 75, Central Helvetia, Medan Helvetia, Medan, North Sumatra. This study employed a quantitative research design, specifically a quasi-experimental study with a Pretest and Posttest Control Group Design. The research involved two classes: an experimental class and a control class. The experimental class received treatment using the Process Oriented Guided Inquiry Learning (POGIL) learning model, while the control class did not receive any treatment. The population of the study comprised all students in Class XI MIPA at SMA N 12 Medan, academic year 2022/2023, totaling 249 individuals distributed across 7 classes. The sample for this study was selected using purposive sampling technique, resulting in Class XI MIPA 5 being assigned as the experimental class and Class XI MIPA 6 as the control class. Data collection in this study was conducted through tests, and the data analysis employed the Paired Sample t-Test and N-gain analysis techniques.

RESULTS AND DISCUSSION

Students' Pretest and Posttest

The POGIL learning model is used in the experimental class while direct learning is used in the control class. Both the experimental class and the control class underwent a pretest and posttest. The purpose of the pretest is given to determine students' initial abilities, and the purpose of the posttest is to see students' cognitive results as a result of using the POGIL learning model. Pretest value data in the experimental class and in the control class are presented in Table 1.

Table 1. Experiment Class and Control Class PreTest Values

No	Experiment class			Control Class		
	Score	F	$\bar{X}$	Score	F	$\bar{X}$
1	20	2		20	1	
2	25	4		25	4	
3	30	6		30	7	
4	35	5	38,33	35	6	37,91
5	40	5		40	5	
6	45	6		45	7	
7	50	6		50	4	
8	55	1		55	2	
9	60	1		-	-	

Based on Table 1, it is known that none of the students in the experimental class and control class achieved the minimum passing grade in the pretest. The average pretest score for students in the experimental class is 38.33, with a minimum score of 20 and a maximum score of 60. In the control class, the average pretest score for students is 37.91, with a minimum score of 20 and a maximum score of 55. The calculation of the data above shows that the experimental class and control class have the same average pretest scores. The low cognitive learning outcomes of the students may be due to both classes not having previously studied the topic of cells, resulting in a lack of full understanding of the material by the students. The data on the posttest scores for the experimental class and control class are presented in Table 2.

Tabel 2. Nilai *PostTest* Kelas Eksperimen dan Kelas Kontrol

No	Experiment class			Control Class		
	Score	F	$\bar{X}$	Score	F	$\bar{X}$
1	60	1		45	1	
2	65	2		50	1	
3	70	3		55	3	
4	75	3		60	7	
5	80	7	83,05	65	5	67,63
6	85	7		70	9	
7	90	8		75	4	
8	95	2		80	2	
9	100	3		85	4	

Based on Table 2, it is known that the average posttest score in the experimental class is 83.05, with a minimum score of 60 and a maximum score of 100. In the control class, the average posttest score is 67.63, with a minimum score of 45 and a maximum score of 85. Both the experimental class and the control class show an increase in scores. The increase is particularly evident in the experimental class, which received the treatment. The data above indicates a difference in learning outcomes, where the experimental class has higher scores compared to the control class. Based on the data, in the experimental class, 9 students did not meet the passing criteria, while 27 students have met the passing criteria. In the control class, 30 students did not meet the passing criteria, while 6 students have met the minimum criteria.

Achievement of Cell Material Learning Indicators

The achievement of learning indicators in this study can be seen based on the scores obtained for each item of questions. An indicator can be declared achieved if 75% of all specified indicators have been achieved. for data on the achievement of learning indicators can be seen in Table 3.

Table 3. Achievement of Learning Indicators

No.	Indicators	Questions item	Exsperiment class		Control class	
			Achievement	criteria	Achievement	criteria
1.	Describe the chemical components of a cell	10	80, 78%	Baik	70,76%	Baik
2.	Describe the structure and function of the parts of the cell	2,6,11,16, 17,18	86,58%	Sangat Baik	69,34%	Baik
3.	Explain the difference between animal cells and plant cells	1,3,7,8, 12,14, 19	84,25%	Baik	65,72%	Cukup
4.	Explain the mechanism of transport across the membrane	4,5,9,13,15,20	80,45%	Baik	64,78%	Cukup

Based on Table 3, the learning indicator achievement based on the average student learning outcomes in the experimental class and control class can be observed. In the first indicator, which involves explaining the chemical components of cells with a single question, the achievement value in the experimental class is 80.78, indicating good performance, while in the control class, it is 70.76, also indicating good performance. For the indicator related to explaining the structure and function of cell parts, which consists of six questions, the achievement value in the experimental class is 86.58, indicating a very good performance, whereas in the control class, it is 69.34, indicating good performance. In terms of the indicator that focuses on explaining the difference between animal cells and plant cells, with a total of seven questions, the achievement value in the experimental class is 84.25, indicating good performance, while in the control class, it is 65.72, indicating sufficient performance. Lastly, in the indicator that addresses the transport mechanism on the membrane, with a total of six items, the achievement value in the experimental class is 80.45, indicating good performance, while in the control class, it is 64.78, indicating sufficient performance.

Data Analysis Prerequisite Test

The next step after obtaining the data for the pretest and posttest learning outcomes is to conduct data prerequisite tests. The prerequisite tests include testing for normality and homogeneity. The normality test is used to determine whether the research data follows a normal distribution. Using SPSS version 21, the normality of the data is tested using the Kolmogorov-Smirnov test.

The significance values (sig) for the pretest and posttest learning outcomes in the experimental class are 0.126 and 0.112, respectively. The normality test for the pretest data in the experimental class (0.126 > 0.05) and the posttest data in the experimental class (0.112 > 0.05) indicates that the learning outcome data in the experimental class follows a normal distribution. The significance values for the pretest and posttest learning outcomes in the control class are 0.079 and 0.135, respectively. The normality test for the pretest and posttest data in the control class results in 0.076 > 0.05 and 0.135 > 0.05, respectively, indicating that the learning outcome data in the control class also follows a normal distribution.

The homogeneity test is conducted after the normality test. The decision criterion is that if the significance value (sig) > α (0.05), then it is considered homogeneous; conversely, if the significance value (sig) < α (0.05), then it is considered not homogeneous. The results of the homogeneity test show a significant value of 0.923. Since 0.923 > 0.05, it can be concluded that the variances of both the experimental class and the control class are homogeneous.

Hypothesis testing

After testing for normality and homogeneity of the data, hypothesis testing is conducted. The purpose of hypothesis testing is to determine whether the POGIL learning model has an influence on students' learning outcomes. The hypothesis test is conducted using the Paired Sample t-Test with the assistance of SPSS version 21. The hypothesis testing is based on the following rules: if the significance value (sig) > 0.05, then H_0 is accepted and H_a is rejected; conversely, if sig < 0.05, then H_0 is rejected. The criteria for the hypothesis test are as follows:

H_0: There is no influence of the POGIL learning model on students' learning outcomes in the topic of cell biology for grade XI.

H_a: There is an influence of the POGIL learning model on students' learning outcomes in the topic of cell biology for grade XI.

Based on the results of the hypothesis testing, the obtained significance value for the pretest data in both the experimental and control classes is 0.863. Since the significance value of 0.863 > 0.05, the decision is to accept the null

hypothesis (H_0). Therefore, it can be concluded that there is no influence of using the POGIL learning model because there has been no intervention, and the average learning outcomes of the experimental class are not significantly different from the control class at the beginning of the instruction (pretest). Both classes are suitable to be included as research samples.

For the hypothesis testing results of the posttest data in the experimental and control classes, the obtained significance value is 0.000. Since the significance value of 0.000 < 0.05, the decision is to reject the null hypothesis (H0) and accept the alternative hypothesis (Ha). Therefore, it can be concluded that the average final learning outcomes (posttest) of the experimental class are significantly different from the control class after the teaching and learning activities. Based on the statistical calculations and hypothesis testing in this research, it can be concluded that the POGIL learning model has an influence on students' learning outcomes in the topic of cell biology for grade XI at SMA N 12 Medan T.P 2022/2023.

Table 4. Paired Sample t-Test Hypothesis Test Results

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pretest Control - Pretest Experiment	-.417	14.411	2.402	-5.293	4.459	-.173	35	.863
Pair 2 Posttest Control - Posttest Experiment	-15.417	16.621	2.770	-21.040	-9.793	-5.565	35	.000

***Normalized*-Gain (N-Gain)**

Normalized-Gain is useful for knowing the magnitude of the increase in student learning outcomes before and after being given treatment. The results of the N-Gain test can be seen in Table 5.

Tabel 5. N-gain Test Results

Class	PreTest	PostTest	N-Gain	Kriteria
Experiment	38,33	83,05	0,71	High
Control	37,91	67,63	0,46	Moderate

The N-Gain results reveal the distinction between the experimental class and the control class. The experimental class demonstrated an N-Gain result of 0.71, falling within the high category, while the control class exhibited an N-Gain result of 0.46, indicating a medium category. These results indicate a significant improvement in learning outcomes in the high category for the experimental class. The hypothesis testing results confirm that the POGIL learning model has a significant impact on students' learning outcomes in the topic of cell biology for grade XI. The hypothesis testing employed the Paired Sample t-Test method, yielding a significance value (2-tailed) lower than the predetermined significance level ($\alpha = 0.05$). Consequently, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_a) was accepted. In conclusion, it can be stated that the POGIL learning model influences students' learning outcomes in the topic of cell biology for grade XI at SMA N 12 Medan T.P 2022/2023.

The cognitive learning outcomes measured after the instruction showed improvement in both the experimental and control groups. In the pretest phase, students did not have a good understanding of the taught topic, resulting in low scores. After receiving the treatment of the POGIL learning model, measurements were taken in the posttest phase. The scores obtained in the posttest phase showed an improvement compared to the previous phase. Significant improvement in learning outcomes was observed in the experimental group.

The success of this study is reflected in the average posttest scores of the experimental group. The experimental group, which implemented the POGIL learning model, had higher average scores compared to the control group, which used

conventional instruction. Additionally, 27 out of 36 students in the experimental group achieved the minimum passing grade. This indicates that students who received instruction using the POGIL model had better learning outcomes than those who received conventional instruction. This finding aligns with Fitriani (2019) on eighth-grade students, which stated that the POGIL learning model has an influence on students' learning outcomes, resulting in improved learning outcomes in the treated class. Previous research by Maulidiawati & Soeprodjo in SMA N 8 Semarang also showed a cognitive learning mastery level of 90%.

In this study, the improvement in students' learning outcomes was calculated using the N-Gain method. The average N-Gain in the experimental group was 0.71, indicating a high category, while in the control group, it was 0.46, indicating a moderate category. This indicates that the class implementing the POGIL learning model in the topic of cell biology experienced a higher improvement in learning outcomes compared to the class using conventional instruction.

The significant improvement in learning outcomes in the POGIL learning model is attributed to the instructional stages that involve active engagement and collaboration among all students within groups to solve given problems (white & Pocklington, 2017). POGIL encourages students to divide tasks within the group according to their respective roles (Lewis & Lewis, 2014). Students in the experimental group performed their roles effectively while working in groups. The initial phase of instruction involves group formation, where each group consists of a minimum of four individuals with different roles. As stated by Hanson (2006), each group member has a role as a manager, recorder, reflector, and presenter. The manager acts as the group leader actively controlling the group's activities to ensure adherence to roles and perform tasks effectively. The recorder and reflector work together to record information from the teacher and other group members during discussions. The recorder is also responsible for reminding group members to submit tasks within the specified time. The reflector ensures that all group members understand the discussed cell biology concepts. The presenter is responsible for presenting the group's discussion outcomes. The division of roles within the group stimulates students to take responsibility for their respective roles. The teacher also plays a role in emphasizing the tasks associated with each role in the initial phase of instruction. This aims to ensure that each student understands the tasks they need to perform when assuming their roles (Zamista & Kaniawati, 2015).

Once the groups are formed, the teacher guides students in the learning process using Student Worksheets. The instruction begins with orientation, where the teacher presents illustrations that students can observe and analyze. It then proceeds to the exploration phase (data gathering), concept formation, application (practice), and concludes with reporting the results of the previous activities. Through the collaborative learning between guided inquiry and group work, students actively engage in the learning activities (Putri & Gazali, 2021). The POGIL learning model is a guided inquiry approach that helps students discover concepts through activities involving higher-order thinking, metacognition, communication, group work, assessment, management, and skill development to succeed in learning without relying solely on memorization (Margarita et al, 2021).

The difficulty level of students' learning in multiple-choice questions related to the cell biology topic can also be observed based on the learning indicators. The achievement of indicators can be determined if students' answers for each learning indicator obtain a score of at least 75. In this study, both the experimental and control groups used four indicators, namely explaining the chemical components of cells, describing the structure and function of cell parts, explaining the differences between animal and plant cells, and explaining the transport mechanisms across the cell membrane. The experimental group implementing the POGIL learning model achieved all four indicators, while the control group using conventional instruction did not achieve them.

CONCLUSION

Based on the conducted research, it can be concluded that students' learning outcomes in the topic of cell biology for grade XI at SMA N 12 Medan T.P 2022/2023 are influenced by the POGIL learning model. This is supported by the findings of the hypothesis testing, where the significance value (2-tailed) is smaller than the predetermined significance level α (0.05) (0.000 < 0.05). As a result, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted. This indicates that the POGIL model significantly affects students' learning outcomes, as there is a significant difference in the average posttest scores between the experimental and control classes after the instructional intervention.

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