

Effect of inquiry science learning on students' metacognitive skill

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Abstract: This study aims to determine the effect of the inquiry learning model on the metacognitive skills of class XI science students at SMA Negeri 1 Manokwari. This study used a quasi-experimental approach with a non-equivalent control group. This study took samples of two groups, namely the XI MIA 4 group as the experimental group, and the XI MIA 7 group as the control group. Purposive sampling is used in the sample method. The instrument used is a test consisting of 12 questions in the form of a description. The findings show that the average final metacognitive ability of the experimental group is 61.22, while the average of the control group is 46.69. The data analyst used the Mann-Whitney non-parametric test to determine whether there was a difference in metacognitive ability between students using the inquiry model and students using the conventional model. $P = 0.012 < 0.05$ indicates that there are differences in metacognitive skills between students who use the inquiry model and students who use the conventional model.

Keywords: Inquiry learning, metacognitive, biology lesson

Pengaruh pembelajaran inkuiri sains terhadap keterampilan metakognitif siswa

Abstrak: Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran inkuiri terhadap keterampilan metakognitif siswa kelas XI IPA SMA Negeri 1 Manokwari. Penelitian ini menggunakan pendekatan eksperimen semu dengan kelompok kontrol non-ekuivalen. Penelitian ini mengambil sampel dua kelompok yaitu kelompok XI MIA 4 sebagai kelompok eksperimen, dan kelompok XI MIA 7 sebagai kelompok kontrol. Purposive sampling digunakan dalam metode sampel. Instrumen yang digunakan adalah tes yang terdiri dari 12 soal berbentuk uraian. Temuan menunjukkan bahwa rata-rata kemampuan metakognitif akhir kelompok eksperimen adalah 61.22, sedangkan rata-rata kelompok kontrol adalah 46.69. Analisis data menggunakan uji non parametrik Mann Whitney untuk mengetahui apakah ada perbedaan kemampuan metakognitif antara siswa yang menggunakan model inkuiri dan siswa yang menggunakan model konvensional. $P = 0,012 < 0,05$ menunjukkan bahwa terdapat perbedaan keterampilan metakognitif antara siswa yang menggunakan model inkuiri dan siswa yang menggunakan model konvensional.

Kata Kunci: Pembelajaran inkuiri, metakognitif, pelajaran biologi

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INTRODUCTION

One of the skills that need to be empowered is metacognitive skills. Biology lessons that consist of concrete and abstract concepts require metacognitive abilities to help students connect biological concepts and solve problems based on these concepts. Metacognition is a person's awareness of how they learn. It is only good but must be exciting and fun for both the teacher and the students themselves so that their metacognitive skills can develop and become active learners. Metacognition encourages students to respond to the problems at hand, answer and explore information, and do not tend to wait whether the material has been learned (Hogan et al., 2015).

School is one type of formal education that is a place where the learning process occurs between educators and students. The success of students' learning can be seen from their metacognitive skills. Schools need to prepare students as lifelong learners in science; students must be taught to acquire skills and apply those skills to cross task boundaries and then help students create new tasks unfamiliar to them, one of which is metacognitive skills (An & Cao, 2014). Whereas metacognition has a relationship with students' thinking abilities (Nunaki et al., 2019) and helps students understand reading content (Nwosu et al., 2021). Teachers have applied a learning approach to empower their students' metacognitive (Heidbrink & Weinrich, 2021). The process of metacognition applied to cognitive monitoring should be further studied (de Boer et al., 2018). future studies should investigate how to build metacognitive capabilities (Sperling et al., 2012). Individual and group adaptation is aided by the fact that students have a high level of metacognitive skills (Cano et al., 2018; Demirel et al., 2015).

Based on observations, SMA Negeri 1 Manokwari is one of the schools that has implemented the 2013 Curriculum in its learning process. In the 2013 curriculum, metacognitive knowledge standards are used as graduation standards for high school students to improve their thinking skills. Metacognition is a parameter that must be achieved by high school students in the 2013 curriculum because it can support the success of student learning. Learners are suggested to be more active in learning activities in the classroom, so those appropriate learning models are needed to develop their metacognitive skills.

In fact, in SMA Negeri 1 Manokwari, especially in class XI MIA, teachers still do not apply variations in learning models. The learning model that teachers often use is the conventional learning method in the form of ordinary discussions. The learning practices that takes place is the teacher explains the material to be taught and then asks students to form groups, discuss and present the results of their discussions. These activities can result in learning activities being less fun, monotonous; students become bored, hope each other in doing the assigned tasks, and students' metacognitive skills become less developed. Improvement of the learning process in the classroom is very necessary, namely by using various learning models. Effective learning is learning that develops metacognitive (van Velzen, 2016). One of the suitable learning models that encourage learners to be more effective and always curious about the material being taught is the inquiry learning model.

A suitable teaching model to overcome the problems that occur is to apply an inquiry-based learning model. The inquiry has no harmful effect on students (Nasir et al., 2020). Inquiry helps students improve their performance and learning output (Joshi & Lau, 2021) and engage in authentic content (Adler et al., 2018). Inquiry teaching teaches students to

conduct an experiment in which the experiment results are accounted for in a written or oral (Susilawati & Sridana, 2015). Effective learning can develop students' metacognitive skills (Ali et al., 2021; Sari et al., 2021; Schuster et al., 2020). Future research needs to examine metacognition (Yasir et al., 2020). The inquiry learning syntax teaches students to strengthen their metacognition (Miarsyah et al., 2021). Students will not know how to use their metacognitive skills if they are not taught as early as possible (Stanton et al., 2015). By empowering students' metacognition, teachers have helped them to learn and become better (Stanton et al., 2021).

Looking at the problems found by the author and the study of research results by other researchers, it appears that inquiry is a student's metacognitive bolster learning. Student metacognition is vital for students to be successful in their learning. Students can be motivated, perform well, think, and achieve passing standards when their metacognitive are good. The objective of this research was to determine the impact of inquiry learning on the metacognitive abilities of students.

METHOD

This study falls under the category of quasi-experimental research. The study was carried out in class XI MIA SMA Negeri 1 Manokwari. The population is the subject of the study. This study's participants were all science students. The students in class XI MIA SMA Negeri 01 Manokwari are divided into nine classes, with 319 students in class XI MIA. The sample is a subset of the population in terms of size and features. The samples will consist of two classes: class XI MIA 4 (35 students) as the experimental class and class XI MIA 7 (35 students) as the control group.

The instrument used to determine students' metacognitive skills and learning outcomes before and after being given treatment is in the form of a test. The test used in the study was a written test in the form of a description. The instrument for implementing this research was in the form of a Learning Implementation Plan (LIP), Student Worksheet (SW), and description questions as a metacognitive skill test. Analysis of instrument validity for each statement item using the CVR (Content Validity Ratio) equation. The assessment is classified as valid if the CVR was in the range of values from 0.7 to 1. The calculate CVR, the formula is used as follows:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

Source: (Lawshe, 1975)

Information :

n_e = This is the number of validators that give an absolutely necessary value (good or excellent)

N = Number of Validators.

The analysis of the instrument in this study is the validity of the device, which includes the validity of the lesson plan, the validity of the SW, and the validity of the description test questions. The validators in this study consisted of 6 validators, with the validity of which can be seen in Table 1.

Table 1. Validation Results

No	Learning tools	Validity	Criteria
1	Learning Implementation Plan (LIP)	1	Valid
2	Student Worksheet (SW)	1	Valid
3	Test	1	Valid

The results of the validation of the three devices are eligible to be used as research tools. Metacognitive calculations using rubrics are as follows: as a research tool.

$$\frac{(Y1 + 2X)}{3} = Y2$$

Source: (Corebima, 2009)

Information:

- Y1 : Non-rubric assessment (Cognitive Ability)
- X : Assessment of metacognitive skills
- Y2 : Metacognitive skills

The normality test is used to evaluate whether or not the data is normal, which is required to decide the kind of statistics to be used in the following study. The Kolmogorov Smirnov Test with $\alpha = 0.05$ was employed in this research to determine normality. The homogeneity test is designed to demonstrate that two or more sample data groups are from populations with similar variance. The Levene test statistical method was used to calculate homogeneity with the assistance of SPSS 20. In this research, hypothesis testing was used to evaluate if there was a significant difference in metacognitive abilities between students who got the inquiry learning model and those who received the traditional learning model. Mann Whitney was used to test hypotheses in this research.

RESULTS

The study results include data on the results of prior metacognitive and data on the results of increasing metacognitive from the experimental and control class. The data analysis of the research results was carried out using the SPSS 20 program. The learning process was carried out five times in each class. Each class is given a pre-test before the learning process takes place and a post-test after the learning process. The pre-test was tested on students at the beginning of the meeting to determine students' initial metacognitive skills and as a comparison with metacognitive skills after receiving treatment between the experimental and the control class. The description of the data of early metacognitive skills in learning biology material on the coordination system in humans is presented in Table 2.

The descriptive analysis in Table 2 displays the data on the experimental and control groups' first metacognitive abilities. The mean of metacognitive abilities achieved by pupils in the experimental class was 48.09, with the greatest score being 81 and the lowest being 21. The control group has the greatest metacognitive ability score of 59, while the lowest is 21, with a mean of 42.52. Students in the experimental class achieved the greatest value of metacognitive abilities after learning, 95, and the lowest score, 32, with a mean of 61.22. The control group had the maximum metacognitive ability score of 68, while the lowest

score achieved was 11, with a mean of 46.69. The Kolmogorov-Smirnov test in the SPSS 20 software was used to get the normality test.

Table 2. Data on the Results of Metacognitive Skills in the Experiment and Control Class

Description	Experiment		Control	
	Prior	Final	Prior	Final
The highest score	81	95	59	68
Lowest score	21	32	21	11
mean	48.09	61,22	42.52	46,69
median	45.5	64	40	50
Standard Deviation	1.62	1,97	1.09	1,26

Table 3. Results of the Final Metacognitive Skill Normality Test

No	Data	Statistik	df	Sig.	α	Note
1	Experiment	0,098	22	0,200	0,05	Normal
2	control	0,237	23	0,002	0,05	abnormal

The normality test in Table 3 shows a significant value of the initial metacognitive skill data in the experimental class of 0.200, the pre-test data sig > 0.05, which confirms that the experimental class data is normally distributed. In contrast, the control class has a significant value of 0.002 < 0.05, indicating the data is not normally distributed. Because the data was not normal, the homogeneity test was not not executed, and the difference was tested utilizing the Mann-Whitney test.

Table 4. Data of Final Metacognitive Skill Difference Test Results

Data	Sig. (2-tailed)	α	Note
Metacognitive	0,012	0,05	Different

The data in Table 4 is a test using the Mann-Whitney test, which can be seen in the sig column. (2-tailed) obtained a value of 0.012. Because a two-sided test was carried out so that the probability of a significant value became (0.012 < 0.05), it was stated that H_1 was accepted and H_0 was rejected (there are differences in the metacognitive skills of the experimental and non experimental class).

DISCUSSION

Before beginning the learning process, students in the experimental and control groups are given a pre-test to assess their early metacognitive abilities. Based on pre-test data from the experimental and control classes, the average outcomes of the experimental class's first metacognitive abilities were greater than the control class's. The experimental class's average starting metacognitive competence was 48.09 out of 22 students, with the greatest score achieved being 81 and the lowest score being 21. While the average first metacognitive ability in the control class was 42.52 out of 23 students, with the highest score of 59 and the lowest score of 21, the experimental and control groups' starting skills vary descriptively. The low average value of the initial metacognitive skills of the two classes was due to the material being tested had never been taught, so that they answered the

questions according to the student's own experiences. The learning process in the experimental class uses an inquiry learning model, while the control class uses a conventional learning model. The instruction process was carried out for five meetings; after the entire learning process was completed, a post-test was carried out to improve students' metacognitive skills after being given treatment (after the learning process). In the inquiry class with the inquiry learning model, the average value of metacognitive skills was higher than the control class, namely 61.22 out of 22 students, while in the control class, the average value of metacognitive skills was 46.69 out of 23 students. Based on the final metacognitive skill data obtained after the learning process, it is known that there is an increase in the value of the inquiry and control class students' metacognitive skills, where the average final metacognitive skill of the treatment class students is higher than the control class.

A non-parametric test is used to conduct the difference test since the data does not conform to the normal distribution. It was discovered that there was a difference in the final metacognitive skills of students in the experimental class and students in the control class, as determined by the results of the non-parametric test (Mann Whitney) conducted with the assistance of SPSS 20. The significance of the difference was $0.012 < 0.05$. The results are in line with Mu'minin & Azizah (2014) found that students' metacognitive skills can be trained well when an inquiry learning model is applied. This proves that the inquiry science learning has a good impact on the metacognitive of students. Students' metacognitive skills can be trained if they use the inquiry learning model. The inquiry science learning can train students' metacognitive skills because learners are intended to become more engaged during the learning process in this model. Students are asked to work on an inquiry-based Student Worksheet (SW) during the learning, which is used to train students' metacognitive skills. In the inquiry-based SW, students must work together with a group of friends to complete all SW activities, which can prepare students' metacognitive skills. Group discussions make students good learners (Brazeal et al., 2021). In the procedures of discussion activities, learners are faced with a problem, and students are asked to formulate problems, make hypotheses and test hypotheses based on the problems given, and calculate the results of the practicum obtained with existing theories so that learners can better understand the material being taught by using the existing good idea and can build their understanding.

The learning process that is carried out repeatedly in five meetings can result in monitoring learning also occurring repeatedly, which can spur the growth of students' metacognitive skills. In inquiry learning, learners are encouraged to monitor each stage carried out. If the self-monitoring process is carried out repeatedly, it will spur the growth of learners' metacognitive skills. It can cause the application of inquiry to be able to bolster their metacognitive skills. Inquiry learning causes students' metacognitive to increase (Andriyanto et al., 2021). As for the control class, students only hear explanations from the teacher. The mindset or understanding of students towards the material being taught is limited to the teacher's explanation. It can cause students' metacognitive skills to be less developed. Based on the data obtained, the inquiry learning model is known to affect students' metacognitive skills. Moreover, the findings are consistent with the findings of Damopolii et al., (2020) that the inquiry learning model applied to the treatment group affects students' metacognitive skills. Suppose Higher metacognitive skills will improve learning outcomes. Other studies have found that inquiry does not cause metacognitive

differences between male and female students (Nunaki et al., 2019). This research has succeeded in strengthening students' metacognitive skills with inquiry learning.

CONCLUSION

A conclusion may be reached based on the findings of the research, which indicate that inquiry learning has an impact on students' metacognitive abilities. It is also known that students taught using the inquiry learning paradigm have better metacognitive abilities than students taught using the traditional learning model.

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