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THE EFFECT OF ETHNOSCIENCE INTEGRATED PHENOMENON-BASED LEARNING ON STUDENTS' SCIENTIFIC LITERACY ON TEMPERATURE, HEAT AND EXPANSION MATERIAL

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ABSTRACT

This study aims to determine the effect of the implementation of ethnoscience integrated phenomenon-based learning on students' scientific literacy on temperature, heat and expansion material. This type of research is a quasi experiment with two-group pretest-posttest design. The population of this study was all grade VII students of SMP Negeri 18 Medan consisting of 352 students. The research sample was taken by simple random sampling technique consisting of two classes, namely class VII-1 as an experimental class and class VII-5 as a control class, each class consisting of 32 students. The research instrument is a multiple-choice test with four options to measure scientific literacy. Data analysis using independent sample t-test and normalized-gain tests (N-gain). Based on the result of the independent sample t-test, it was found that the sig. value is 0.00 which is less than 0.05. The percentage increase in N-gain in scientific literacy in the experimental class was 74% (high category) and in the control class was 41% (medium category). Based on statistical data, it can be concluded that there is an effect of the application of ethnoscience integrated phenomenon-based learning on students' scientific literacy skill on temperature, heat and expansion material.

Keywords: ethnoscience, phenomenon-based learning, scientific literacy

INTRODUCTION

Science is a way to understand about nature and the world. The essence of science is as a product, process, attitude, and technology. Science as a process is developing skills through discovery activities so that they can behave and act appropriately. The implementation of science is realized in the learning of natural science. Science is essentially a science that studies various natural phenomena that occur while maintaining competencies related to science, namely science as a scientific process ability, science as a scientific product (concepts, understandings, facts, and ideas), and science as a scientific attitude (Budiarso et al., 2020). This shows that science learning needs to be based on phenomena that occur in everyday life.

The process of science either using knowledge or through the process of creating requires a certain understanding in practice referred to as scientific literacy (Snow & Dibner, 2016). According to the Organization for Economic Cooperation and Development (OECD, 2017). Scientific literacy is defined as the ability to engage with science-related issues. Scientific literacy skills enable students to be active in understanding and solving problems related to natural phenomena and everyday life. OECD (2019) defines Scientific literacy as the ability to engage with issues related to science, science ideas, as a reflective citizen. OECD (2019) describes three aspects that characterize the assessment of students' Scientific literacy abilities context, knowledge, and competence. The competencies that must be possessed by someone who is scientifically literate are also described in the OECD (2019), namely being able to explain phenomena scientifically, evaluate and design scientific discoveries, and interpret scientific data and evidence. Research findings by Palines & Cruz (2021) show that students' perceived scientific literacy is affected by factors, especially teacher personality traits, teaching methods, teaching strategies, teaching procedures, classroom management, teaching materials, and learning environments. Through Scientific literacy, students are able to understand the material easily and can apply it directly (Poernomo et al., 2021).

Science learning activities by observing phenomena have the aim of increasing student curiosity and making it easier for students to understand abstract concepts. Observing phenomena before conducting an experiment makes students curious about the problems found and more directed in conducting investigations. Learning by observing phenomena can build students' knowledge, then connect it with initial knowledge so that a complete concept is obtained. This is in line with Naik (2019) which explains that phenomenon-based learning ensures students have a positive learning experience and have the opportunity to gain insights and use them in connection with scientific concepts, theories, and principles in order to solve problems in everyday life.

The reality in the field of education shows that the scientific literacy ability of students in Indonesia is still lace. According to data published by the OECD from the Programme for International Student Assessment (PISA) survey period, Indonesia is usually in the bottom 10. The latest data in 2018 shows Indonesia is ranked 74th out of 79 countries. It showed that the level of scientific literacy in Indonesia is still far below the average.

Based on preliminary studies conducted by the researcher in grade VII of SMP Negeri 18 Medan through observation and interviews, students' scientific literacy and have not been explored optimally. Science learning activities have not raised problems from phenomena in everyday life into natural science learning. The teaching materials used in learning are science package book with Kurikulum Merdeka. Students were only able to answer rote questions and cannot answer questions that require understanding concepts of science. It showed that these questions have begun to lead to scientific literacy, but during observations the researcher saw that students had not been able to solve these problems correctly. The researcher observed that teachers often ask students to give responses in learning, but the answers given by students are only in the form of logic or only reading what is written in the book. Based on these cases, it can be concluded that students' scientific literacy have begun to be explored, but not yet with appropriate indicators and instruments.

Temperature, heat, and expansion material in class VII Junior High School is chosen by the researcher in this study. The material was chosen because it is related to natural phenomena that are also integrated with Indonesian culture, especially North Sumatra. Some cultural phenomena that can be raised are the diversity of traditional houses in North Sumatra with different roofing materials, food preservation techniques with smoking and many other phenomena related to the concept of temperature, heat and expansion. These phenomena will later be packaged by the researcher into natural science learning to improve students' scientific literacy ability. This research aims to aims determine the effect of the implementation of the ethnoscience integrated phenomenon-based learning on students' science literacy on temperature, heat and expansion materials.

PURPOSE

The focus of this research is to determine the effect of the implementation of ethnoscience integrated phenomenon-based learning on students' scientific literacy on temperature, heat and expansion material.

RESEARCH QUESTION

Based on the background of the problems that have been described earlier, the following problems have been formulated that will be solved through this research, namely:

1. How is the effect of ethnoscience integrated phenomenon-based learning on students' scientific literacy on temperature, heat, and expansion material for seven-grade SMP Negeri 18 Medan?
2. How is the increase of students' scientific literacy by implementing ethnoscience integrated phenomenon-based learning on temperature, heat, and expansion material for seven-grade SMP Negeri 18 Medan?

METHOD

This type of research is a quasi experiment with a two-group pretest posttest design. Quasi-experimental is a form of design that involves at least two groups. One group as an experimental group and another group as a control group (Rukminingsih et al., 2020). This research was conducted from February to March 2024 in the even semsester of 2023/2024 program academic year. The population of this study was all grade VII students at SMP Negeri 18 Medan consisting of 352 students. The research samples were taken with a simple random sampling technique consisting of two classes, namely class VII-1 as an experimental class and class VII-5 as a control class. There are three data collection techniques in this research, namely observation, interviews, and test. The instrument used in this research namely scientific literacy multiple choice test consisted of 30 questions. The data analysis techniques used in this study were the independent sample t-test to determine whether there is an effect of ethnoscience integrated phenomenon-based learning on students' science literacy, and the N-gain test to see the increase in students' science literacy ability.

RESULT AND DISCUSSION

Based on the results of research on the science literacy ability of students in kela VII SMP Negeri 18 Medan, with the pretest of 30 multiple-choice questions, it is known that students' science literacy skills are still relatively low. Pretest data on students' science literacy skills are shown in the Table 1. Table 1 show that the average pretest scores of science literacy in both classes are low.

Table 1. Scientific Literacy Initial Ability

Experiment Class		Control Class	
Score Interval	**f**	**Score Interval**	**f**
16-21	4	13-19	3
22-27	7	20-26	8
28-33	6	27-33	11
34-39	8	34-40	8
40-45	6	41-47	1
56-51	1	48-54	1
$\bar{x}$ = 31.0		$\bar{x}$ = 28.8	
SD = 7.7		SD = 8.5	
$\sum n = 64$			

Scientific literacy pretest data normality test using Shapiro-Wilk with the help of SPSS 22.0. Data on the normality test results of the initial science literacy test are shown in Table 2.

Table 2. Scientific Literacy Pretest Normality Test

Instrument	Class	Sig.	Conclusion
Scientific literacy	Experiment	0.125	normal
	Control	0.170	normal

The data is normally distributed if Sig. > 0.05. Table 2. shows the Sig. value in the control and experimental classes is greater than 0.05 so that it can be concluded that the initial test data of science literacy students are normally distributed.

A homogeneity test is performed to find out whether the sample comes from a homogeneous population or not. The homogeneity testing criteria used are if Sig. > 0.05 then the sample comes from a homogeneous population, if Sig. < 0.05 then the sample comes from an inhomogeneous population. The homogeneity test is performed with Lavene 's Test with the help of SPSS 22.0. The results of the homogeneity test are shown in Table 3.

Table 3. Scientific Literacy Pretest Homogeneity Test

Instrument	Levene Statistic	Sig.	Conclusion
Scientific argumenta-tion	0.042	0.839	homogenous

Table 3. indicates the value of Sig. students' initial science literacy ability is greater than 0.05. Based on this it can be concluded that the sample used in this study came from a homogeneous population.

The final scientific literacy ability of the experimental class and control class was measured through posttest administration after the application of the ethnoscience integrated phenomenon-based learning in the experimental class and conventional learning in the control class. Posttest result data in experimental and control classes are presented in the form of frequency distributions as shown in Table 4.

Table 4. Frequency Distribution of Scientific Literacy Posttest Scores

Eksperimental Class		Control Class	
Scores Interval	**f**	**Scores Interval**	**f**
66-71	2	43-50	3
72-77	9	51-58	3
78-83	11	59-66	7
84-89	3	67-74	16
90-95	6	75-82	2
96-100	1	83-90	1
$\bar{x}$ = 82.0		$\bar{x}$ = 65.5	

Based on Table 4, it can be seen that the posttest score of science literacy in experimental classes taught with the ethnoscience integrated phenomenon-based learning is better than the control class taught with conventional learning. The average posttest score obtained showed a significant difference in value changes.

The hypothesis test of the posttest results of science literacy was carried out using the manova test after the final data of students' science literacy was declared normally distributed and had homogeneous variance. The manova test was performed using the help of SPSS 22.0. The hypotheses tested on the posttest results of science literacy and scientific argumentation are: (1) Ha: $\mu1 \neq \mu2$: there is an influence of the ethnoscience integrated phenomenon-based learning on students' science literacy and scientific argumentation; and (2) Ho: $\mu1 = \mu2$: there is no effect of the ethnoscience integrated phenomenon-based learning on students' science literacy and scientific argumentation.

The results of the hypothesis test to see the average similarity of students' science literacy abilities from the experimental class and the control class using the independent sample t-test are presented in Table 5.

Table 5. Independent Sample t-Test

df	Mean Difference	Std. Error Difference	Sig.
62	10.19	2.036	0.000

Table 5 of the independent sample t-test results shows Sig. 0.000 whose value is less than 0.05, meaning that there is a significant effect of ethnoscience integrated phenomenon-based learning implementation on students'scientific literacy.

The percentage increase in students' science literacy with the application of the ethnoscience integrated phenomenon-based learning can be calculated through the N-gain test. The percentage increase in N-gain in science literacy of experimental and control class students is presented in Table 6.

Table 6. Percentage Increase in N-gain in Scientific Literacy

Class	Pre-test	Post-test	N-gain (%)	Category
Experiment	40.52	82.08	74	high
Control	38.75	65.52	41	medium

Based on Table 6. It can be seen that the percentage increase in N-gain in students' science literacy is 74% with the application of ethnoscience integrated phenomenon-based learning which is included in the high category, while the percentage increase in N-gain in science literacy in the control class is

41% which is included in the medium category. The percentage increase in N-gain of each experimental and control class science literacy indicator can be seen in Table 7 and Table 8.

Table 7. Percentage Increase in Scientific Literacy of Experimental Class per Indicator

Indicator of Scientific Literacy	Experiment Class		N-gain (%)	Category
	Pre-test	Post-test		
Explaining phenomena scientifically	15.4	27.3	72	high
Evaluating and designing scientific investigations	7.8	25.4	73	high
Interpreting data and evidence scientifically	11.9	25.2	66	medium

Table 8. Percentage Increase in Scientific Literacy of Control Class per Indicator

Indicator of Scientific Literacy	Control Class		N-gain (%)	Category
	Pre-test	Post-test		
Explaining phenomena scientifically	14.7	21.9	42	medium
Evaluating and designing scientific investigations	9.0	19.2	44	medium
Interpreting data and evidence scientifically	10.8	19.3	40	medium

The average score of science literacy per indicator in the experimental class with the application of the ethnoscience integrated phenomenon-based learning was higher than the increase in science literacy per indicator of the control class taught with conventional learning. The highest percentage increase in N-gain occurred in the indicator of scientific lliteration, namely evaluating and designing scientific investigations, which was 73% (high) in the experimental class and 44% (medium) in the control class. While the lowest percentage increase in N-gain occurs in indicators of science literacy, namely interpreting data and evidence scientifically. This is in line with the results of Santoso et al.'s (2023) research that by applying contextual phenomenon-based learning shows effective results to improve students' science literacy.

The application of the ethnoscience integrated phenomenon-based is adopted from problem-based learning (PBL) with stages, namely orienting students to ethnoscience phenomena, organizing students to learn, guiding individual and group investigations, developing and presenting works, and analyzing and evaluating phenomena descriptively (Saudah et al., 2019). So, in this study each stage in learning focuses on scientific phenomena that are integrated with ethnoscience to improve students' scientific literacy and argumentation skills.

This study examines Temperature, Heat, and Expansion material. The first meeting studied the topic of Temperature and its Measurement. The first phase of learning with the ethnoscience integrated phenomenon-based learning researchers presented a phenomenon in the form of temperature differences in traditional houses with the same shape and area but with different roof materials. The first house uses a ijuk roof while the second house uses a tin roof. The temperature of the two houses turned out to be different after being measured using a temperature measuring instrument. This phase of students' science literacy skills can be explored in the form of explaining phenomena scientifically such as identifying and predicting things that cause temperature differences in the two traditional houses.

In the second phase, researchers organize students to learn by dividing students into six heterogeneous groups in order to create cooperation, communication, and collaboration in groups to answer problems raised from ethnoscience integrated scientific phenomena. Researchers also directed students to sit together with their group mates conducively. Researchers distribute students' worksheets to be discussed and worked on in groups through experiments. Students in this phase have the opportunity to collect as much information as possible to practice their science literacy skills such as exploring the questions asked in the students' worksheet and how to solve them.

In the third phase, researchers guide investigations both individually and in groups. The investigation conducted by students conducted experiments in the form of measuring temperatures in miniature traditional houses using digital thermometers. This phase of science literacy skills that are explored in the form of students can present the data obtained in the form of tables and interpret them.

The fourth phase is that students are given time to develop and present the results of work in the form of problem solving raised from the integrated phenomenon of ethnoscience as presented in the first phase. The work that has been done is then ready to be presented in front of the class.

The fifth phase is that students together with researchers analyze and evaluate the integrated phenomenon of ethnoscience descriptively. Students in this phase are also explored science literacy skills, namely interpreting data and evidence scientifically such as analyzing learning at the first meeting and drawing conclusions.

Based on the description above, it is known that the students' scientific literacy skill was increasingly improved at each meeting. Every meeting with the implementation of the ethnoscience integrated phenomenon-based learning is sought to explore and train every indicator of scientific literacy so that in the end all indicators were achieved. Based on the results of research and data analysis, it can be concluded that there is an effect of the ethnoscience integrated phenomenon-based learning on students' scientific literacy on temperature, heat and expansion material of class VII SMP Negeri 18 Medan. The results of this study are also supported by Santoso et al. (2023) that contextual phenomenon-based learning gets a positive response because this learning relates problems from phenomena in everyday life using simple investigations. The results of his research explained that based on the implementation of learning, student activities, student literacy tests, and student responses to Physics learning by applying contextual phenomenon-based learning showed effective results to improve students' scientific literacy.

Based on the data obtained, the increase in N-gain of students' scientific literacy in the experimental class was higher than in the control class. This is in line with the results of research by Sholahuddin et al. (2021) which states that students in experimental class taught with PBL and ethnoscience-integrated PjBL experience a higher increase in scientific literacy skill than control class. The scientific literacy skill of both classes increases, so it is necessary to explore more about ethnoscience elements to improve students' scientific literacy.

The percentage increase in N-gain of each indicator of scientific literacy also increased. Students' scientific literacy on indicators of explaining phenomena scientifically in experimental classes is 72% (high). The second indicator of scientific literacy, namely evaluating and designing investigations scientifically, obtained experimental class N-gain of 73% (medium). This increase is in line with the large number of these two indicators appearing and explored in the learning phase of each meeting during the learning of temperature, heat, and expansion material. The third indicator of scientific literacy is interpreting data and evidence scientifically obtained N-gain, which is 66% (moderate). Unlike the other two indicators, for the third indicator this is smaller in increase because it appears less frequently in the learning phases at each meeting.

CONCLUSION

Based on the results of the research and discussion on the effect of the ethnoscience integrated phenomenon-based learning on students's scientific literacy on temperature, heat and thermal expansion, the following conclusions can be drawn: (1) The results showed that the application of ethnoscience integrated phenomenon-based learning significantly affected students' science literacy on temperature, heat and expansion material in grade VII of SMP Negeri 18 Medan in 2023/2024 academic year, and (2) there was an increase in science literacy skills after applying the Ethnoscience Integrated Phenomenon-Based Learning Model in experimental classes where science literacy scores were in the high category.

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