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FOSTER STUDENT'S SCIENCE LITERACY SKILLS ON ENVIRONMENTAL POLLUTION TOPICS THROUGH THE ETNOSCIENCE APPROACH

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Abstract: This study aims to describe the improvement of students' science literacy on environmental pollution topics using an ethnoscience approach. The type of research is pre-experimental with a pretest-posttest one-group design. This research was conducted on students of class VII-B of State junior high school (SMP Negeri 49 Surabaya, Indonesia) in the 2021/2022 school year. Research instruments used are pretest-posttest sheets and response questionnaires. Data collection techniques used in this study include tests and questionnaires. The data analysis techniques used are normality tests, t-paired tests, and N-Gain tests. The results showed that students' science literacy increased significantly after applying ethnoscience-based learning to environmental pollution topics. The t-pair test obtained a p-value = 0.000 < 0.05, which significantly differed between post-test and pretest scores. N-Gain also gained an average of 0.73, which shows an increase in the science literacy ability of students with high categories. The results of student responses to learning with an ethnoscience approach to practicing student science literacy fall into the category of excellent, with an overall percentage of 97.5%. This study concludes that students' science literacy has improved after learning an ethnoscience approach to environmental pollution topics.

Keywords: *Science Literacy, Ethnoscience, Environmental Pollution*

INTRODUCTION

Science has an important position in accommodating the development of science and technology. Science has three aspects: processes, products, attitudes, and technology. Science is the skill of experimenting using the scientific method with a discussion of natural phenomena that arise from the ideas and research of scientists [1]. Quality human resources can be prepared through science education to take the era of industrialization and globalization because science education has excellent capabilities and a strategic role in the development of the times. In the 21st-century, science has developed rapidly, which requires students as a young generation to have creativity, critical thinking skills, and independence in every challenge faced so that students will have high productivity. In the face of 21st-century obstacles, one of the keys to success is "science literacy" because science-literate individuals will be interested in mandating scientific data as a material to overcome anxiety in life and create profitable scientific products [2].

Science literacy or science literacy includes an understanding of how knowledge can change the way individuals interact with the world, where through this way, broader goals can be achieved [3]. The definition of science literacy is the ability to utilize science knowledge, recognize problems, make conclusions based on facts, and understand and give birth to provisions regarding nature and the transformation that takes place in nature as an impact on human life. Science literacy has a multidimensional nature when paying attention to its definition. Science literacy is not only focused on understanding science education [4]. A person who is "literate in science" means a person who can make wise decisions to interact with his environment and understand the correlation of society with science and technology and success in the social and economic fields. It is generated using scientific concepts, process capabilities, and values in their functions. But to realize these skills is certainly not easy. It can be seen at the level of student science literacy in Indonesia which still needs improvement.

The OECD released a 2018 PISA study that found that Indonesian students' ability to science literacy scored an average of 389 from the OECD average score of 489 [5]. In 2018, PISA said Indonesia was ranked 70th out of 78 countries in science literacy skills [6]. The last measurement of science literacy was carried out in 2018, as shown by the results of the 2018 PISA study that a score of 389 was the acquisition of science literacy scores of Indonesian students. The score shows the science literacy of Indonesian students in the low category while still below the OECD average score. Looking at the current condition of students who need to be improved in science literacy, there needs to be a proper effort to overcome the low level of student science literacy. Based on this statement, efforts to develop student science literacy can be fulfilled through efforts to implement ethnoscience learning in the teaching and learning process. Contextual learning can train students' science literacy to support students in connecting science concepts to life problems and motivate them to develop the knowledge obtained [7]. The current paradigm of science education is ethnoscience-based science learning, one of the efforts to improve student science literacy [8].

Learning with an ethnoscience approach prioritizes realizing systematic knowledge rather than mere deep knowledge. Students confront the topic studied with the context of their activities and the relationship to science and technology. Therefore learning is not only informative but also practical and useful for life. Science learning becomes one of the dimensions in the study of science designed to produce a link between technology and social science. Some characteristics of the application of ethnoscience are presenting cultural topics related to science, reconstruction of knowledge that develops in society, namely local science into scientific science, building mastery of concepts, and utilizing scientific approaches for the exploration of knowledge and skills [9]. Thus the application of ethnoscience learning becomes one of the efforts to develop student science literacy.

The realm of ethnoscience research on science learning has been widely carried out based on Javanese culture, research focus, content, and scientific context [8]. Ethnoscience is the activity of transforming original science with scientific science. Original science means all knowledge of people's lives is reflected in local wisdom [10]. So that the application of ethnoscience learning makes students more sensitive to everyday problems, and students are encouraged to find solutions to these problems. Arifatun's research supports that through ethnoscience learning, students can appreciate culture more and utilize science according to technology to improve their ability to use scientific knowledge to solve various problems [11]. Therefore, efforts to improve student science literacy are carried out by applying ethnoscience learning in the teaching and learning process at SMP Negeri 49 Surabaya using environmental pollution topics closely related to students' environmental conditions. Innovative teaching topics will create active learning activities and can build their knowledge through involvement in ethnoscience learning.

Based on the interview results of one of the science teachers of stated junior high school (Negeri 49 Surabaya), the learning has not utilized teaching topics that support students' activeness. Also, in accommodating students' science literacy skills. Therefore, it is necessary to apply ethnoscience to foster student science literacy in student worksheets and task sheets for students. Student worksheets can train students in science literacy because the teaching topics can encourage students to be more active in obtaining their concepts and knowledge. Therefore, we focus on training students' science literacy skills through an ethnoscience approach to environmental pollution topics.

RESEARCH METHODS

The study was conducted using a pre-experimental study with one group pretest-posttest design. The design of the study can generally be seen in Figure 1.

$$O_1 \longrightarrow X \longrightarrow O_2$$

Figure 1. Pattern One Group Pretest-Posttest Design [12]

Information: O_1: Pretest before treatment; X: The treatment given is the learning of pollution topics in an environment with an ethnoscience approach; O_2: Posttest after treatment

The research was held in the even semester of the 2021/2022 school year. The subject used is students of class VII-B SMP Negeri 49 Surabaya with 20 children. In simple experiments with strict control, the research success can be achieved using a sample of 10-20 students. Probability sampling is not always necessary in educational research, especially experimental research. It may not be possible to select subjects from a larger population. Thus, researchers usually use available sampling (availability sampling); we utilize available subjects, such as a group of students in a certain class [13]. Research instruments were used in the form of pretest-posttest sheets and response questionnaires. Multiple-choice pretest-posttest sheets total ten questions that refer to science literacy indicators to measure students' science literacy. The response questionnaire consists of 6 statements using a score of 1 if agreed (Yes) and a score of 0 if it disagrees (No) to find out students' responses about how the results of applying the ethnoscience approach in learning. Tests and questionnaires are data collection techniques used in this study.

Data analysis techniques used to analyze pretest-posttest results are normality tests, t-pair tests, and N-Gain tests. Testing is done using the SPSS application. This normality test is imposed to determine whether or not the distribution of data is normal. If the Sig value > 0.05, then Ho is acceptable, which means the data is distributed normally. If the Sig value < 0.05, then Ho is rejected, which means the data is not distributed normally [12]. Then the N-Gain test is performed to review the increase in pretest and posttest results. The following formula can be used to calculate N-Gain.

$$\text{N- Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}} \text{ x } 100\%$$

[14]

After obtaining the N-Gain score, the upgrade category can be known through the defining process in the following table 1.

The response questionnaire is calculated using the following equations:

$$\text{Percentage} = \frac{\text{Number of values obtained}}{\text{Maximum value}} \text{ x } 100\%$$

Table 2 defines the percentage of respondents who have been calculated through the

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equation towards learning with an ethnoscience approach to environmental pollution topics.

Table 1. N-gain Score Criteria

Normalized Gain Value	Interpretation
0.70 ≤ N-Gain ≤ 1.00	High
0.30 ≤ N-Gain < 0.70	Moderate
0.00 < N-Gain < 0.30	Low
N-Gain = 0.00	No increase
-1.00 ≤ N-Gain<0.00	There was a decrease

[14]

Table 2. Percentage Criteria for Student Response Enforceability [15]

Enforceability (%)	Category
0 – 20	Very less
21 – 40	Less
41 – 60	Enough
61 – 80	Good
81 – 100	Very Good

RESULTS AND DISCUSSIONS

The implementation of the research was carried out during two meetings in person in the classroom using environmental pollution topics. The learning model used is problem-based learning, where the learning step consists of five phases. The first phase is the orientation of students on problems. The second phase is organizing students to learn, and the third phase is that teachers guide individual and group investigations. The fourth phase is students developing and presenting the results of their work. The fifth phase is when teachers and students analyze and evaluate the problem-solving process. Here is an image of the implementation of learning that has been done.

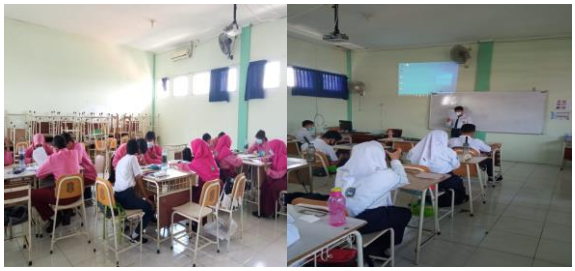

Figure 2. Learning Implementation Process

The research conducted resulted in an N-Gain pretest and posttest of student science literacy and responses from students after learning using an ethnoscience approach. The process of processing data from research results is carried out through several stages. Research data in the form of pretest and posttest values will be conducted on normality tests, t-paired tests, and N-Gain. The following table can be considered the results of the N-Gain description that has been obtained, which aims to see the significance of improving student science literacy.

Table 3. Of Each Student's N-Gain Results

No	Value		N-Gain	Category
	Pretest	Posttest		
1	50	90	0.80	High
2	20	70	0.63	Medium
3	40	80	0.67	Medium
4	40	80	0.67	Medium
5	80	100	1.00	High
6	40	90	0.83	High
7	20	60	0.50	Medium
8	30	90	0.86	High
9	10	90	0.89	High
10	40	70	0.50	Medium
11	30	80	0.71	High
12	50	90	0.80	High
13	50	100	1.00	High
14	40	80	0.67	Medium
15	30	100	1.00	High
16	30	70	0.57	Medium
17	10	80	0.78	High
18	30	60	0.43	Medium
19	10	70	0.67	Medium
20	30	70	0.57	Medium
Average	34	81	0.72	High

Table 3 depicts the results of pretests and posttests of science literacy and N-Gain for each student. A good improvement was seen in the results presented for pretest and posttest science literacy. Students' initial abilities can be known through pretest results. After learning activities with an ethnoscience approach about environmental pollution topics, students' abilities can be known through posttest results. The average student gets an N-Gain result with a high category of 0.72. The N-Gain results prove that with the application of learning using an ethnoscience approach, there is an increase in the science literacy ability of students with high categories. Pretest and posttest results showed that each student had differences in improving science literacy. Student science literacy increased with a high category of 10 students, and student science literacy increased by a medium category of 10 students. The students tested had different N-Gain scores, indicating that each student's ability to absorb information differed. The variation in the proficiency of the science process of each student is caused by the mastery of students in absorbing different information [16]. Furthermore, N-Gain is also carried out on each indicator of science literacy in table 4.

Table 4 shows that N-Gain results of each aspect of the science literacy indicator obtained an average of 0.72, which belongs to the high category. Learning with an ethnoscience approach shows a good improvement in every aspect of science literacy indicators. The indicator identifies scientific issues with the highest N-Gain result of 0.83, which belongs to the high category. Then the indicator explaining scientific phenomena, making predictions, and drawing conclusions based on scientific evidence belongs to the medium category with N-Gain results of 0.63 and 0.67, respectively. It shows the ability to identify scientific issues that students have improved. It means that students can identify issues scientifically well because, in these indicators, students are trained to connect the knowledge gained from learning with phenomena or cultures contained in their surrounding environment. Applying ethnoscience in learning activities, namely integrating local culture into learning, can support students to learn topics that are, in essence, closely students and studied scientifically so that the learning process is more optimal [10]. On indicators explaining scientific phenomena, making predictions, and drawing conclusions based on scientific evidence also included a good increase even though it belongs to the medium category. T the average student in Indonesia is still in the stage of understanding basic science. The average science ability of Indonesian students is still in the phase of identifying basic facts and has not been able to communicate and connect various science topics [17].

This research shows that students' science literacy increases after learning by applying student worksheets with an ethnoscience approach. Culturally integrated science education can encourage students to build a relationship between the facts around them and their knowledge. Students' science literacy abilities have improved. Student worksheet applied based on ethnoscience utilizes traditions still maintained in the student environment. It concluded that the existence of sacred trees that indirectly an effort to maintain water quality and reduce the impact of water pollution. Learning about environmental pollution topics based on ethnoscience-based learning characteristics can train students' science literacy. These characteristics include presenting cultural themes related to science, reconstructing science, and utilizing scientific approaches when exploring concepts. The condition of students who are accustomed to living hand in hand with culture, it is hoped that implementing various activities containing ethnoscience elements will make it easier for students to understand science. As stated by Holbrook, when explored logically in student thinking and related to the surrounding environment and its interests, science will be easily explored [18].

The student's learning environment needs to be considered to improve students' science literacy. As with the implementation of ethnoscience-based learning, the teaching topics used are obtained from sources that support life and original topics and have cultural values aligned with the learning experience. The application of learning in the socio-cultural environment of students is essential to do, considering the lack of concern for the socio-cultural environment as a source of learning that causes the low quality of science literacy and education in Indonesia [19]. The application of science learning topics should take advantage of the culture that develops in the community [20].

Table 4. N-Gain Results for each Aspect of Science Literacy Indicator

Science Literacy Indicator	Value		N-Gain	Category
	Pretest	Posttest		
Explaining Scientific Phenomena	190	450	0.63	Medium
Identifying Scientific Issues	180	530	0.83	High
Making Predictions and Conclusions Based on Scientific Evidence	310	640	0.67	Medium
Average N-Gain			0.72	High

Furthermore, to find out whether the data of the research results are distributed normally or not, it is necessary to test normality. Normally distributed data can be called representative of the population and can be done t-paired tests. Here are the results of the normality test that has been obtained.

Table 5 Normality Test Results

Science Literacy Test	Shapiro-Wilk	
	f	Sig.
Pretest	20	.066
Posttest	20	.110

Information: df: Number of students; ; Sig.: Significance value.

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Table 5 shows normality test results in the Sig column. The significance value was obtained on the pretest of 0.066 > 0.05 and on the posttest 0.110 > 0.05. The resulting significance value indicates that the data is distributed normally. It is studied from the significant value generated through the Shapiro-Wilk normality test, an efficient and valid normality test used for a small sample number. Using the Shapiro-Wilk method, if obtained a significance value of > 0.05, it means that the data can be called the normal distribution.

After the data is known to be a normal distribution, then pretest and posttest analyses are done using a paired t-test with the aim that the difference between the student's pretest and posttest results can be known. The results of the paired t-test are shown in Table 6.

Table 6 t-Paired Test Results

	Paired Samples Test Paired Differences			
	Mean	t	f	Sig. (2-tailed)
Pretest - Posttest	-47.000	-14.104	9	0.000

Table 6 shows t-pair test results in the Sig column. (2-tailed) indicates that p-value = 0.000 means p-value < 0.05. It indicates the value is significant or H0 is rejected. The t-pair test uses the p-value value to determine whether the pretest and posttest data are significant or not. H0 is rejected if the p-value < the significance level and H0 is accepted if the p-value > the significance level, with the significance being $\alpha = 0.05$. It proves a significant difference after learning with an ethnoscience approach to environmental pollution topics in the pretest and posttest scores of students.

Furthermore, finding students' responses to learning with an ethnoscience approach that can train students in science literacy is done through student response questionnaires. The results of questionnaires for student responses containing six statements are presented in Table 7.

Table 7 Response Questionnaire Results

Statement Number	Percentage (%)	Category
Statement 1	100	Very good
Statement 2	100	Very good
Statement 3	100	Very good
Statement 4	95	Very good
Statement 5	90	Very good
Statement 6	100	Very good
Overall percentage (%)	97.5	Very good

Table 7 shows that the implementation of ethnoscience-based learning obtained an overall percentage of 97.5%, which means that the criteria for the percentage of student responses belong to the very good category, namely 81% - 100%. It proves that almost all students answered "Yes," which means agreeing on positive statements related to learning with an ethnoscience approach to environmental pollution topics. Statement 1, 2, 3, and 6 obtained a percentage of student response of 100%. It belongs to the category of very good, which shows all students agree that science learning using an ethnoscience approach to environmental pollution topics is interesting and fun. The learning is also carried out systematically and clearly and makes it easier for students to learn environmental pollution topics and provide new knowledge.

Statement 4 and 5 obtained 95% and 90% of student responses. It falls into the category of very good, which shows almost all students agree that with an ethnoscience approach, students can apply environmental pollution topics in everyday life and help solve environmental problems. The activities are reading illustrations of phenomena in the surrounding environment and theories in teaching topics, including the application of teaching topics that contain activities about science concepts in daily human life, which aims as a form of science literacy training for students to identify problems scientifically [21]. Ethnoscience-based learning can stimulate students to respond to environmental developments and problems, especially those related to natural phenomena, local advantages, and problems in the surrounding environment [2]. Therefore, the purpose of practicing science literacy skills can be realized. It is proven that almost all students agree that the application of ethnoscience approaches to the learning of environmental pollution topics can train students to solve problems in their social environment. Holbrook revealed in his journal The Meaning of Scientific Literacy that science literacy means an appreciation of science by increasing the components of learning within oneself to contribute to the social environment [22].

The results showed a good improvement in students' science literacy skills after applying ethnoscience-based learning using the Problem Based Learning learning model. Problem-based learning is a learning method that puts students at the center of learning through unstructured problem solving [23]. Problem-based learning helps construct knowledge as students activate prior knowledge in initial discussions [24]. Problem-based learning steps are to orient students to problems, organize students to learn, guide individual and group investigations, develop and present work, and analyze and evaluate the solving process. The application of the problem-based learning model can improve students' science

literacy. Problem-based learning is a constructivist-based learning model that can help students mature their abilities. In addition, it can also be used to stimulate students' interest in global and surrounding issues [25]. The problem-based learning model can train and help students' science literacy skills [26]. The implementation of the problem based learning learning model can significantly improve science literacy skills [27-29].

CONCLUSION

Students' science literacy in-state junior high school (SMP Negeri 49 Surabaya) using ethnoscience-based learning on environmental pollution has increased significantly. In the normality test obtained significance values at pretest 0.066 > 0.05 and on posttest 0.110 > 0.05 indicating normal distribution data. In the t-pair test, it was found that p-value = 0.000 < 0.05 means that the test is significant or H0 is rejected. It explains the significant difference between posttest and pretest results. Furthermore, the N-Gain analysis showed that after applying learning with an ethnoscience approach, students' science literacy increased with a high category, namely an average N-Gain of 0.73. As for the results of student response to learning with an ethnoscience approach in practicing student science literacy, an overall percentage of 97.5% is classified as an excellent category.

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