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IMPLEMENTATION OF PROJECT-BASED LEARNING MODELS TO IMPROVE SCIENCE LITERACY OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract: This study aims to provide an overview of students' scientific literacy effectiveness through project-based learning (PjBL). The type of research used is pre-experimental design research through one group pretest-postest design. The subjects in this study were 22 students of class VII A in junior high school SMP Negeri 3 Sumberejo, Bojonegoro, in the 2022/2023 academic year. The data collection techniques used were tests and questionnaires. Research instruments are science literacy tests and student response questionnaire sheets. The results were analyzed using the N-Gain and t-paired tests with effect size. The implementation observation sheet and the response questionnaire were analyzed descriptively and quantitatively. The results showed that the science literacy ability of grade VII A students of SMP Negeri 3 Sumberejo increased from an average pretest score of 30.6 to 38,03 at the post-test. Students' science literacy ability is in a low category with an average N-Gain of 0.10 with an effect size of 0.63 in the moderate category. Improving students' science literacy skills is also supported by implementing learning that is carried out correctly. The application of project-based learning received a positive response from students. Students find learning using project-based learning environmental pollution material fun, attractive, and easy to understand and use, helping to understand the concept of environmental pollution and practicing science literacy. The implication of this study's results is that students should practice many scientific literacy questions referred to as indicators of scientific literacy competency.

Keywords: *Science literacy, Project-based Learning, Environmental Pollution.*

INTRODUCTION

Science literacy is connecting science with existing issues using scientific ideas. PISA also defines science literacy as the ability to scientifically explain phenomena, investigate and evaluate science, and interpret data and evidence scientifically [1]. PISA states that the assessment of science literacy is divided into three aspects, namely (a) aspects of content or scientific knowledge; (b) aspects of the process; (c) context aspects [2]. Scientific literacy skills are indispensable for the digital era because societal problems related to science and technology can be solved using existing scientific concepts [3].

Scientific literacy will help students learn and adapt to modern society that already uses science and technology. Scientific literacy can also be used to solve global problems such as environmental, health, and economic problems [4]. Dani stated that scientific literacy needs to be owned by every individual; with scientific literacy, every individual can solve problems related to knowledge and technology due to the development of the times [5]. The same thing was conveyed by Pratiwi, who stated that scientific literacy is important for students because scientific knowledge offers the fulfillment of individual needs and happiness. Scientific literacy is also used as a solution to problems in life that require scientific information [6].

Although scientific literacy is important, scientific literacy skills in Indonesia are still low. This is obtained from the achievement of the Program for International Student Assessment (PISA) scores in 2018. Indonesia is ranked 5th from the bottom; in other words, Indonesia is ranked 74th out of 79 countries with a science score of 396 points [7]. The low scientific literacy is caused by learning science in junior high school using verbal language and not emphasizing practice so that students understand science concepts only by rote [8]. Students' ability to read still needs to improve. It is caused by a need for more access, especially in isolated areas [9]. The results of observations in the form of interviews with science subject teachers for class VII, which were conducted at SMPN 3 Sumberejo, Sumberjo District, Bojonegoro Regency, were conducted on August 11, 2022, related to low scientific literacy at SMP Negeri 3 Sumberejo are as follows: 1) Mastery of students' scientific literacy low category, this is evidenced from the results of interviews with science subject teachers regarding students' understanding of the three main competencies according to PISA, namely: 1. Aspects of identifying scientific issues (problems): students cannot yet recognize scientific objects when given problems students can only answer as much as possible knowing the keywords of the problems given; 2. Aspects of explaining scientific phenomena: students have yet to apply scientific knowledge to a given condition or problem, so they cannot apply scientific theories they have learned at school; 3. Aspect using scientific evidence:

students have not been able to interpret the results of scientific findings that have been studied, so participants are less able to conclude the scientific evidence and problems provided. In other words, students have not been able to provide arguments or describe the consequences of a finding. 2). teachers still dominate learning, and learning is dominated by students who excel. During the learning process, students who excel are always active and dominate in learning, while students with less ability will follow the opinions of those who excel. The science subject teacher for class VII conveyed this. 3) Collaboration between students needs to be improved. Teachers often assign them individually, and students always choose their groups. It is caused by the distance between students' homes being far from each other. Another fact was also found at SMPN 3 Sumberejo that one of the class VII students still had difficulty reading.

One solution to increase scientific literacy is by implementing Project Based Learning. Implementing STEM-integrated PjBL increases scientific literacy in the material of organizational life systems [10]. Implementing project-based energy teaching materials increases students' scientific literacy skills [11]. In line with research conducted by Rizkamariana, Literacy skills in the PjBL class had increased in all aspects nor aspects of skills [12]. Project-based learning is a learning model that actively involves students in solving problems through scientific stages, either carried out independently or in groups embodied in a product within a certain time limit [13]. Project Based Learning is based on constructivist learning theory, where students are trained to find new ideas to realize certain products [14]. The essence of constructivist theory is that students must find and translate complex information into other situations. It requires a thought process for students to find these ideas [15]. The syntax of project-based learning is: (1) start with the essential question, (2) design the project, (3) create a schedule, (4) monitor the students and the progress of the project, (5) Assess the outcome, (6) evaluation of the experience [16]. The application of PjBL is student-centered by emphasizing practice and real-world issues [17].

Issues that are rife today are environmental pollution, especially water pollution. The theme of pollution itself is part of KD 3.8 Analyzing the occurrence of environmental pollution and its impact on ecosystems for class VII Semester 2 junior high school. Water pollution is when substances, living things, and other components enter the water, which causes the quality of the water to decrease. The quality of the water decreases, causing the water not to function according to its designation [18]. One example of water pollution occurred in the village of Kayulemah, Sumberejo District, Bojonegoro Regency, where there is a tofu factory. Processing of tofu will have residue or commonly called waste, tofu waste in the form of liquid and solid. Until now, tofu waste in the village is only used as an animal feed with a relatively low selling value. Therefore, it is necessary to have further handling to process the waste so that it has a higher selling value.

Based on this description, researchers will conduct research with learning methods that can improve scientific literacy. The problem statement in this study is "How is the effectiveness of implementing project-based learning on the scientific literacy of junior high school students ."The purpose of this study is to provide an overview of the effectiveness of the PjBL learning model on the scientific literacy of junior high school students. The results of this study are expected to contribute to improving the quality of science learning and to obtain a PjBL model to improve the scientific literacy of tested students.

RESEARCH METHODS

The type of research used was quasi-experimental. Pre-Experiment Design or quasi-experimental, namely research carried out without a control class and comparison class [19]. The research design used was one group pretest-posttest. Research Design One group Pretest-Postest was measured by giving a pretest before the treatment was carried out, and giving a Post-test was given after the treatment.

O_1 ---------- X ---------- O_2

Information :
O_1: Pretest (before treatment)
X: Treatment
O_2: Post-test (after treatment)

The population in this study was the entire group of class VII A students at SMPN 3 Sumberejo, Kayulemah Village, Sumberejo District, Bojonegoro Regency for the 2022/2023 academic year with a total of 22 students consisting of 8 female students and 14 male students. Taking the subject of this research uses purposive sampling. Purposive sampling is a non-random sampling technique because the selected objects and subjects are based on certain considerations [2].

The data collection used in this study was using a knowledge test in the form of multiple choice questions given before and after the project-based learning model was applied made by Fatmawati and Utari, which has been validated by four expert validators and has been field tested with reliable instrument results with r = 0.48 which is included in the medium category [21]. Student

response questionnaires to the application of the project-based learning model. Student response questionnaires are given after the learning is carried out. The student response questionnaire was presented in the form of description questions related to learning using a project-based learning model.

The data obtained will be tested with a normality test. The normality test used is the Shapiro-Wilk Normality Test because the sample is less than 50 paired t-tests. The data are analyzed descriptively and quantitatively. Analysis of students' outcomes pretest and post-test data using N-gain. The gain test is the difference between the post-test and pretest values [22]. The data obtained also will be calculated by the value of the effect size. The questionnaire of student responses to learning with project-based learning to improve students is analyzed descriptively and qualitatively because the instrument is in the form of a description question.

RESULTS AND DISCUSSION

This research was conducted in 2 face-to-face meetings, at the first meeting (2 x 40 minutes) and the second meeting (3 x 40 minutes), by implementing project-based learning to increase scientific literacy. The material used in this study was environmental pollution K.D 3.8 and 4.8 class VII at SMP Negeri 3 Sumberejo, which was held in November 2022. The data obtained during the research were in the form of students' scientific literacy test results and students' responses to learning.

Scientific literacy ability can be measured using a pretest and post-test. A comparison of the pretest and post-test values of students' scientific literacy on the theme of environmental pollution is presented in the graph below.

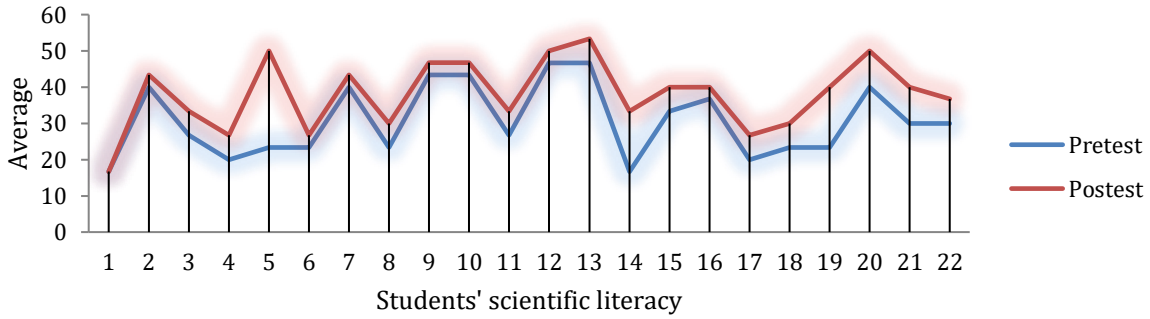

Figure 1. Comparison of students' scientific literacy pretest and post-test score

Figure 1 shows that the lowest pretest score was 16.67, which was obtained by two students, while the highest pretest score was 46.67. The lowest post-test score was obtained by one student, and the highest post-test score was 53.33, obtained by one student. Data from the pretest and post-test results will be tested using N-Gain. The percentage results of the N-Gain test are stated in Figure 2.

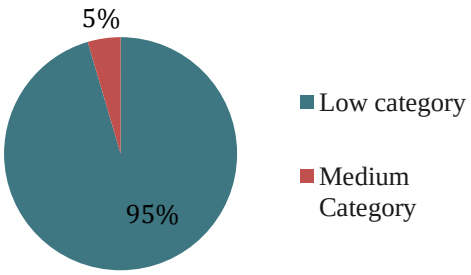

Figure 2. Result of N-gain test

Figure 2 shows that only 5% of students are included in the moderate category, namely one student. This percentage is obtained from the number of students who get moderate scores / the total number of students multiplied by one hundred. At the same time, 21 other students get low N-Gain criteria. Students' initial scientific literacy abilities in this study were shown through the results of the pretest. Based on the results of the pretest, it can be said that all students have not met the KKM (Minimum Completeness Criteria) set by the school, which is 75. The average score of the pretest results obtained is 30.6. Meanwhile, the results of the post-test showed an increase. Although it was not significant, the average post-test score was 38.03. The data is then analyzed using the N-Gain Test. Data from the analysis of students' scientific literacy tests obtained an average N-gain result of 0.10, which was included in the low category.

Table.1 N-gain Criteria

Gain Index	Gain Criteria
0.7 < (<N-Gain>) ≤ 1.0	High
0.3 < (<N-Gain>) ≤ 0.7	Medium
0.0 < N-Gain ≤ 0.3	Low

Through the application of project-based learning on the theme of environmental pollution, it is expected to improve students' scientific literacy

abilities. Students' scientific literacy skills are trained during learning activities when discussing in groups and working on worksheets. There is an increase in students' scientific literacy skills after the implementation of a project-based learning model on environmental pollution. This is evidenced by the results of the paired t-test on the pretest and post-test scores of students' scientific literacy abilities. Prior to that, the Shapiro-Wilk normality test was carried out using the SPSS application as a determinant of the data obtained and was normally distributed. The result is a significant level > 0.05 of 0.60, which means that the data is normally distributed. Then a paired t-test was carried out, which is presented in Table 1.

Table.2 Paired t-Test Result

	Mean	t	df	Sig (p)
Pretest-Posttest	-7,425	-5,899	21	.000

Paired t-test was conducted with a significance level of 5%. According to the table above, a significance value of 0.00 <0.05 is obtained so that Ho is rejected and H1 is accepted. That is, there is a difference between the value of scientific literacy before and after the application of the PjBL learning model on environmental pollution material, which indicates that there is an effect of treatment on students' scientific literacy abilities.

Furthermore, the data will be tested for its Effect Size. The results of the Effect Size test using Excel obtained a result of 0.63. This score can be interpreted as the Effect Size value in the medium category.

After carrying out project-based learning to increase scientific literacy in environmental pollution material, students are given a response questionnaire. Filling out the response questionnaire was carried out by 22 respondents. Following are the results of student responses to learning by applying the PjBL model presented in table 3.

Table 3. Student Responses to project-based learning model to improve student literacy.

No.	Student Responses	Score
1.	Learning with the Project Based Learning model allows me to identify problems scientifically	100%
2.	Learning with the Project Based Learning model makes me more interested in scientific studies.	100%
3.	Project-based learning makes me active during learning activities	86.36%
4.	Learning with the Project Based Learning model encourages me to develop skills in science	100%
5.	I can understand the concept of water pollution with the Project Based Learning model	90.90%
6.	The role of the teacher helps me when I have difficulties in working on projects so that I become more active	100%
7.	The time given by the teacher is effective for working on the project	100%
8.	Activities in groups make me active in asking each other questions and conveying opinions or ideas	90.90%
9.	I can dig up information from projects I'm working on easily	100%
10.	I like science learning activities with the Project Based Learning model because it makes it easy	100%

Based on the response questionnaire showed that there was a good response from students after learning the PjBL model. All questions were included in the very good category with a percentage of 86.36% -100% according to Guttman's criteria if the score was between 81% - 100% included in the very good category. From the results of the student response questionnaire analysis, there were several questions that received a response of "No" the lowest percentage of questions at number 3 related to student activity in learning got a percentage of 86.36%. In addition, questions number 5 and number 8 also get the answer "No" with a percentage of 90.90%.

Observational data on the project-based learning process on environmental pollution material to increase scientific literacy was observed by an observer, namely a class VII science teacher. Project-based learning consists of 6 stages of learning (syntax), namely determining fundamental questions, designing project implementation, preparing schedules, monitoring project completion, testing learning processes and outcomes, and evaluating experiences. But there are some syntaxes that are not perfect during the learning process. In the syntax of determining basic questions according to observers at this stage, the researcher was not clear in giving directions for questions, so several groups could not find

problems in the phenomena that had been displayed. In the syntax for designing the implementation of the project, the point of formulating the problem of the learning researcher is not perfect. This is because some groups still cannot formulate problems from the phenomena that have been presented. This is because some of these groups do not understand the phenomena or issues that have been presented. Furthermore, in the syntax for preparing the point schedule for making a project backup plan, researchers have not done well learning. This is because students are still confused about how to process tofu waste into high-selling value apart from the projects they have previously designed. In the experience evaluation point of communicating project results, observers said that several groups had not been able to present their project results to the fullest, even though each group had succeeded in carrying out the project according to the results of their design. The same thing was expressed by Pamungkas, Aminah, and Nurorosyid (2018); students were still unable to provide arguments or assessments regarding the concepts underlying the problem. One of the factors that cause students difficulty in giving arguments related to concepts is students' lack of understanding regarding the meaning of the concepts that underlie the problem [22]. The teacher does not train students to formulate problems, make hypotheses, determine variables, compile experimental procedures, interpret data and make sense of the data obtained, practicum implementation is still verified, and in some classes, it is a cookbook [23].

Science learning that has started to be carried out by practicum, the activities are too structured and are proof or verification in nature, and do not provide space for students to be creative in solving problems in the everyday environment [24]. The ability of scientific literacy in project-based learning on environmental pollution material after learning there is an increase in students' scientific literacy. The increase in students' scientific literacy can be seen from the average pretest and post-test scores that have increased, although the increase is not significant, and the post-test results do not meet the minimum completeness. The average N-gain result is 0.10 in the low category, with an effect size of 0.63 in the medium category. This is caused by several factors. One of the factors is that there are students who still have difficulty reading. Besides that, some students also find it difficult to interpret what the scientific literacy questions are, so students have difficulty answering them. This was conveyed directly by several students after working on the pretest and post-test questions. This fact is also supported by the pretest average results of 30.6 and 38.03 for the post-test results of these tests that do not reach the minimum completeness. The low scientific literacy of students is caused by students being less trained in solving questions with scientific literacy characteristics [25]. Teachers do not train students' scientific literacy only based on Student Worksheets made by other people and school textbooks so that students learn science by memorizing concepts, theories, and laws that cause these students difficulty applying scientific concepts in life [26]. This is supported by Putri's research which states that students' low scientific literacy is caused by students' low interest in reading. 50% of class VII students at SMPN 2 Pematang Tiga Bengkulu Tengah still have difficulty reading [27]. Students are used to being given tests in the cognitive domain. As a result, learning is only limited to memorizing; such scientific literacy is low [28].

In terms of student responses to project-based learning, it tends to be good. This is evidenced by several questionnaire questions getting a percentage of 100%. However, there were a number of questionnaire questions that received negative responses or "No" answers, such as questions number 3 and number 8, related to student activity in groups. Both questions did not get a perfect score of 86.63% on the third question and 90.09% on the second question. Number 8, this is due to the fact that only one printout is given to each group so that students who excel will be active, and students who are less able tend to follow students who excel. Question number 5, related to understanding the concept of water pollution by applying project-based learning, also did not get a maximum score of only 90.09%. This was because some students did not understand the project objectives that had been carried out to reduce water pollution. Besides that, some students still needed more explanation about water pollution. Factors that make students inactive during learning are students who have quiet characteristics and lack self-confidence, so they don't want to show their abilities [29]. Students will experience difficulties when learning if the teaching materials used are incomplete [30]. The lack of time allocation provided for the learning process and limited learning resources causes students to be less enthusiastic and less actively involved in learning [31].

CONCLUSION

Based on the results of the discussion in this study, it can be concluded that the application of the project-based learning model (PjBL) increases scientific literacy. This is evidenced by the average initial test of scientific literacy from 30.6 to 38.03. The score of students' scientific literacy abilities from the average N-Gain result is 0.10 in the low category, and the Effect size value is 0.63 in the medium category. Then the results of the students' responses showed positive responses

in all aspects with a percentage of 86.36% - 100%, so they were classified as very good criteria

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