



Improving Science Literacy Competence of Grade VII Students Through The Implementation of Project-Based Learning

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Abstract

The aim of this research is to find out the increase in the ability of students in scientific literacy after the Project Based Learning model is applied in their learning. This type of research is classroom action research. The research subjects consisted of 32 students in class VII E of SMPN 1 Bojonegoro for the 2022/2023 academic year. The data collection techniques used tests and observations. AKM-based formative tests and observation sheets are used for the data collection instruments. Processing the value of students' abilities in scientific literacy is calculated using the calculation of the percentage between the correct score and the maximum total score. The test results obtained are grouped into 5 categories; Very Good, Good, Adequate, Poor, and Very Poor. The results of the study show that the scientific literacy skills of students' competence on indicators of explaining a phenomenon scientifically, conducting evaluations and compiling scientific investigations, and interpreting scientific evidence have increased with an average score in pre-cycle learning of 67.58 which is in the adequate category and in cycle II follow-up increased to 83.58 which was in the Good category. The conclusion from this study is that the implementation of Project Based Learning is proven to be able to improve the scientific literacy skills of students in class VII E of SMP Negeri 1 Bojonegoro for the 2022/2023 academic year.

Keywords: *Science Learning, Project Based Learning, Competency Science Literacy Ability*

Abstrak

Tujuan diadakannya penelitian ini adalah untuk mengetahui peningkatan kemampuan siswa dalam literasi sains setelah model *Project Based Learning* diterapkan dalam pembelajarannya. Jenis penelitian ini adalah penelitian tindakan kelas, dilakukan dalam 2 kali siklus yang setiap siklusnya terdiri dari perencanaan, tindakan, pengamatan, dan refleksi. Subjek penelitian terdiri dari 32 siswa di kelas VII E SMPN 1 Bojonegoro tahun pelajaran 2022/2023. Teknik pengumpulan data yang digunakan meliputi tes dan observasi. Instrumen pengumpulan data yang digunakan adalah tes formatif berbasis AKM dan lembar observasi. Pengolahan nilai kemampuan siswa dalam literasi sains dihitung menggunakan perhitungan presentase antara skor benar dengan jumlah skor maksimum. Hasil tes yang diperoleh dikelompokkan kedalam 5 kategori; Sangat Baik, Baik, Cukup, Kurang, dan Sangat Kurang. Hasil dari penelitian menunjukkan bahwa kemampuan literasi sains kompetensi siswa mengalami peningkatan dengan nilai rata-rata pada pembelajaran pra siklus sebesar 67,58 yang berkategori cukup dan pada tindakan siklus II meningkat menjadi 83,58 yang berkategori baik. Kesimpulan dari penelitian ini yaitu implementasi *Project Based Learning* terbukti mampu meningkatkan kemampuan literasi sains siswa kelas VII E SMP Negeri 1 Bojonegoro Tahun Pelajaran 2022/2023.

Kata Kunci: *Pembelajaran IPA, Project Based Learning, Kemampuan Literasi Sains Kompetensi*

INTRODUCTION

Indonesian citizens must possess critical thinking, creativity, communication, problem-solving, and literacy skills in the 21st century (Suryandari et al., 2018). Junior high school students can develop an understanding of science and apply it to solve social problems through Natural Science education. The ability to understand and apply science to meet societal needs is known as science literacy (Dwiyanti & Rahayuni, 2020). Students must improve their competence in science literacy to be able to produce solutions to social problems based on acquired scientific knowledge and skills (Pratiwi et al., 2019). Therefore, science literacy is crucial for students, particularly in the digital era (Pratiwi et al., 2019)

However, based on interviews with science teachers and observations carried out in class VII E SMPN 1 Bojonegoro obtained information that the ability of students in science literacy competence is still in the category of less. There are several causal factors that allow the emergence

of problems of low science literacy competence of students, namely 1) students, 2) models used in learning, and 3) learning methods used. Problems from students that arise are students' low interest in reading, especially during the Covid-19 pandemic, students' book reading habits have decreased. In addition, students have difficulty expressing their understanding of a phenomenon in doing essay questions or when given oral questions by the teacher. If given an elaboration question, students will only write 1-2 sentences with the same sentence as in the book.

The study reveals that students struggle with interpreting data from visual aids such as pictures and graphs, explaining scientific phenomena, and analyzing real-world problems. This suggests that their understanding of science is limited to textbook knowledge. It is important for educators to focus on improving these skills to enhance students' comprehension of scientific concepts. Students demonstrate an understanding of scientific concepts and their relationship to real-life phenomena. However, the learning model employed tends to rely heavily on the lecture method and problem-solving, which does not actively engage students in direct experiences. However, the learning model employed tends to rely heavily on the lecture method and problem-solving, which does not actively engage students in direct experiences. As a result, students tend to be passive learners with limited opportunities to contribute to the building and acquisition of knowledge.

This finding is relevant to international science literacy assessments conducted by organizations such as the (OECD, 2016). It is known that students in Indonesia have relatively low science literacy skills. In 2018, Indonesia ranked 62 out of 71 countries (Narut & Supardi, 2019), with a score of 396 that did not meet OECD standards (Yulianti et al., 2019). Indonesian students' low science literacy is primarily in the Competency dimension. They tend to memorize material and struggle with analyzing and applying concepts to real-world problems (Sholikah & Pertiwi, 2021). This phenomenon is attributed to students' lack of interest in reading and writing (Hasasiyah et al., 2019). Another factor to consider is the use of the learning model, facilities, and infrastructure, as well as the availability of learning resources and teaching materials that may not have adequately prepared students for literacy activities (Sujudi et al., 2020)

To enhance students' science literacy, it is recommended to implement learning that frequently connects learned concepts with real-life scenarios or problems. (Suryandari et al., 2018) suggest that the Project Based Learning (PjBL) model can provide students with direct experiences, enabling them to actively search for and construct knowledge. Additionally, PjBL can help students connect scientific knowledge to real-life situations.

(Suryandari et al., 2018) said that through project-based learning, students do not have to memorize theories or formulas, but rather analyze and think critically about the information obtained from reading activities to solve problems through making a product. This is in accordance with the opinion (Handayani, 2020) that the PjBL model demands critical thinking from students in finding new ideas to solve problems. The PjBL model has 6 stages of learning and each stage is able to improve students' ability in literacy (Suryandari et al., 2018), 1) starting with important questions, taking contextual topics and starting with investigations using student science skills, 2) planning project work, and selecting activities related to science skills in answering important questions, 3) compiling a schedule of activities, 4) monitoring the progress of student projects, 5) assessing student project results, 6) evaluating student learning experiences.

Other research has also been proven by (Winarni & Purwandari, 2020) (Fauziah et al., 2023) that students experience an increase in science literacy skills, especially in pollution material. Environmental problems that are close to the lives of students in Bojonegoro are water pollution caused by the influence of human activities. Especially from the results of research (Elvania, 2022) the condition of water in the Kalitidu river, Bojonegoro is in class II water quality, even though the water in the river is still used by local people in various daily activities such as a place to bathe, wash clothes, and defecate. The use of polluted water is an environmental problem that requires attention because based on the results of the UNESCO World Water Development Report 2021 research (Lin et al., 2022), around 829,000 people die every year due to diarrheal diseases through consuming polluted water. Therefore, water pollution material is important for students to learn. Based on

theoretical studies and findings in class VII E SMPN 1 Bojonegoro, it is suspected that there is an influence by applying the PjBL model in improving students' competency science literacy skills.

METHOD

The research was conducted from March-May 2023 and is a Classroom Action Research adaptation of Kemmis and Taggart (Sumarni et al., 2016), which is in the form of a spiral from one cycle to the next. Each cycle consists of planning, action, observation, and reflection. The next cycle begins with revised planning based on the findings in the first cycle, action, observation, and reflection. Before carrying out the action in the first cycle, it is necessary to carry out preliminary actions (pre-cycle) to identify existing problems in the classroom. The spiral cycle in PTK is organized as in Figure 1.

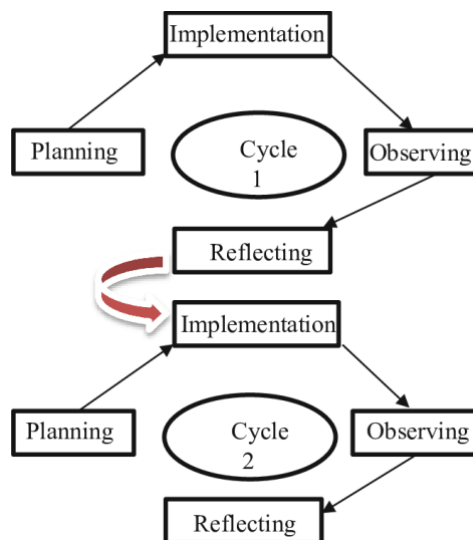


Figure 1. Cycle in PTK

The subjects in this study were students of class VII E SMPN 1 Bojonegoro totaling 32 people, consisting of 14 male students and 18 female students. SMPN 1 Bojonegoro has implemented an independent curriculum for grade VII in every school program, including learning activities. The research data was obtained using two techniques, namely: 1) written tests for formative tests at the end of learning in the pre-action stage, formative tests in the first cycle, and formative tests in the second cycle, 2) non-tests in the form of observation by directly observing learning activities using the Project Based Learning (PjBL) model implemented by teachers and students.

The type of test used in this study is an AKM-based written test totaling 7 questions with details of 1 multiple choice question, 1 matching question, 1 complex multiple choice question, 1 true false question, 2 essay questions, and 1 short description question. The sub-material Interaction between Components of Living Things for pre-cycle learning, sub-material Biodiversity in Indonesia in cycle I, and sub-material Human Influence on Ecosystems in cycle II. The written test used includes aspects of the science literacy competency component with indicators of explaining scientific phenomena, conducting evaluations and designing scientific investigations, and interpreting scientific evidence and data. Quantitative descriptive is used as a technique in this study, then the answers from the tests given to students are used as a reference in analyzing the data. Assessment of students' science literacy skills is obtained through the calculation of the percentage between the correct score and the maximum score (Purwanto, 2002). The test results were then categorized into 5 categories as in table 1. Categories of science literacy skills of student competence.

Table 1. Categories of students' competency science literacy skills

Category	Score
Very Good	86-100
Good	76-85
Enough	60-75
Less	55-59
Very Lacking	<54

Source: Purwanto in Muhammad, et al., 2018

RESULT AND DISCUSSIONS

A. Data Analysis

1. Pre-cycle Condition

In pre-classroom learning, the implementation of learning in this initial condition was carried out by applying a conventional model with the lecture method and answering problems in the science package book. From the results of pre-classroom learning, it is known that the ability of students in competent science literacy in class VII E at the pre-classroom stage is at the sufficient indicator, this can be seen in the results of the formative test conducted at the end of the lesson. There are three indicators assessed on competency science literacy skills, the first indicator is explaining scientific phenomena, in this indicator students get a score of 71.88 which is categorized as sufficient. The second indicator is evaluating and designing investigations. Students get a score of 67.86 which is categorized as sufficient. In the third category, namely interpreting scientific data, students get a score of 63.02 which is categorized as sufficient. The three indicators of students' competency science literacy skills get an average of 67.68 and are categorized as sufficient.

2. Cycle 1 Condition

Cycle I learning was still carried out in the same class, namely class VII E SMP Negeri 1 Bojonegoro on March 29 and 30, 2023. Learning is carried out as an effort to overcome the findings in the pre-cycle stage, where students are still unable to convey a scientific phenomenon based on their own understanding, students also still have difficulty understanding and translating the contents of an infographic. Therefore, learning in cycle I was carried out using the PjBL model to overcome the problems of students' competency science literacy. In this first cycle learning, teacher and student activities were also observed related to the implementation of PjBL syntax by two observers. The first observer was the science teacher of SMPN 1 Bojonegoro and the second observer was a research colleague. The results of the observation of the implementation of PjBL learning by teachers and students are in Table 2.

Table 2. Observation Results of Implementation of PjBL Learning cycle I by Teachers and Students

No	Leaning Syntax	Teacher Activities		Student Activities	
		Observer 1	Observer 2	Observer 1	Observer 2
1	Introduction	3	4	4	4
2	Fundamental Question	3	3	3	3
3	Project Planning	3	4	2	3
4	Developing a Schedule of Activities	3	3	3	4
5	Monitoring Project Progress	4	4	4	4
6	Project Outcome Assessment	3	4	3	3
7	Evaluation of Learning	3	3	3	3
8	Closing	4	4	4	4
9	Total	26	28	26	28
10	Percentage	81,03%	86,68%	81,03%	86,68%
11	Average	83,70%		83,70%	

The observation results of teacher activities and student activities showed that the stages in the PjBL model had been carried out and each received an average percentage of 83.70%, which was already in the good category. Students' competency science literacy skills in this first cycle learning increased in all three indicators. The first indicator is explaining scientific phenomena, students get a score of 76.56 which is categorized as good. In the second indicator, namely evaluating activities and designing investigations, students get a score of 75.45 which is categorized as sufficient. In the third category, namely interpreting scientific data, students get a score of 75.52 which is in the good category. The three indicators of students' competency science literacy skills get an average value of 75.84 and are categorized as good.

3. Cycle II Condition

The second cycle learning was carried out on May 3 and 4, 2023 as a follow-up improvement from the first cycle learning. The first cycle learning results still have students who have not actively participated in the activities of explaining scientific phenomena and also assessing the success of the projects made. Therefore, in the second learning cycle the teacher used the PjBL model with a modified windows shopping method at the presentation stage of the project results assessment, so that all group members would get the role of explaining their respective projects, and also asking or responding to the results of other group projects. In this second cycle, observations were also made regarding the implementation of PjBL learning activities by teachers and students. The results of observations of the implementation of PjBL learning by teachers and students in the second cycle are in Table 3.

Table 3. Observation Results of Implementation of PjBL Learning Cycle II by Teachers and Students

No	Learning Syntax	Teacher Activities		Student Activities	
		Observer 1	Observer 2	Observer 1	Observer 2
1	Introduction	4	4	4	4
2	Fundamental Question	3	4	3	4
3	Project Planning	4	3	3	4
4	Developing a Schedule of Activities	4	4	3	4
5	Monitoring Project Progress	4	3	4	3
6	Project Outcome Assessment	3	4	4	4
7	Evaluation of Learning	3	3	4	3
8	Closing	4	4	4	4
9	Total	29	29	29	30
10	Percentage	89,29%	89,29%	89,29%	93,30%
11	Average	89,29%		91,29%	

From the results of the observations made, it can be seen that teacher activities and student activities in the second cycle are in accordance with the stages in the PjBL model with an average percentage of 89.29% and 91.29% which are categorized as Very Good. The implementation of learning in this second cycle also experienced an increase compared to the first cycle. In addition, students' competency science literacy skills in cycle II increased in all three indicators. In the first indicator, namely explaining phenomena scientifically, students obtained a score of 82.81 which was categorized as good. In the second indicator, namely conducting evaluation activities and designing investigations, students get a score of 83.04 which is categorized as good. In the third category, namely interpreting scientific data, students get a score of 84.90 which is in the good category. The three indicators of competency science literacy skills in students get an average of 83.58 and are categorized as good.

DISCUSSIONS

Students' science literacy skills in the three indicators including explaining scientific phenomena, evaluating and carrying out investigation design, and interpreting scientific data from pre-cycle learning to action in cycle 2 always increased. These results are in accordance with the results of research from (Fauziah et al., 2023; Nuraini & Waluyo, 2021; Winarni & Purwandari, 2020) that competency science literacy skills can be improved using the PjBL model. Students' competency science literacy skills have increased from pre-cycle to cycle II actions in each indicator as illustrated in Figure 2..

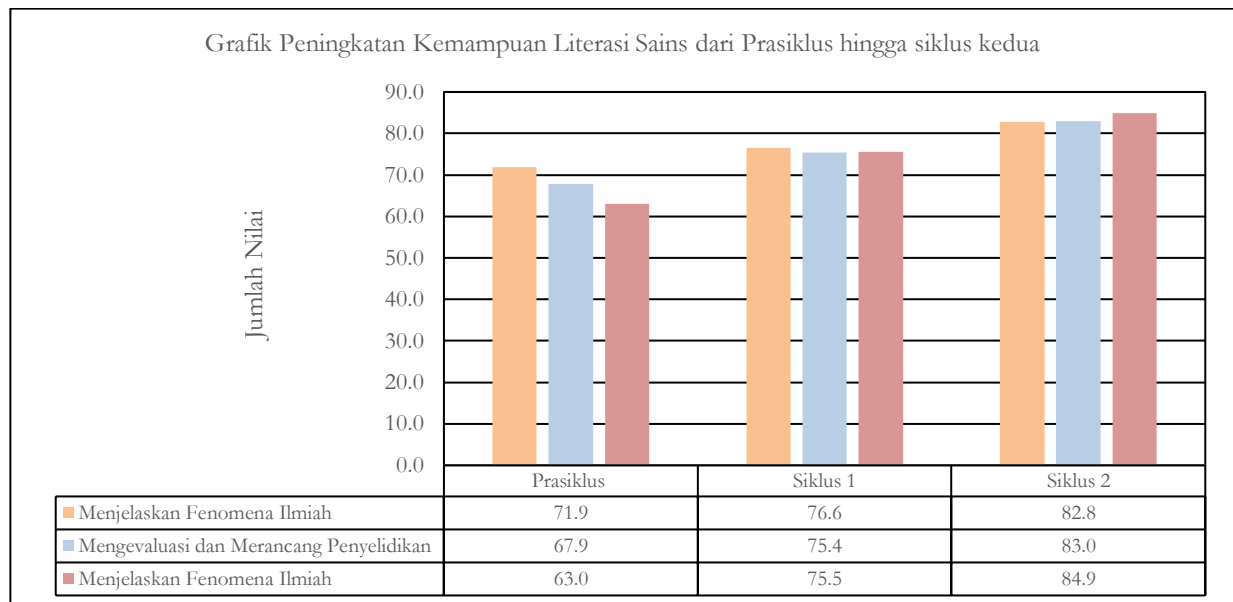


Figure 2. Improvement in Students' Science Literacy Ability from Pre-Cycle to Cycle II

According to (Andini & Rusmini, 2022), the PjBL model can enhance students' critical thinking skills. This is a crucial aspect that can impact students' science literacy skills. Therefore, PjBL is a suitable model to develop students' competence in science literacy (Fauziah et al., 2023). The PjBL model utilized comprises six syntaxes: formulating fundamental questions, designing projects, scheduling activities, monitoring project progress, assessing project results, and evaluating learning experiences (Banawi, 2019).

Competency science literacy indicators are integrated into each syntax of the Project-Based Learning model. During the stage of determining the fundamental question, it is important to explain scientific phenomena using competency science literacy indicators. At the stage of determining the fundamental question, students are faced with contextual problems and are guided to understand the phenomenon before proposing a solution. During the project design stage, it is important to utilize science literacy skills such as evaluating and carrying out scientific inquiry design. It is crucial to create a logical flow of information and maintain a formal register with precise word choice. Additionally, it is important to avoid biased language and ensure grammatical correctness. This includes designing problem-solving procedures to produce a product. In addition, when assessing the results of the project's learning outcome evaluation, it is important to consider the competency of science literacy indicators, particularly in interpreting scientific evidence and data. During this stage, students analyze the success of the product testing and are able to draw conclusions and take follow-up actions to correct any resulting shortcomings.

The first indicator is to explain phenomena scientifically, students are expected to explain, connect, and predict certain cases (Novili et al., 2017). Students are given problems related to water pollution in the Kalitidu river, Bojonegoro. At this stage students analyze the causes of water pollution in the Kalitidu river and then with the group discuss the solution. At this stage students conduct a literature study which is an important part of project learning. This statement is reinforced by (Susiati et al., 2018) that through reading activities from various literature sources

during project learning students can improve their science literacy skills. Similar results were also obtained (Suryandari et al., 2018) that through project learning can improve students' ability in literacy, especially in finding and gathering information, students do not have to memorize theories or formulas, but rather analyze various information to solve problems through making products.

In the second indicator, students conduct an investigation and design a simple water filtration device to address water pollution caused by human activities, such as disposing of household waste in rivers. The students design the investigation by identifying the controlled variable, which is polluted water, the independent variable, which is the filtration device design, and the dependent variable, which is the filtration water results. According to (Khatimah et al., 2020), the students' ability to develop scientific competence can be observed when they work on projects using the PjBL model. Students can apply scientific concepts and theories to solve everyday problems through practice. The PjBL model can provide students with experience in creating products scientifically and evaluating their success (Sholikah & Pertiwi, 2021).

The Indicator of Interpreting Data requires students to analyze, interpret, and draw conclusions from specific cases (Novili et al., 2017). In this indicator, students are presented with a graph of population growth data in Bojonegoro. They must then analyze the relationship between population growth and the level of demand for clean water, as well as the amount of household waste that will be generated. Interpreting graphs requires specific skills, as noted by (Afriana et al., 2016). These skills include visualizing solutions, inferring data, connecting variables, making estimates, and drawing conclusions. Project-based learning activities can enhance students' literacy abilities (Afriana et al., 2016). To enhance students' literacy skills, project-based learning activities are consistently and continuously provided. These activities require students to solve problems by designing and manufacturing products based on scientific literature. The language used is clear, objective, and value-neutral, with a formal register and precise word choice. The text adheres to conventional structure and formatting features, with a logical flow of information and causal connections between statements. The text is free from grammatical errors, spelling mistakes, and punctuation errors. No changes in content have been made.

CONCLUSION

Based on this study, the use of the PjBL model in class VII E SMPN 1 Bojonegoro was able to produce an increase in students' ability in science literacy competencies on Ecology and Biodiversity material in Indonesia which experienced an increase in scores from the pre-cycle of 67.58 in the category of less than in cycle I of 75.84 with a good category and in cycle II getting a score of 83, 58 in the good category. The increase occurred in all three indicators, in the indicator explaining the phenomenon scientifically, the acquisition of student scores was 71.9 at the pre-cycle stage and increased to 82.8 in the second cycle of action. In the indicator of evaluating and organizing scientific investigations, the score was 67.9 at the pre-class stage and increased to 83.0 in the second cycle action. In the indicator of interpreting scientific evidence, students scored 63.0 in the pre-classroom and increased to 84.9 in the second cycle of action. Learning using the PjBL model requires relatively longer implementation time than other models, therefore it is necessary to have good time management so that implementation can be optimal.

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