Edu Sains
Jurnal Pendidikan Sains dan Matematika
p-ISSN : 2338-4387
e-ISSN : 2580-3247

INCREASING SCIENTIFIC LITERACY IN THE INHERITANCE AND BIOTECHNOLOGY CHAPTER BY IMPLEMENTING PROBLEM-BASED LEARNING

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Abstract
This research aims to increase students' scientific literacy at SMPN 2 Buduran by implementing problem-based learning. The method used is two cycles of CAR. As a result, in the context aspect of cycle I, 60% of students got a score of B, which increased in cycle II to 62.9% of students got a score of A. In the content aspect of cycle I, 66% got a score of B, then experienced an increase in cycle II, as many as 57.2% of students got a score of A. In the competency aspect of cycle I, as many as 51.6% of students got a score of C; this increased in cycle II, as many as 60% got a score of B. The increase in scientific literacy can be seen in the increase in student learning outcomes. In cycle I, the average class score on the pre-test was 66.2 with a completion percentage of 11.4%, then increased on the post-test with an average class score of 79.4 and a completion percentage of 68.5%. In cycle II, the average class score on the pre-test increased rapidly to 78, with a completion percentage of 62.8%. Then, in the post-test, it reached an average score of 91.4 and a completion percentage of 100%. Problem-based learning has been proven to increase student's scientific literacy.

Keywords: scientific literacy, PBL, inheritance, biotechnology

Abstrak
Penelitian ini bertujuan untuk meningkatkan literasi sains siswa di SMPN 2 Buduran dengan menerapkan pembelajaran berbasis masalah. Metode yang digunakan adalah PTK sebanyak dua siklus. Hasilnya, pada aspek konteks siklus I sebanyak 60% siswa memperoleh nilai B, kemudian meningkat pada siklus II menjadi 62,9% siswa memperoleh nilai A. Pada aspek isi siklus I sebanyak 66% memperoleh nilai B, kemudian mengalami peningkatan pada siklus II, sebanyak 57,2% siswa memperoleh nilai A. Pada aspek kompetensi siklus I sebanyak 51,6% siswa memperoleh nilai C kemudian meningkat pada siklus II, sebanyak 60% memperoleh nilai B. Selain itu, peningkatan literasi sains terlihat pada peningkatan hasil belajar siswa. Pada siklus I, nilai rata-rata kelas pada pre-test sebesar 66,2 dengan persentase ketuntasan 11,4%, kemudian meningkat pada post-test dengan nilai rata-rata kelas sebesar 79,4 dan persentase ketuntasan 68,5%. Pada siklus II, nilai rata-rata kelas pada pre-test meningkat pesat menjadi 78 dengan persentase ketuntasan 62,8%, kemudian pada post-test mencapai nilai rata-rata 91,4 dan persentase ketuntasan 100%. Pembelajaran berbasis masalah terbukti dapat meningkatkan literasi sains siswa

Kata Kunci: literasi sains, PBL, pewarisan, bioteknologi

INTRODUCTION

Science is experiencing rapid development in the 21st century. Science exists because it is felt that it has various solutions to overcome the problems faced by everyday society. Apart from that, science also has the potential to produce and develop various things by honing scientific process skills (Fajriah et al., 2017). Living by adapting and learning science is a new challenge every individual must develop in the 21st century (Nofiana & Julianto, 2018). One of the things that someone must do to face these challenges is to understand and utilize scientific information, which can be accessed easily through any platform and literature. One of the keys to success in facing challenges in the 21st century is scientific literacy (Irianto & Febrianti, 2017); (Hidayah & Rahmawati, 2023).

The Organization for Economic Co-operation and Development (OECD) organizes a program to measure scientific literacy skills. This program is called PISA (Program for International Student Assessment) and is participated in by various countries worldwide. This program is intended for children aged 15 years or the equivalent of the 9th-grade study group at Junior High Schools in Indonesia. According to data compiled based on the 2022 Kemristekdikbud report regarding "PISA 2022 and the Recovery of Indonesian Learning", Indonesia is ranked 68th out of 78 countries, with details in mathematics with a score of 379, science with a score of 398, and reading with a score of 371. Indonesia is lagging compared to its cognate country, Malaysia. Malaysia is ranked 47th on PISA. Moreover, Singapore was ranked first, beating various Asian countries (OECD, 2024). From this data, it is known that the literacy skills possessed by 15-year-old children in Indonesia are at a low level, not to mention this is exacerbated by lagging in learning and literacy due to the Covid-19 pandemic (Tambunan, 2021) (Hatmo, 2021).

According to the PISA standards, scientific literacy consists of three main dimensions that must be possessed to understand various natural phenomena resulting from human activities. These three dimensions include, among others, scientific knowledge (content), scientific competence (process), and scientific application (context) (Pertiwi et al., 2018). PISA provides minimum limits on school curriculum material; it should cover the scope of content (knowledge). This is because relevant science learning is considered to increase student's awareness of the urgency of science when it is linked to today's society and global developments (Kartika & Nuroh, 2023).

Various obstacles are faced in achieving quality learning relevant to the demands of scientific literacy. In their research, Nurhairani et al. (2019) stated that several factors influence the insignificant increase in student scientific literacy quality in Indonesia. These problems include: 1) The science material taught is less relevant to factual events and everyday life, thus affecting students' understanding of the material; the less factual the material, the more difficult it is for students to comprehend and comprehend the material (Purwadhi, 2019), 2) implementation of learning that is not comprehensive and not integrated due to limited resources, 3) low science competency of teachers (Fuadi et al., 2020). These obstacles then

influence several aspects of scientific literacy; Ariska & Rosana (2020) have reported that students have a low ability to identify issues in the science context, while Atta et al. (2020) have reported that students have a low ability in the science process and knowledge content domains.

One of the chapters related to everyday life is Inheritance and biotechnology. This chapter is part of the application of genetics and technology, which is then studied to study the phenomena of the descendants of everyday living things. In its application, this chapter is relevant to issues or problems often occurring in the surrounding environment to fulfill the context aspect. This chapter requires an understanding of the main concepts, and it is factual. (Waruwu, 2020), This chapter also includes competence because it is one of the materials that is the basis for the birth of the sciences of developing molecular biology, which is currently on the rise in the 21st century, thereby building critical thinking skills (Latif et al., 2022).

The impacts that have been identified should be a reflection for educators and researchers. Educators and researchers must fix various obstacles that occur in the field. One way educators can do this is by choosing a learning model that meets various aspects of scientific literacy needs. (Zahro et al., 2019) believes that science is complex, so strategies are required to convey concepts in science learning, helping students improve their scientific literacy skills.

The learning model is one of the critical factors that can influence student's understanding. There are various learning models that educators can choose and apply; however, for science learning, the learning model that is considered reasonable is the one that can help students explore more things, such as discovery, inquiry, problem-based learning, and project-based learning models. These learning models are focused and refer to student-centered learning, making students more active in finding out (Rusilowati, 2018). According to Nurtanto et al. (2020), various learning models can be used by the teacher; the learning model that can help improve students' literacy skills is the problem-based learning model. This model can help improve literacy skills because it refers to factual scientific content, which is presented in a problem that is studied in depth, thereby fostering high-level thinking abilities in students. Based on this view, the author feels interested in implementing the problem-based learning model to increase students' scientific literacy at SMP Negeri 2 Buduran.

METHOD

This research was carried out at SMP Negeri 2 Buduran, Sidoarjo Regency, on students in grades IX - F. The number of students was 35, with details of 20 male and 15 female students. This research lasted two and a half months, from 12 February 2024 to 24 April 2024. Classroom Action Research consists of 2 cycles, each with four main stages: planning, acting, observing, and reflecting. This research instrument is a pre-test and post-test in the form of multiple-choice questions to measure the development of student's abilities before and after receiving treatment. The Student Worksheet is also used as a benchmark (Table 1) for scientific literacy abilities,

covering three aspects (content, context, and competency). The instrument is based on Hafizah and Nurhaliza's (2021) research about the concept of science literacy that occurs in problem-based learning models.

Table 1. Students Worksheet Assessment

Criteria	Classification of answer	Score	Value Range
Excellent (A)	The answer is correct, precisely according to the context	4	81-100
Good (B)	The answer is correct, but not precisely according to the context	3	71 - 80
Enough (C)	Incorrect answer, not precisely according to the context	2	61 - 70
Not enough (D)	Did not answer	1	<60

RESULTS AND DISCUSSION

The research was carried out in two different cycles and had different results. Preparing student modules and Student Worksheets is very important in determining the credibility of students' value criteria. (Choirudin *et al.*, 2021). The results are presented in diagram form to compare cycle one and cycle II in three main aspects of scientific literacy: 1) context, 2) content, and 3) competency. These three aspects are fundamental in determining student's literacy abilities (Imansari *et al.*, 2018); (Permatasari & Fitriza, 2019).

In the Student Worksheet Cycle I, the context aspect that students must study is that students are presented with an article about COVID-19, which is still ongoing. Students can describe the issues that society will face so that these problems must be overcome. The content aspect that students must understand is that DNA is genetic material that can be repaired and changed by adjusting the code of ethics (bioethics). Meanwhile, in the competency aspect, students are asked to find a solution to overcome existing issues.

In the Student Worksheet in cycle II, the context aspect that students must study is that students are presented with an article about oil spills in the ocean. Students can explain issues that impact the lives of underwater animals and humans. The content aspect that students must understand is that living creatures in the microorganism group have a role in everyday life; the most important thing is how a scientist can use them. Meanwhile, in the competency aspect, students are asked to find a solution and explain why this solution can overcome the existing issue. As a result, aspects of the science context increased in cycle II compared to cycle I, as shown in Diagram 1.

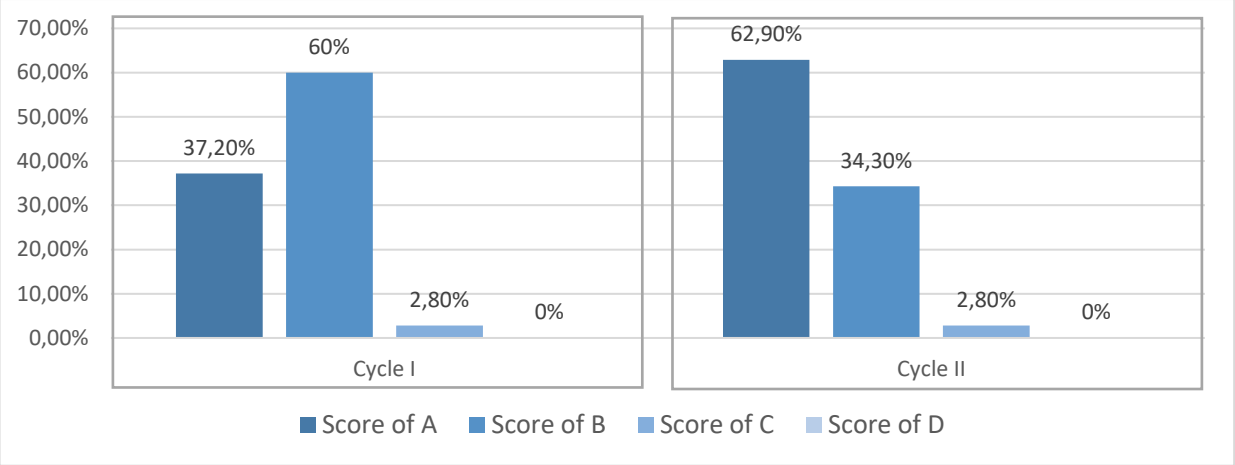

Diagram 1. Outcomes learning of context aspect

Diagram 1 of the context aspect shows that in cycle I, the percentage of students who got an A score was 37.20%, a B score was 60%, a C score was 2.8%, and a D score was 0%. Meanwhile, in cycle II, the percentage of students who got an A score increased to 62.9%, a B score was 34.3%, a C score was 2.8%, and a D score was 0%.

Understanding the context of the material can impact students' learning processes and academic achievements (Ambarita *et al.*, 2021). So, improving the context aspect should also increase learning outcomes. Apart from context, aspects of science content also increased in cycle II compared to cycle I, as can be seen in Diagram 2.

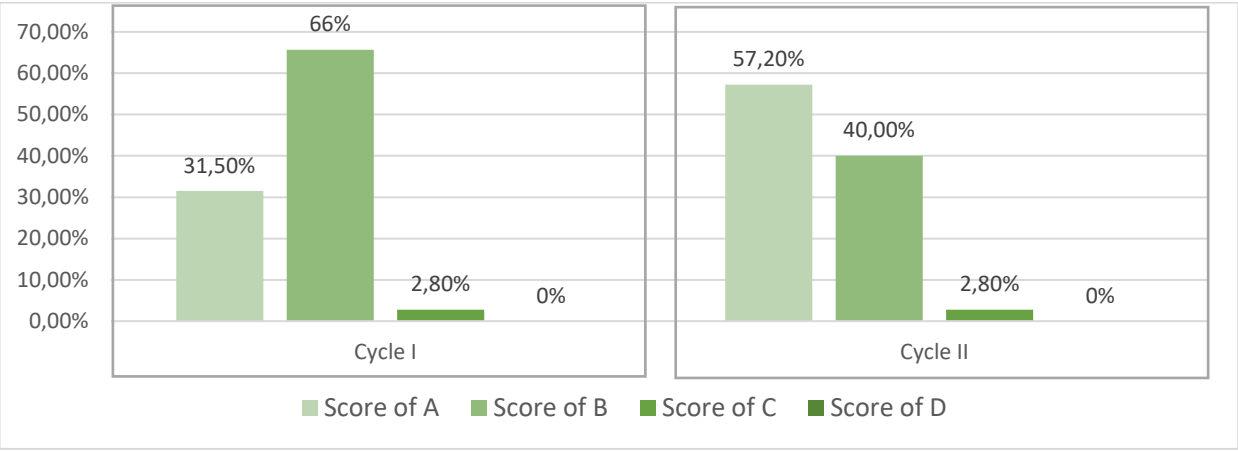

Diagram 2. Outcomes learning of content aspect

Based on diagram 2 of the content aspects, it can be seen that in cycle I, the percentage of students who got an A score was 31.50%, a B score was 66%, a C score was 2.8%, and a D score was 0%. Meanwhile, in cycle II, the percentage of students who got an A score increased to 57.2%, a B score was 40%, a C score was 2.8%, and a D score was 0%. The science competency aspect also increased in cycle II compared to cycle I, which can be seen in Diagram 3.

A good understanding of content can impact the ability to understand good concepts (Muslichatun *et al.,* 2021). Content understanding increased in cycle II, so most students scored A (excellent). Based on Wahyuni & Triayomi (2024), one way to understand reading content well is to read quickly. Therefore, students have been taught the ability to read quickly since elementary school. However, several obstacles affect student's ability to understand the content, including a lack of motivation and interest in the chapter, not being used to holding books, and an infrastructure that could be more optimal (Alpian & Yatri, 2022).

Based on the three competency aspect diagram, it can be seen that in cycle I, the percentage of students who got an A score was 28.6%, a B score was 20%, a C score was 51.6%, and a D score was 0%. Meanwhile, in cycle II, the percentage of students who got a score of A was stagnant, with the same percentage value, namely 28.6%, while the score of B had increased to 60%, the score of C had decreased significantly to 11.6%, and the score of D is 0%.

The competency aspect was initially shallow but increased in cycle II. This low competency ability can be triggered by several things, such as students being less motivated, not yet finding their goals/aspirations, so they do not know what competencies to apply in everyday life, and lack of adequate facilities and infrastructure so that students get a better picture of competency. Science, or the teacher's need for more effort in managing the class (Moslem *et al.,* 2019). The impact of student's lack of ability to apply this competency is that their critical thinking skills are less sharp, as well as their ability to analyze and relate the material to daily activities (Nuzulaeni & Susanto, 2022). Based on diagram three, students' ability to analyze material application within the scope of competency has increased.

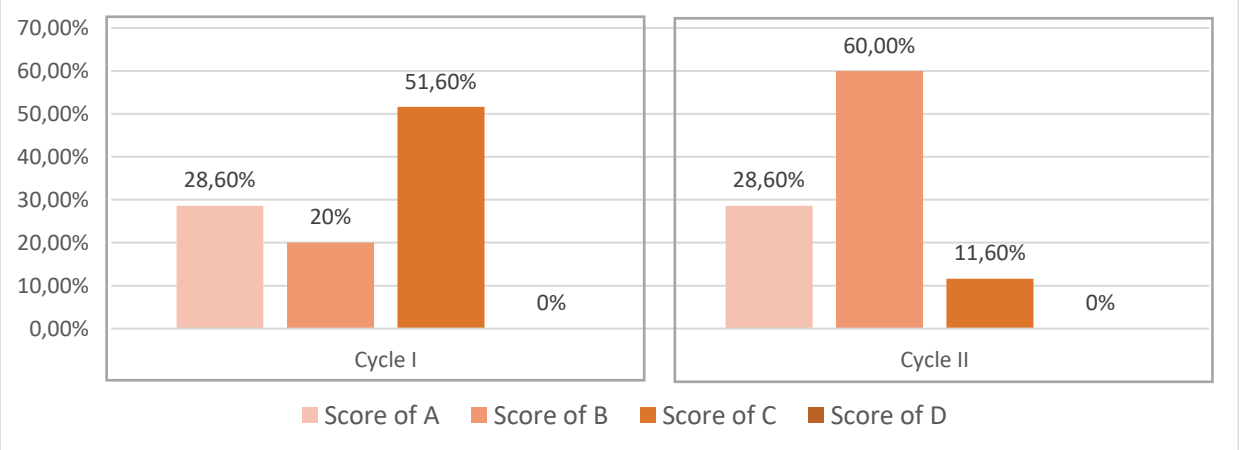

Diagram 3. Outcomes learning of competency aspect

Apart from assessing the Student Worksheet, pre-test and post-test assessments are carried out in each cycle with a minimum completeness score of 80. The pre-test and post-test content is the material studied at the meeting to measure the effectiveness of students' understanding before and after participating in learning activities. The pre-test and post-test results can be seen in Table 2.

Table 2. Outcomes Learning of Cycle I and Cycle II

No	Categories	Nilai			
		Cycle I		Cycle II	
		Pre-test	Post-test	Pre-test	Post-test
1	Number of students	35	35	35	35
2	Lowest value	50	70	70	80
3	The highest score	100	100	100	100
4	Number of students who have not yet completed	31	11	13	0
5	Number of students who have completed	4	24	22	35
6	Average class score	66,2	79,4	78	91,4
7	Completion percentage	11,4%	68,5%	62,8%	100%

Table 2 shaws that the average class score increased during the pre-test and post-test; additional students still needed to complete it. Even in cycle II, the completion percentage reached 100%, which shows an Excellent increase in student learning outcomes. As literacy skills increase, student learning outcomes increase, as Gowa *et al.* (2022) revealed.

Literacy is an ability that must be honed and improved. This is not only for the nation's progress but also for each region, especially since Indonesia has many remote areas that still need more educational facilities and have minimal literacy awareness. Urban areas tend to have communities and students with better literacy awareness than remote areas (Yudiana *et al.,* 2023). Literacy awareness can improve critical thinking skills because of the various analyses and dialogues carried out by the head. Literacy itself is one of the community's daily needs to keep up to date with the latest developments (Anisa *et al.,* 2022).

Apart from choosing a learning model, there are several things that schools can also do to encourage increasing student's scientific literacy. This has also been implemented by SMP Negeri 2 Buduran with the same hopes. These things include habituation (reading activities without bills), development (reading activities with bills), and finally, learning (integrating scientific literacy into various science subjects). Thus, the school is oriented towards the School Literacy Movement program and helps improve student’s scientific literacy (Fairuza, 2020).

CONCLUSION

Based on the research results, it is known that students' scientific literacy has increased. In the context aspect of cycle I, as many as 37% of students got a score of A, 60% got a score of B, and 2.8% got a score of C. These results increased in cycle II of the context aspect; as many as 62.9% of students got a score of A, 34.3% got a score of B, and 2.8% got a score of C. In the content aspect of cycle I, 31.5% of students got a score of A, 66% got a score of B, and 2.8% got a score of C. Then there was an increase in the content aspect of cycle II, as many as 57.2% of students got a score of A, 40% got a score of B, and 2.8% got a score of C. Furthermore, in the competency aspect of cycle I, students who got an A score were 28.6%, a B score was 20%, and a

C score was 51.6%. This experienced a change in the competency aspect of cycle II; as many as 28.6% of students got a score of A, 60% got a score of B, and 11.6% got a score of C.

Additionally, increasing scientific literacy can be seen in increasing student learning outcomes. In cycle I, the average class score on the pre-test was 66.2 with a completion percentage of 11.4%, then it increased in the post-test with the class average score reaching 79.4 and a completion percentage of 68.5%. In cycle II, the average class score on the pre-test increased rapidly to 78, with a completion percentage of 62.8%. Then, in the post-test, it reached an average score of 91.4 and a completion percentage of 100%.

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