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Research Article

Application of the Problem-Based Learning to Improve Scientific Literacy Skills Through Practicum Worksheet for Grade 11 Students of Senior High School 1 Samalanga

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Abstract
Problem-based learning (PBL) model invites students to be able and trained so that students in solving problems can improve students' scientific literacy abilities. This research aims to determine the application of the problem basic learning (PBL) model to improve scientific literacy skills through practicum worksheet for grade XI students at Senior High School (SMA) 1 Samalanga. The subjects of this research were students in grade XI of SMA Negeri 1 Samalanga for the 2023/2024 academic year, totaling 31 students. Meanwhile, the type of research used is classroom action research. This research was conducted in two cycles. In the first cycle, the material discussed was acids and bases from various experts, and in the second cycle, the material discussed was acids and bases in daily life, including conducting practical work using worksheets. The research data collection instruments are observation, test with 5 multiple-choice questions, and questionnaires, all three of which are analyzed using a percentage test. The results of the analysis based on pretest and posttest score data using the PBL model increased from 53% to 75%. Apart from that, improvements can also be seen in the aspects of students' attitudes and skills with an average score of 72% with "good" criteria. Based on these results, it can be concluded that the application of the problem based learning model through practicum worksheet can improve students' scientific literacy skills. It is recommended that research using the Practicum-based PBL worksheet can be continued on other chemical materials.

Keywords: High School Students, Practicum, Problem-based Learning, Scientific Literacy, Worksheet

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1. INTRODUCTION

The Merdeka Curriculum, an alternative to the 2013 Curriculum, was officially launched by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia in 2022. This curriculum focuses on core materials, utilizes digital technology, and grants teachers the freedom to use teaching materials that suit the needs and characteristics of their students. All these efforts are undertaken while upholding the values of Pancasila as the main foundation of education. The Pancasila Student Profile is crucial for shaping young generations who understand Pancasila (Solehah, 2023).

Problem-Based Learning (PBL) is a model that can be used to support the Pancasila Student Profile in the learning activities of the Merdeka Curriculum. This model employs real or authentic problems presented in an open and structured context to help students learn critical thinking and problem-solving skills. According to David Johnson & Johnson (Trianto, 2010), PBL consists of four stages: (1) defining the problem; (2) identifying the problem; (3) developing alternative strategies; and (4) selecting and implementing the chosen strategy. (5) Conducting an evaluation. Students must identify and analyze the problem, gather and evaluate relevant information, generate creative ideas and solutions, and consider various perspectives before reaching a conclusion (Mashami & Khaeruman, 2020; Simamora, 2024).

Chemistry, as a natural science, is often referred to as the mother of sciences due to its ability to relate to other sciences. The teaching and learning process in schools is used to enhance students' knowledge. Learning is a fundamental activity in the entire school process (Agustin et al., 2024). It represents a relatively permanent change in behavior in a person as a result of experience or practice, involving both physical and psychological aspects (Muderawan et al., 2019). One way to empower students' potential is by providing a laboratory. Laboratories are essential as a means to enhance students' knowledge and skills in science learning activities. A laboratory is one of the educational facilities that can be used as a place to train students in understanding concepts and improving skills in conducting scientific experiments (Emda, 2017).

The 21st-century skills encompass four key areas: literacy in the digital era, inventive thinking, effective and correct communication, and high productivity in life. A competitive generation is needed in mastering science and technology, focusing on scientific literacy skills (Setiawan et al., 2017). Scientific experiments help students solve current issues, which can be addressed through scientific literacy. Scientific literacy is essential for solving cases/issues occurring in science (Asworo, 2024; Pardiana, 2024; Wibowo & Ariyatun, 2020).

Given the importance of scientific literacy, educating the public to achieve scientific literacy is a primary goal in every science education reform (DeBoer, 2000). This is because in the learning process, students do not only listen to the teacher's explanations but also participate in additional activities, such as observing and demonstrating experiments in real laboratories. Students' abilities to obtain information also vary. Cognitive tests are a way to measure students' learning outcomes. Cognitive ability is related to students' intellectual learning outcomes. Enhancing cognitive abilities can improve students' thinking skills and mastery in the cognitive domain (Sudjana, 2012 in Vidayanti et al., 2017). This is beneficial for obtaining the necessary data during the learning process. This study investigates the use of the Problem-Based Learning model to enhance the scientific literacy skills of students in Grade XI at SMA Negeri 1 Samalanga.

2. METHOD

2.1 Research Design

This research was conducted in two cycles. In the first cycle, the material discussed was acids and bases from various experts, and in the second cycle, the material discussed was acids and bases in daily life, including conducting practical work using worksheets.

2.2 Participants

This study involved 31 students from Grade X at SMA Negeri 1 Samalanga. The research employed classroom action research (CAR), aiming to improve the quality of graderoom learning. CAR focuses on what happens in the graderoom and is planned through cycles; each cycle goes through four stages: planning, action, observation, and reflection. All these stages are tailored to enhance the quality of learning (Arikunto, 2010).

Table 1. Criteria for Students' Learning Outcomes

Interval	Category
81 – 100	Very Good
61 – 80	Good
41 – 60	Acceptable
21 – 40	Poor
1 – 20	Very Poor

2.3 Data Collection Tool

The instruments used in this study include a knowledge test with 5 multiple-choice questions ranging from levels C1 to C4 based on Bloom's taxonomy. The collected data were processed and analyzed. The

percentage of students' learning mastery refers to the school's criteria for achieving learning objectives (KKTP), which is 65. Students are considered to have mastered the material if their test results are above 65. Besides the test instruments, this study also used observation sheets for the implementation of learning and skill instruments by applying the Problem-Based Learning model. The criteria for mastery are presented in Table 1 (Arikunto, 2010).

3. RESULTS

This research was conducted to determine the role of the PBL (Problem-Based Learning) model assisted by laboratories in improving the scientific literacy of high school students. The study began with a pre-test consisting of 5 multiple-choice questions aimed at identifying the initial literacy of students before they received treatment. After the treatment, the PBL model assisted by laboratories was applied in the learning activities. Table 2 shows the results of the pre- and post-test in this study.

Table 2. Results of Cognitive Tests in Cycles I and II

Variable	Cycle 1	Cycle 2
Mean	60.2	72.4
Completed Students	15	25
Incomplete Students	16	8
Max	80	100
Min	20	40

As shown in Table 2, the percentage of students who met the cognitive test mastery criteria in Cycle I was 53%. Thus, the number of students with scores below the minimum competency criterion (KKTP), which is below 62, was greater than those with scores above the KKTP. Therefore, teachers must reflect and improve their teaching approach during Cycle I. On the other hand, the cognitive test results of students in Cycle II was 81% with a good gradeification. Consequently, the number of students with scores above the KKTP, which is above 62, was greater than those below the KKTP. Based on the data, the average cognitive test scores of students increased significantly from Cycle I to Cycle II. The students' scores in the first cycle were in the sufficient category, which was 60.2. Their scores increased in the second cycle as they directly conducted practical work and observed the results using worksheets based on scientific literacy. They seemed interested in completing the worksheets to process, interpret, and analyze the data. As a result, the students' cognitive test scores increased significantly during the second cycle.

Borax testing is crucial for students because borax is hazardous when present in food. The data on borax testing results are shown in Table 3 below.

Table 3. Borax Identification Results

No	Sample	Positive for Borax	Negative for Borax
1.	Tofu		√
2.	Tempeh	√	
3.	Noodles	√	

From Table 3, it is found that some foods tested positive for borax, indicated by a brownish color change when turmeric was added. Using the PBL model, students were able to solve several current cases.

The results of this study align with previous research findings that show the PBL model has a significant impact on students' cognitive abilities with good average scores. PBL also improves students' conceptual understanding and their ability to use scientific literacy to solve problems. Furthermore, other research found that the PBL model significantly influences physical learning to improve student learning outcomes (Anggraeni & Moersilah, 2024; Desimah et al., 2019).

4. CONCLUSION

Based on the results of the research conducted, it can be concluded that the application of the problem-based learning model can improve students' scientific literacy through practical worksheets. This can be seen from the increase in average pre-test and post-test scores from Cycle I to Cycle II from 53% to 75%. Some foods, such as noodles and tempeh, were found to contain borax during testing, highlighting the importance for students to avoid consuming foods containing borax. Teachers are expected to be able to vary the learning models to avoid boredom and create an enjoyable learning atmosphere. The Problem-Based Learning model can be a solution to enhance students' scientific literacy skills.

Data Availability Statement. All data can be obtained from the corresponding author.

Conflicts of Interest. The authors declare no conflicts of interest.

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