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THE USE OF PROBLEM-BASED LEARNING (PBL) MODEL TO IMPROVE SCIENCE LITERACY SKILLS IN SCIENCE EDUCATION

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Abstract

This research aimed to enhance science literacy skills in the aspect of competence related to interpreting data and scientific evidence using the problem-based learning model in science education at State Junior High School 16 Surakarta. The research method employed is collaborative classroom action research conducted in two cycles. Each cycle comprises four stages: 1) planning, 2) implementation, 3) observation, and 4) reflection. Data collection techniques involve pre-test and post-test questions on science literacy in the aspect of competence related to interpreting data and scientific evidence, consisting of five multiple-choice items in each cycle. The average results of science literacy in the aspect of competence, specifically interpreting data and scientific evidence indicators, in the first cycle were 57.30, and in the second cycle, it increased to 61.15. Based on the research findings, it can be concluded that the problem-based learning model can enhance science literacy skills in the aspect of competence related to interpreting data and scientific evidence in science education at State Junior High School 16 Surakarta.

***Keywords**: Problem Based Learning, Scientific Literacy, Competence Aspect, Interpret Data and Evidence Scientifically*

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INTRODUCTION

The 21st century is marked by rapid technological advancements, bringing significant changes in lifestyle and societal interactions, with digital technology playing a pivotal role across various aspects of life (Chu et al., 2016). In this era, students are expected to develop 4C skills, including critical thinking, creativity, communication, and collaboration. Additionally, they are required to master basic literacy skills such as reading, writing, numeracy, cultural understanding, information technology, financial literacy, and science literacy (World Economic Forum, 2015). Science literacy is crucial for supporting the development of 21st-century competencies. A society with the knowledge to connect science, technology, and society, understand scientific facts, and solve everyday life problems is considered scientifically literate (Bond in Pratiwi et al., 2019). Achieving science literacy enables individuals to use the scientific knowledge acquired through education and available technology to address challenges.

The Programme for International Student Assessment (PISA) defines science literacy as the capacity to engage with scientific issues, ideas, and concepts, enabling individuals to participate in reasoned discourse about science and technology (OECD, 2018). PISA divides science literacy into three aspects: context, knowledge, and competencies. Context refers to the application of scientific knowledge to solve real-world problems, incorporating issues related to the science curriculum of participating countries, including personal, local, national, and global contexts. Knowledge involves understanding the fundamental scientific knowledge, including content, procedural, and epistemic knowledge. Competencies include the ability to explain phenomena scientifically, evaluate and design scientific investigations, and interpret data and evidence scientifically.

Science literacy plays a vital role in helping students understand aspects such as the environment, technology, health, modern society, and the economy (Pratiwi et al., 2019). It is also crucial for students to solve various challenges faced by modern society. The concept of science literacy in education is not limited to understanding facts and theories but also involves the learning process to comprehend and make sense of phenomena relevant to daily life. Given the importance of science literacy, it is essential for science teachers to focus on the competencies aspect when implementing instructional activities (Rahayu, 2015). The goal of science education reform is to develop scientifically literate societies (DeBoer, 2000).

Based on the 2018 PISA results, Indonesia's science literacy scores dropped from an average of 489 to 396 (OECD, 2018). Factors contributing to Indonesia's low ranking in PISA include insufficient training for students in solving contextual problems and the lack of implementation of science literacy in science education

by teachers (Fakhriyah et al., 2017). This is further supported by observations and interviews conducted at SMP Negeri 16 Surakarta, where it was found that assessment instruments used by teachers primarily tested low-order thinking skills. However, to support science literacy, assessment instruments should include high-order thinking skills. During classroom activities, students were less active and struggled to interpret data presented by teachers.

The importance of using appropriate instructional models to develop science literacy should be considered in the teaching process to equip students with strong competitiveness in the current information technology era. In science education, students should not only understand concepts and processes but also actively engage in real-world cases. One approach that can facilitate this is the implementation of problem-based learning (PBL). The PBL model provides students with direct experiences, encourages active learning by allowing them to seek and construct their own knowledge, and connects this knowledge to real-life contexts scientifically (Setyowati et al., 2023). Tamam & Subrata (2022) reported that the application of PBL effectively improves students' science literacy at the elementary school level.

According to Kurniawati and Hidayah (2021), the problem-based learning model allows students to be actively involved in the learning process, utilize scientific learning, recognize problems related to daily life, and make the learning experience more engaging. Each stage of problem-based learning requires students to independently formulate problems, solve them, gather data, and draw conclusions. Science education is successful when it links the concepts taught to students with everyday situations. When students understand the material, they are better able to apply it to solve real-life problems (Herman et al., 2022). Providing problems in student worksheets (LKS) stimulates students to develop science literacy competencies, particularly in interpreting data and scientific evidence, as this model allows students to directly engage with issues around them. Based on these challenges, the researcher is interested in conducting a classroom action research titled “The Use of Problem-Based Learning Model to Improve Science Literacy Skills in Science Education”.

RESEARCH METHOD

The method used in this study is collaborative classroom action research (PTKK). Sakdiah (2021) explains that the PTKK method is a research approach that involves teachers and teams in building future teachers, with the aim of improving the quality of teachers in addressing classroom learning problems to enhance the effectiveness of learning. This collaborative classroom action research consists of four stages: 1) planning, 2) implementation, 3) observation, and 4) reflection (Kemmis, McTaggart & Nixon, 2014). The research was conducted in two cycles, with each cycle consisting of one meeting. The illustration of the research method is presented in Figure 1.

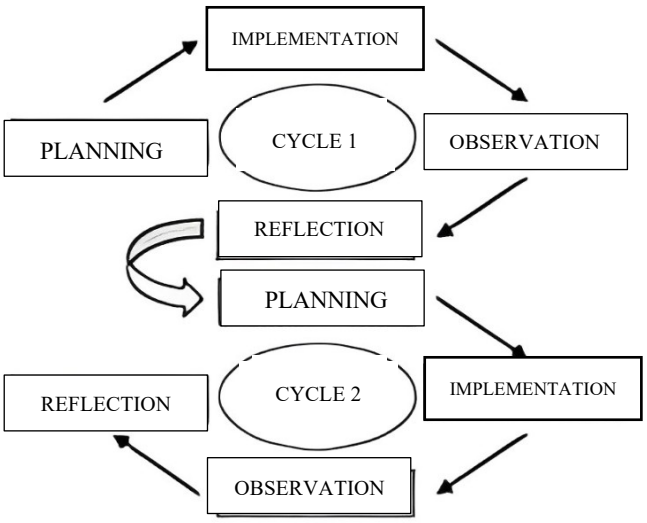

Figure 1. Stages in the Cycle of Collaborative Classroom Action Research Implementation

This collaborative classroom action research was carried out at SMP Negeri 16 Surakarta for the academic year 2023/2024, in collaboration with a science teacher at SMP Negeri 16 Surakarta. The subjects of this research were students of class VIIF, consisting of 26 students. Cycle 1 was conducted on August 14, 2023, and Cycle 2 was conducted on August 21, 2023. The research data consisted of test results on the science literacy aspect of the competency indicator for interpreting data and scientific evidence. The instruments used

in this study were pre-test and post-test questions in the form of multiple-choice questions, with 5 questions each in Cycle 1 and Cycle 2, to assess the science literacy competency indicator for interpreting data and scientific evidence on the topic of matter and its changes. The sub-indicators for the science literacy competency indicator for interpreting data and scientific evidence are presented in Table 1.

Table 1. Sub-Indicators for Science Literacy Competency Indicator in Interpreting Data and Scientific Evidence

Indicator	Sub-Indicator
Interpreting data and scientific evidence	Converting data from one representation to another Analyzing and interpreting data and drawing appropriate conclusions Identifying assumptions, evidence, and reasoning in texts related to science Distinguishing between arguments based on scientific evidence and theory and arguments based on other considerations Evaluating scientific arguments and evidence from various sources

Source: Zahropi dkk., (2019)

RESULTS AND DISCUSSION

The research conducted at SMP Negeri 16 Surakarta employed a collaborative classroom action research method with two cycles. The aim of this study was to evaluate the implementation of the problem-based learning (PBL) model in enhancing the science literacy competency indicator for interpreting data and scientific evidence on the topic of matter and its changes. During the planning phase, the researcher designed teaching modules using the problem-based learning model. The material for Cycle 1 focused on the states of matter and particle models. In Cycle 2, the material taught was about changes in the states of matter. Table 2 presents the data on the science literacy competency indicator for interpreting data and scientific evidence during Cycles 1 and 2.

Table 2. Results of Science Literacy Competency Indicator for Interpreting Data and Scientific Evidence

	Cycle 1		Cycle 2	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Students Average	53,08	61,53	55,38	66,92
Students Average in A Cycle	57,30		61,15	

Source: Personal Data (2023)

Based on Table 2, in Cycle 1, the average pre-test score for the science literacy competency indicator for interpreting data and scientific evidence was 53.08, and the average post-test score was 61.53. In Cycle 2, the average pre-test score was 55.38, and the average post-test score was 66.92. The average score for Cycle 1 was 57.30, and for Cycle 2, it was 61.15. The implementation of the problem-based learning model from Cycle 1 to Cycle 2 showed an increase of 3.85 points. This indicates that the problem-based learning model effectively improved students' science literacy competency in interpreting data and scientific evidence.

These results align with the study by Adiwiguna et al. (2019), which demonstrated that the STEM-oriented PBL model positively influenced students' critical thinking and science literacy skills by increasing student engagement with peers and teachers and enhancing their critical thinking abilities in addressing given problems. This suggests that the problem-based learning model can improve various aspects of science literacy as students become more active in learning activities, enabling them to find solutions to the problems presented.

CONCLUSION AND SUGGESTIONS

A. Conclusion

Based on the research conducted, the average score of science literacy in the competency indicator of interpreting data and scientific evidence was 57.30 in Cycle 1 and 61.15 in Cycle 2. Therefore, it can be concluded that the problem-based learning model effectively enhances the science literacy competency in interpreting data and scientific evidence in science lessons at SMP Negeri 16 Surakarta.

B. Suggestions

Further research is recommended on the application of the problem-based learning model to improve science literacy in other aspects, such as context and knowledge, to assess the effectiveness of the PBL model in enhancing science literacy in these areas.

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