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The Effect Of The Problem-Based Learning Model In The Merdeka Curriculum On Junior High School Students' Mathematical Problem-Solving Skills

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Abstract— The Merdeka Curriculum has begun to be implemented in several schools across Indonesia. This curriculum change presents a new challenge for educators, requiring them to adapt to its application. Additionally, problem-solving skills are among the essential competencies needed in the 21st century. One of the learning models that can be applied to Merdeka Curriculum is Problem-Based Learning. Therefore, this study aims to examine the effect of the Problem-Based Learning (PBL) model in the Merdeka Curriculum on the mathematical problem-solving skills of seventh-grade junior high school students. This study used a quasi-experimental method. The sample used in this study was 30 seventh grade of junior high school students. Data were collected using a mathematical problem-solving skills test instrument in the form of a pretest and posttest. Hypothesis testing was conducted using the Independent Sample T-test, preceded by prerequisite tests, namely the normality test and the homogeneity test. Based on the research findings, the sig. (2-tailed) value in the Equal Variance Assumed section was 0.008, which is less than $\alpha = 0.05$, leading to the rejection of H_0. Since H_0 is rejected, it can be concluded that the Problem-Based Learning (PBL) model has a significant positive effect on students' mathematical problem-solving skills.

Keywords— Merdeka Curriculum; problem-solving; Problem-Based Learning; mathematics.

I. INTRODUCTION

Learning is an activity carried out to facilitate students in improving the quality of their learning. Gagne et al. stated that learning is a series of structured activities designed to enable the learning process in students [1]. Education in the 21st century must be adaptable to meet various needs arising from advancements in science, technology, and the arts [2]. Therefore, continuous efforts are required to improve the existing quality of education [3]. Therefore, a new curriculum, the *Merdeka* Curriculum, has been introduced and implemented in Indonesia.

The *Merdeka* Curriculum serves as a new alternative to improve the previously implemented curriculum. It introduces a novel concept designed to allow students the freedom to choose and determine their desired education, access diverse and technology-based learning resources, and develop skills relevant to the future [4]. This *Merdeka* Learning concept is part of *Society 5.0*, which integrates technological advancements with societal challenges, demonstrating that technology has become an essential

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part of social needs [5]. Furthermore, teacher involvement in curriculum development is crucial to aligning its content with students' needs in the classroom [6].

Mathematics, as one of the subjects taught in schools, plays a crucial role in education. One of the objectives of mathematics learning, as outlined in the curriculum, is to train students in solving mathematical problems. Problem-solving is the process of finding a way to achieve a goal that cannot be attained immediately [7]. In problem-solving, students engage in various higher-order thinking processes to develop solutions to the challenges they encounter [8]. There are four stages of problem-solving: (1) understanding the problem, (2) devising a plan to solve it, (3) executing the planned solution, and (4) reviewing the steps taken [7]. The importance of problem-solving skills is emphasized by the National Council of Teachers of Mathematics, which states that students' mathematical thinking involves five key competencies: problem-solving, reasoning, mathematical connections, communication, and representation [9]. Students must develop problem-solving skills to effectively tackle problem-based questions [10].

Although problem-solving skills are essential, field observations indicate that students' mathematical problem-solving abilities remain low. Research revealed that students' problem-solving skills are still categorized as weak [11]. This aligns with the findings of Yuristia & Musdi who stated that students' ability to solve mathematical problems remains low, requiring further action to improve it [12]. In addition, research that has been conducted shows that students' low problem-solving skills stem from a lack of confidence, difficulty understanding given problems, weak comprehension of concepts and principles, and insufficient calculation skills [13]. Several cognitive factors influence students' mathematical problem-solving abilities, including prior knowledge, academic background, and text comprehension skills [14]. One way to enhance students' mathematical problem-solving skills is by selecting an appropriate teaching method [10]. One instructional model that is considered applicable is Problem-Based Learning (PBL).

Problem-Based Learning (PBL) is one of the teaching strategies that prioritizes student engagement over direct teacher instruction [15]. The PBL model helps students better connect what they have learned with real-world problems, enabling them to identify relevant and contextual issues [16]; [17]. PBL is also used in the curriculum to solve problems related to the real world [18]. The implementation of PBL in the classroom allows students to take an active role in solving meaningful problems [19]. Consequently, throughout the learning process, students construct knowledge and enhance their mathematical problem-solving skills.

The learning process using the PBL model consists of several steps: (1) identifying the problem, (2) analyzing the problem, (3) researching and reporting, (4) presenting solutions and reflecting, and (5) reviewing and evaluating [20]. Research conducted by Boye & Agyei indicates that the PBL model intervention is more effective in teaching mathematical concepts [21]. Similarly, a study by Mushlihuddin et al. found that the PBL model is influential and effective in enhancing students' mathematical problem-solving skills [22]. This results of other studies also show that the improvement in students' mathematical problem-solving skills is greater for those taught using the PBL model compared to those taught through conventional learning methods [23].

Most of the previous studies were conducted using the 2013 curriculum, whereas some schools have now begun implementing the *Merdeka* Curriculum. Therefore, the aim of this study is to examine and describe whether the PBL learning model, implemented within the *Merdeka* Curriculum, has an effect on students' mathematical problem-solving skills.

II. Research Method

This study used a quantitative approach with a quasi-experimental design. The specific research design used was the *Nonequivalent Group Pretest-Posttest Design*, in this research design, there are two sample classes: the experimental class and the control class [24]. Each sample class is given different treatments and administered a pretest and posttest at the same time. The following is the table of the research design used:

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Table 1. Nonequivalent Group Pretest-Posttest Research Design

Group	Pretest	Treatment	Posttest
E_1	T_1	X_1	T_2
E_2	T_1	X_2	T_2

Description:

E_1: Experimental Class Group

E_2: Control Class Group

X_1: Using the Problem-Based Learning (PBL) model

X_2: Using the direct instruction model

T_1: Pretest given to both the first and second classes

T_2: Posttest given to both the first and second classes

This study was conducted at a public junior high school in Yogyakarta during the even semester of the 2024/2025 academic year. The population in this study consisted of all Grade VII students, while the sample included 30 students from Grade VII D as the experimental group, which was taught using the Problem Based Learning model, and 30 students from Grade VII E as the control group, which was taught using the direct instruction model. The sampling technique used in this study was purposive sampling.

The research instrument used was a test instrument in the form of two open-ended questions designed to measure students' mathematical problem-solving skills. To validate the test instrument, validity and reliability tests were conducted. Following this, data analysis was performed using the Independent Sample T-test. The assumption tests that needed to be met included the normality test and the homogeneity test. The following are the indicators of mathematical problem-solving skills used in this study:

Table 2. Indicators of Mathematical Problem-Solving Skills Test

Aspect	**Indicator**	**Question Type**	**Question Item**
Understanding the problem	Identifying and understanding the given information in the problem.	Essay	1, 2
	Identifying what is being asked in the given problem.		
Planning the solution	Planning the steps or procedures for solving the problem by drawing diagrams, writing models, or formulating equations based on the given problem.		
Executing the solution	Performing calculations according to the planned procedure.		
Reviewing the solution	Checking or verifying the obtained answer.		

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III. Research Results

. The experimental class was given treatment using the Problem-Based Learning (PBL) model on the topic of the surface area of three-dimensional shapes with flat faces. The instruments prepared in this study included a teaching module, Student Worksheets (Indonesian: *Lembar Kerja Siswa*; LKS), and test questions in the form of a pretest and posttest to measure problem-solving skills, consisting of two questions. Before administering the test instrument, an assessment was conducted to determine its validity and reliability. The results of the validity test are as follows.

Table 3. Validity of the Mathematical Problem-Solving Skills Test

No. Item	r_{xy}		Description
	Pretest	Posttest	
1	0.863	0.770	High Validity
2	0.758	0.901	High Validity

From the table above, it can be seen that both tested questions have high validity, making them feasible for use as research instruments. The reliability test was calculated using Cronbach's Alpha formula, resulting in a pretest score of 0.840 and a posttest score of 0.855, both of which fall into the high category.

After that, normality and homogeneity tests were conducted as assumption tests that needed to be met. The normality test was performed using the Kolmogorov-Smirnov test. The results of the normality test presented in Table 4 below.

Table 4. Normality Test of Pretest and Posttest Data

	Class	*Sig*
Mathematical Problem-Solving Skills	Pretest Experimental	0.072
	Posttest Experimental	0.109
	Pretest Control	0.200
	Posttest Control	0.200

From the table above, it can be seen that the Sig. value of the pretest-posttest in the experimental and control classes is greater than $\alpha = 0.05$, so H_0 is accepted. Thus, it can be concluded that the average pretest and posttest scores of students' mathematical problem-solving skills are normally distributed. Meanwhile, the homogeneity test was conducted using Levene's Test. The results presented in Table 5 below.

Table 5. Homogeneity Test of Control and Experimental Classes

		Sig.
Pretest Mathematical Problem-Solving Skills	*Based on Mean*	0.745
Posttest Mathematical Problem-Solving Skills		0.136

Based on the table above, it is known that the Sig. Based on Mean value for the Pretest is 0.745, and the Sig. Based on Mean value for the Posttest is 0.136. Since both values have Sig. > 0.05, H0 is accepted. Thus, it can be concluded that the variance of the Pretest-Posttest groups in the experimental and control classes comes from a homogeneous population. Next, a hypothesis test was conducted using the Independent Sample T-test to examine the effect of the PBL learning model on students' mathematical problem-solving skills. The results of the Independent Sample T-test are presented in Table 6 below.

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Table 6. Independent Sample T-Test

		F	Sig.	t	df	Sig. (2-tailed)
Mathematical Problem-Solving Skills	Equal variances assumed	0.725	0.398	−2.744	57	0.008
	Equal variances not assumed			−2.754	55.045	0.008

From the test results, the Sig. (2-tailed) value was 0.008, which is less than $\alpha = 0.05$, leading to the rejection of H_0. Therefore, it can be concluded that the Problem-Based Learning (PBL) model affects the mathematical problem-solving skills of Grade VII junior high school students.

IV. DISCUSSION

In this study, the learning model used was Problem-Based Learning (PBL), which was implemented in a classroom following the *Merdeka* Curriculum. Throughout the learning process, students formed groups to engage in collaborative discussions to solve mathematical problems related to the surface area of three-dimensional shapes with flat faces. Peer interaction plays a crucial role in learning, making it essential for teachers to create a collaborative environment in the classroom [25]. The OECD also includes collaborative skills among the essential competencies required in the 21st century [26]. The following are the results of students' responses regarding their problem-solving skills.

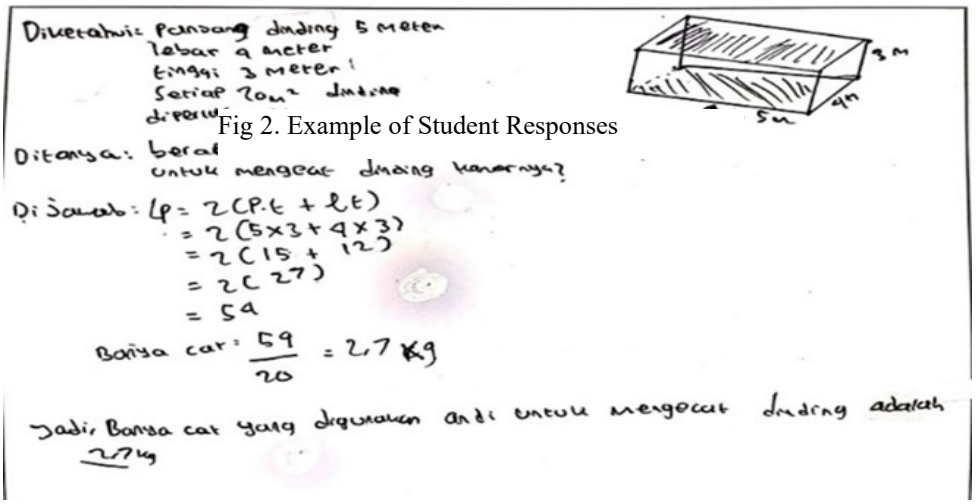

Fig 2. Example of Student Responses

Fig 1. Students' Responses in the Experimental Class

Based on the responses above, it can be seen that students were able to identify the given information and understand what was being asked in the mathematical problem-solving task. Additionally, students demonstrated proficiency in outlining the strategy to solve the problem by applying the surface area formula for an open-top and open-bottom rectangular prism, $L_p = 2(pl + lt)$, to determine the total painted surface area. Moreover, students successfully performed the calculations accurately. In the final step, when verifying their answers, students also showed a clear understanding of the process.

However, some student responses indicate that they were unable to identify the given information in the problem and failed to determine what was being asked. Additionally, some students struggled to formulate a strategy or apply the correct formula to solve the given problem and made errors in their calculation procedures. An example of such student responses is shown in the following figure.

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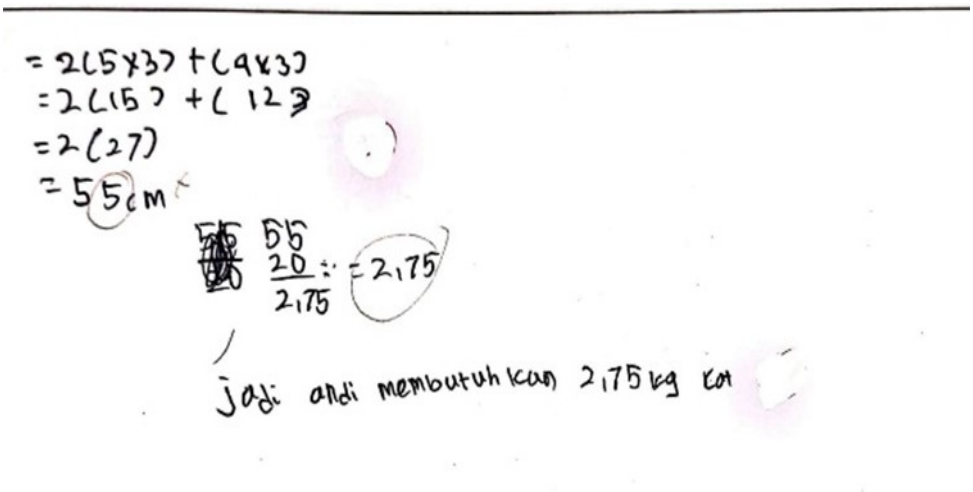

Based on the analysis and the student responses presented above, the implementation of the Problem-Based Learning (PBL) model in the *Merdeka* Curriculum has been effective in improving students' problem-solving skills. Although some students still faced difficulties in solving the problems, the majority were able to understand and complete the tasks successfully. Therefore, it can be concluded that the use of the Problem-Based Learning (PBL) model in the *Merdeka* Curriculum has a significant effect on the mathematical problem-solving skills of Grade VII junior high school students.

V. CONCLUSION

Based on the results of this study, it can be concluded that the Problem-Based Learning (PBL) model in the *Merdeka* Curriculum affects the mathematical problem-solving skills of Grade VII junior high school students. Therefore, the PBL model can be implemented in schools that have adopted the *Merdeka* Curriculum intending to enhance students' mathematical problem-solving abilities. Additionally, this study can serve as a consideration for teachers in applying the PBL model within the *Merdeka* Curriculum to improve students' mathematical problem-solving skills. Furthermore, future research can be expanded by incorporating students' cognitive abilities or comparing the effectiveness of PBL with other instructional models to help teachers select the most suitable teaching approach for their students.

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