



**THE EFFECT OF THE PROBLEM-BASED LEARNING (PBL) MODEL ON THE MATHEMATICAL PROBLEM-SOLVING ABILITIES OF 11TH-GRADE STUDENTS OF WELDING AND METAL FABRICATION ENGINEERING AT STATE VOCATIONAL HIGH SCHOOL 1 RANAH BATAHAN**

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**Abstrak**

This study was motivated by the low mathematical problem-solving ability of students at SMK Negeri 1 Ranah Batahan. The research aimed to determine the effect of applying the Problem-Based Learning (PBL) model on the mathematical problem-solving ability of grade XI Welding and Metal Fabrication students. This quantitative study used a quasi-experimental method (one group pretest-posttest design). The sample consisted of 20 students selected through purposive sampling. Data were collected using essay tests based on problem-solving indicators and analyzed with Shapiro-Wilk normality test, Levene's homogeneity test, and paired t-test at a 0.05 significance level. Results showed an increase in the mean score from 43.06 (pre-test) to 50.43 (post-test). The paired t-test produced a p-value of  $0.033 < 0.05$ , indicating a significant effect of PBL on students' mathematical problem-solving skills. The implementation of PBL encouraged more active participation, better connection of concepts to real contexts, and increased learning motivation

**INTRODUCTION**

Education is the primary foundation of national development, playing a crucial role in developing high-quality, adaptive, and highly competitive human resources (Setiawan, 2023). Advanced education emphasizes not only the transfer of knowledge but also the development of critical thinking, creativity, and problem-solving skills relevant to the

demands of Society 5.0 (Siregar, 2024; Daimah & Suparni, 2023). In this regard, mathematics is an essential subject that contributes to the development of students' logical and systematic thinking patterns (Pangkey, 2024).

However, observations and interviews at SMK Negeri 1 Ranah Batahan indicate that mathematics learning remains teacher-centered, the use of innovative learning media and strategies is limited, and students tend to be passive. They struggle to solve problem-based problems, are less able to collaborate, and often memorize formulas without understanding the concepts. This results in low mathematical problem-solving skills.

One alternative believed to address these issues is the implementation of the Problem-Based Learning (PBL) model. PBL positions students at the center of learning through contextual problem-solving that requires in-depth analysis, collaboration, and the precise application of concepts (Sumantri, 2016; Yusri, 2018). This model aligns with constructivism theory, which emphasizes meaningful learning through exploration and social interaction (Harto, 2022).

Previous research, such as that conducted by Sari (2020), has shown that PBL has a positive effect on improving mathematical problem-solving skills. However, research related to the application of PBL to vocational high school students, particularly those majoring in Welding Engineering and Metal Fabrication, is still limited. This gap in this research also contributes to the study of PBL implementation in vocational contexts.

This research is expected to provide theoretical contributions in the form of strengthening empirical evidence on the effectiveness of PBL in improving mathematical problem-solving abilities, as well as practical contributions for teachers in choosing appropriate learning strategies. The purpose of this study is to determine the effect of the application of the Problem-Based Learning model on the mathematical problem-solving abilities of class XI Welding and Metal Fabrication Engineering students at SMK Negeri 1 Ranah Batahan.

## METHODS

This study used a quantitative approach with a quasi-experimental design using a one-group pretest-posttest design. This design was used to determine the effect of implementing the Problem-Based Learning (PBL) model on mathematical problem-solving abilities.

The research population was all eleventh-grade students of the Welding and Metal Fabrication Engineering program at a State Vocational High School in West Sumatra. The research sample was taken by purposive sampling of 20 students from one class, considering the uniformity of the material, learning schedule, and the availability of research time.

The data collection technique used a descriptive test based on mathematical problem-solving ability indicators, which included: understanding the problem, planning a solution, implementing the plan, and re-checking the answers. The test instrument was validated by material experts and tested for reliability before use, resulting in a test reliability of 0.79.

The data were analyzed with the help of statistical software using the Shapiro-Wilk normality test, homogeneity of variance test, and paired sample t-test at a significance level of 0.05 to determine the differences between the pretest and posttest results.

## RESULT AND DISCUSSION

The study was conducted from May 5–June 14, 2025, over four sessions. Data on students' mathematical problem-solving abilities were obtained through a pre-test and a post-test, each consisting of three descriptive questions. The analysis results are shown in Table 1.

**Table 1. Mean, Standard Deviation, Highest Score, and Lowest Score**

Test	Average	S	Highest Score	Lowest Score
Pre-test	43,06	19,83	70,8	2,8
Post-test	50,43	20,18	77,8	6,2

The post-test scores were higher than the pre-test scores, both on average, highest score, and lowest score. The Shapiro-Wilk normality test showed that the data were normally distributed ( $P = 0.100 > 0.05$ ) and the Levene homogeneity test showed that the variance was homogeneous ( $P = 0.585 > 0.05$ ). The paired t-test produced a P-Value of  $0.033 < 0.05$ , so  $H_0$  was rejected and it was concluded that there was a significant effect of the implementation of Problem-Based Learning (PBL) on mathematical problem-solving abilities.

The improvement in scores after implementing PBL indicates the impact of Problem-Based Learning (PBL) on mathematical problem-solving skills. Students were more active in discussions, analyzing problems, and connecting mathematical concepts to real-world situations. This finding aligns with research by Sumantri (2016) and Yusri (2018), which confirmed that PBL can encourage critical thinking and collaboration.

In the context of vocational high schools, particularly in the Welding and Metal Fabrication Engineering program, PBL offers the added benefit of relevant real-world problems, thereby increasing learning motivation. These results also reinforce the notion that meaningful learning occurs when students actively engage in knowledge construction through interaction and hands-on experience.

## **CONCLUSION**

Based on the data analysis and research results that have been conducted, it can be concluded that there is an influence of the application of the Problem Based Learning (PBL) Model on the Mathematical Problem Solving Ability of Class XI Welding and Metal Fabrication Engineering Students at SMK Negeri 1 Ranah Batahan which is proven by the hypothesis test value obtained by the paired t-test with the results obtained that  $0.033 < 0.05$ .

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