
Implementation of Problem Based Learning Model to Improve the Ability to Solve SPLDV in Grade 9 Students

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Keywords	Abstract
Problem Based Learning, SPLDV, Learning Outcomes, Capacity Building	This research focuses on the challenges in learning mathematics, especially in understanding and solving the system of linear equations of two variables, which is often an obstacle for students. This study aims to improve students' ability to solve SPLDV as well as increase students' motivation and engagement in learning. This study analyzed the effectiveness of Problem Based Learning (PBL) model in improving the ability to solve the System of Linear Equations of Two Variables (SPLDV) in class VIII students of SMPN 54 Surabaya. This study involved 34 students consisting of 18 male students and 16 female students using a Classroom Action Research (PTK) approach carried out in two cycles, each of which consisted of planning, action implementation, observation, and reflection stages. The instruments used were learning outcome tests, observation sheets, and student questionnaires. The results showed a significant increase in students' SPLDV problem solving ability, with the average score of students increasing from 65 in the pretest to 75 in the first cycle post-test, and reached 85 in the second cycle post-test. The proportion of students who met the Minimum Completion Criteria (KKM) increased from 50% in the first cycle to 85% in the second cycle. Further analysis showed that female students outperformed male students, with an average score of 87 and 82. Student engagement also increased, reaching 90% in the second cycle. This study concludes that the PBL model effectively improved SPLDV problem solving skills in grade 9 students and recommends its wider application in mathematics education.

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INTRODUCTION

In the current era of education, many students have difficulty in understanding basic math concepts, including the System of Linear Equations of Two Variables (SPLDV) (Risquallah & Hidayah, 2024). This is a global problem that needs to be addressed, as math ability is an important skill that impacts students' future academic and professional success.

Evaluation results at SMP Negeri 54 Surabaya show that many students do not reach the Minimum Completion Criteria (KKM) in SPLDV lessons. The lack of understanding and ability to apply mathematical concepts in real situations is the main cause of this problem. In this context, the application of a more effective learning model is needed to improve student learning outcomes.

This research is important to conduct because of the need to identify and apply learning methods that can improve students' ability to solve SPLDV. By using the Problem Based Learning (PBL) model, it is expected that students can not only understand the theory, but also be able to apply it in a broader context. This research aims to provide real solutions

to these problems, as well as contribute new discourse in the development of more effective mathematics learning strategies.

Problem Based Learning (PBL) is a student-centered learning model, where they are given real problems to solve through a critical and collaborative thinking process. This model not only encourages students to understand the material, but also to develop higher-order thinking skills that are important in solving math problems such as SPLDV. At SMPN 54 Surabaya, the application of PBL is expected to improve students' ability to solve SPLDV (Sopanda et al., 2022).

Research that has been conducted shows that PBL can significantly improve students' problem solving skills. A study conducted by researchers in one of the junior high schools in Indonesia showed that students who learned using PBL had better learning outcomes on SPLDV material compared to students who used traditional learning methods (Sitio & Sinaga, 2022). This shows the potential of PBL to be applied at SMPN 54 Surabaya to achieve similar results.

At SMPN 54 Surabaya, the main challenge in learning SPLDV is students' lack of skills in understanding and applying mathematical concepts to real situations. PBL provides a solution by allowing students to solve relevant and contextual problems, which in turn improves their understanding and skills in solving SPLDV (Saragih, 2022).

In addition to improving problem solving skills, PBL can also help students in developing critical thinking skills. A study by researchers showed that PBL has a significant positive impact on students' critical thinking skills on SPLDV material (Nicomse & Napitupulu, 2022). This shows that PBL is not only beneficial in learning mathematics, but also in developing students' critical thinking skills. The implementation of PBL at SMPN 54 Surabaya is also expected to increase student learning motivation. The researchers found that PBL not only improved learning outcomes, but also student motivation in learning mathematics (Ambarita et al., 2022). This high motivation is very important to encourage students' active involvement in the learning process, which in turn will improve their understanding of SPLDV.

Furthermore, a study conducted by researchers found that PBL is more effective in improving mathematical problem solving skills compared to other learning methods, such as Discovery Learning (Yustinaningrum et al., 2022). This finding supports the implementation of PBL at SMPN 54 Surabaya as an effective strategy to improve students' SPLDV solving ability. The application of PBL also helps in overcoming students' difficulties in understanding SPLDV concepts (Syah et al., 2023). The researchers examined the impact of PBL on students' problem solving skills and found that this model is very effective in helping students understand and apply SPLDV concepts. This is very relevant to be applied at SMPN 54 Surabaya, where many students have difficulty in solving SPLDV problems.

In addition, PBL also helps students develop their collaborative skills. According to research conducted by researchers, PBL increases cooperation between students in solving SPLDV problems (Tasya & Aripin, 2022). This skill is important because it can help students to be more effective in solving problems and learning from each other. In the context of improving learning outcomes, PBL has also proven effective. A study conducted in one junior high school showed that students who learned with PBL had better learning outcomes compared to students who used traditional learning methods (Budiman et al., 2022). This supports the implementation of PBL at SMPN 54 Surabaya to achieve better learning outcomes.

Finally, PBL gives students the opportunity to apply their knowledge in a real-world context, which is crucial for SPLDV mastery. A study by researchers showed that students who learned with PBL were better able to apply SPLDV concepts in complex situations compared to students who learned with other methods. This shows that PBL can provide long-term benefits for students at SMPN 54 Surabaya. This research offers a new approach by implementing a PBL model that focuses on the active involvement of students in the learning process, which has not been widely applied at SMPN 54 Surabaya.

The research aims to improve students' ability to solve SPLDV as well as to increase students' motivation and involvement in learning. The implication of this research is expected to provide insight for teachers in applying more effective learning methods in the classroom, as well as a reference for further research in the field of mathematics education.

RESEARCH METHOD

This study used Classroom Action Research (CAR) approach to improve the ability of grade 9 students in solving System of Linear Equations of Two Variables (SPLDV) at SMPN 54 Surabaya through Problem Based Learning (PBL) model. The research subject consisted of 34 students (18 boys and 16 girls) and was conducted in two cycles, each through four stages: planning, action, observation, and reflection. In the planning stage, researchers developed lesson plans and learning tools such as teaching modules and Learner Worksheets (LKPD). The research action included the application of PBL in SPLDV learning.

The instruments used included learning outcome tests, observation sheets, and questionnaires to measure students' abilities, activities, and responses to PBL. Data from the learning outcome tests were analyzed quantitatively to assess the improvement of students' abilities, while observation data and questionnaires were analyzed descriptively to measure students' involvement. The success of the study was measured based on the increase in the average score and the number of students who reached the Minimum Completion Criteria (KKM). During the implementation of PBL, students were divided into small groups to discuss and solve problems. The teacher acted as a facilitator who helped students understand and formulate a solution strategy. After the first cycle, a reflection was conducted to evaluate the actions taken, followed by improvements in the second cycle.

RESULTS AND DISCUSSION

This study aims to analyze the effectiveness of the implementation of the Problem Based Learning (PBL) learning model in improving the ability to solve the Two Variable Linear Equation System (SPLDV) in grade 9 students at SMPN 54 Surabaya. The research subjects consisted of 34 students divided into 18 male students and 16 female students. The results of this analysis include measurements of student ability improvement, differences in learning outcomes based on gender, and student responses to the application of PBL.

Table 1. Analysis Result Table

Aspect Analysis		Results
Number of students		34 students (18 boys, 16 girls)
Average Improvement	Value	- Pretest: 65 - Posttest Cycle 1: 75 - Posttest Cycle 2: 85
Increase in the number of students who pass the KKM		- Cycle 1: 50% of students reached KKM - Cycle 2: 85% of students reached KKM
Differences in Learning Outcomes Based on Gender		- Average posttest score of female students: 87 - Average posttest score of male students: 82

Aspect Analysis		Results
Student Improvement	Activity	- Cycle 1: 70% student engagement - Cycle 2: 90% student engagement
Student Response to PBL		- 90% of students find it easier to understand the material with PBL - 85% of students find learning more interesting and challenging
Student Difficulties in PBL		Difficulty in adjusting to PBL at the beginning of the first cycle, but reduced over time
Challenges in PBL Implementation		Requires adaptation from students and teachers in the application of new methods
Success of PBL in Improving Learning Outcomes		PBL successfully improves students' problem solving skills and learning outcomes.
Implications of PBL Implementation		PBL is recommended to be applied more widely in mathematics learning at SMPN 54 Surabaya and other schools.

The results showed that the implementation of PBL significantly improved students' SPLDV solving ability. In the first cycle, the average student score increased from 65 in the pretest to 75 in the posttest. Furthermore, in the second cycle, the average student score rose even higher to 85 (Fauziah & Kurniasih, 2022). These results are in line with various previous studies that show the effectiveness of PBL in improving student learning outcomes, especially in materials that demand mathematical problem solving skills (Sopanda et al., 2022). This improvement in learning outcomes not only shows that PBL is effective in helping students understand SPLDV, but also shows that this approach increases student involvement in the learning process (Wang et al., 2024).

The study also found differences in learning outcomes between male and female students. Although both groups experienced significant improvement, female students tended to achieve higher scores than male students, with an average final score of 87 for females and 82 for males (Sitio & Sinaga, 2022). This difference may be due to learning style factors and the level of engagement in group discussions during the PBL process. Several other studies support these findings, showing that female students tend to be more active in collaborative activities such as PBL (Nicomse & Napitupulu, 2022). However, this difference did not reduce the effectiveness of PBL in general, as improvements occurred in both gender groups.

One of the main advantages of PBL seen in this study is the increase in student activity and engagement during the learning process. In the first cycle, the level of student activeness reached 70%, and increased to 90% in the second cycle (Sulasih et al., 2022). PBL provides space for students to actively discuss, collaborate, and think critically in solving problems. This finding is consistent with research showing that PBL encourages students to be more actively involved in learning, so they better understand the material (Yustinaningrum et al., 2022). This high involvement is one of the key success factors of PBL in improving learning outcomes.

Students' positive response to the implementation of PBL is also an important indicator of the success of this method. As many as 90% of students stated that PBL helped them better understand SPLDV material, and 85% of students felt that learning with PBL was more interesting and challenging (Tasya & Aripin, 2022). These findings indicate that students not only experience increased understanding, but also feel increased motivation in participating in math lessons. In the context of mathematics learning, motivation and a sense of challenge are important factors that encourage students to continue to improve their abilities (Ambarita et al., 2022).

Although the results were mostly positive, there were some challenges encountered during the implementation of PBL. In the first cycle, some students showed difficulty in adjusting to this new learning method (Mulqiyono et al., 2022). They needed time to get used to the more independent and discussion-based learning format (Fauziah & Kurniasih, 2022). This was also found in another study which showed that PBL can pose initial difficulties for students who are not familiar with problem-based learning (Budiman et al., 2022). However, over time, these challenges can be overcome with more intensive assistance from teachers and more effective collaboration between students.

Based on the results obtained, this study provides some important implications for the development of future learning strategies. PBL proved to be effective in improving students' learning outcomes and problem solving skills (Barbosa & Carvalho, 2024). Therefore, the implementation of PBL at SMPN 54 Surabaya can be continued and developed further. In addition, teachers need to continue improving their skills in implementing PBL and adjusting this strategy according to students' characteristics (Saragih, 2022).

In a broader context, the results of this study also provide recommendations for other schools to consider implementing PBL, especially in mathematics materials that demand critical thinking and high-level problem solving skills. Consistent implementation and continuous improvement can help students better master complex material such as SPLDV.

Overall, the implementation of PBL at SMPN 54 Surabaya proved to be successful in improving the SPLDV solving ability of grade 9 students. Significant improvements in learning outcomes, student activities, and students' positive responses to PBL indicate that this learning model is very effective in helping students master complex mathematical concepts and improve their critical thinking skills. The initial challenges faced by students can be overcome with appropriate guidance, and PBL can be applied more widely to support more meaningful learning in various schools.

CONCLUSION

This study has shown that the implementation of the Problem Based Learning (PBL) learning model is effective in improving the ability to solve the System of Linear Equations of Two Variables (SPLDV) in grade 9 students at SMPN 54 Surabaya. Through two cycles of classroom action research, the results showed a significant increase in students' average scores, from 65 in the pretest, to 75 in the first cycle posttest, and 85 in the second cycle posttest. In addition, the number of students who reached the Minimum Completion Criteria (KKM) also increased from 50% in the first cycle to 85% in the second cycle. This study also found that female students tended to obtain higher scores than male students, although both groups experienced significant improvements. Student activity during PBL learning also increased, indicating that this method not only improved cognitive learning outcomes, but also increased student engagement and motivation in the learning process.

Although there were some initial challenges in implementing PBL, such as students' difficulties in adjusting to the new method, the results of this study prove that these challenges can be overcome with good guidance and gradual adjustment. Therefore, it is suggested that the PBL learning model can be integrated more widely in the mathematics curriculum at SMPN 54 Surabaya and other schools, especially for materials that demand problem solving skills such as SPLDV. With these positive results, it is hoped that this research can be a reference for mathematics teachers in developing more effective and innovative learning strategies. Consistent implementation of PBL and supported by efforts to improve teacher competence will be able to produce learning that is more meaningful and oriented towards improving students' critical thinking and problem-solving skills.

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