



Improving Student Learning Outcomes in Reflection Learning (Geometric Transformation) through the Problem Based Learning Model for Class XI SMAN 4 Palu

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ABSTRACT

This research applies Classroom Action Research (PTK). This research was conducted in class XI of SMA Negeri 4 Palu, with the research process carried out in the even semester of the 2024/2025 school year, adjusted to the schedule of mathematics lessons in the class. The results showed an increase in the percentage of students' completeness, with cycle I reaching 47.05% and cycle II reaching 88.23%. This indicates that the application of the Problem Based Learning model contributes positively to the improvement of student learning outcomes on material reflection (geometric transformations) in class XI SMA Negeri 4 Palu. The application of the Problem Based Learning model that focuses on real contexts relevant to students can facilitate understanding of mathematical concepts more effectively. Solving real problems through the Problem Based Learning model is expected to prepare students to face realistic problems that they may face in the future

Keywords : Mathematics, Problem Based Learning, Geometry Transformation

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INTRODUCTION

Learning (PBL). Burhana and colleagues (2021) argue that issues related to low motivation and learning outcomes, as well as students' critical thinking skills, can be overcome by implementing the Problem-Based Learning model. Previously, Masduriah (2020) conducted research on the effect of using the problem-based learning (PBL) model on students' high-level thinking skills. The results of the study showed a positive effect of using the PBL model on students' high-level thinking skills. However, this study has limitations, namely that students pay less attention to learning because they feel unfamiliar with HOTS-based questions. In this regard, the issues raised by researchers in this study focus on the Palembang context that is relevant to students' daily lives. The purpose of this is for students to be able to understand the problem in depth and be able to reflect on their experiences related to the problem.

The Problem-Based Learning model has learning characteristics that focus on students, designed based on real problems that encourage students to build rich knowledge of contextual mathematical concepts through a series of constructive questions (Malmia, et al., 2019).

In addition, PBL does not only focus on problem solving, but can also develop other skills, such as communication skills. This happens because there is an opportunity to practice good communication through discussion and presentation activities (Larsson, 2001; Azman & Shin, 2012; Ali, 2019). Tan (2003) stated that problem scenarios in PBL serve as stimuli for scaffolding and expanding the realistic context that students may face in the future.

The application of the Problem-Based Learning model is expected to improve the learning outcomes of students in class XI of SMA Negeri 4 Palu related to reflection material on Geometric Transformation. The formulation of the problem in this study is "can the application of the Problem-Based Learning model improve students' learning outcomes on reflection material at SMA Negeri 4 Palu?". This study aims to improve the learning outcomes of students in class XI of SMA Negeri 4 Palu on reflection material (Geometric Transformation) by applying the Problem-Based Learning model.

METHOD

This study applies Classroom Action Research (CAR). This research was conducted in class XI of SMA Negeri 4 Palu, with the research process carried out in the even semester of the 2024/2025 academic year, adjusted to the mathematics lesson schedule in the class. The material to be analyzed is geometric transformation, with a focus on the reflection sub-material. The number of students to be studied is 34 students. The form of the test used is an essay or description consisting of five questions. This study focuses on the mathematical communication skills and discipline of students in class XI of SMA Negeri 4 Palu.

This study focuses on students of class XI SMA Negeri 4 Palu in the even semester, consisting of 34 students, with details of 12 males and 22 females. The main objective of this study is to analyze student learning outcomes in mathematics learning. Researchers conduct planning, collect data, and analyze and draw conclusions.

This study is planned to take place in two learning cycles. If after two cycles of action the established success indicators have not been achieved, then the process will continue to the next cycle. Each cycle consists of four stages according to Kurt Lewin, namely: (1) planning; (2) action/implementation; (3) observation; and (4) reflection (Suwandi, 2009: 27).

Data collection methods in this study include documentation, observation, questionnaires, tests, and interviews. The data analysis method that will be applied in this study is a comparative descriptive technique to analyze quantitative data by comparing results between cycles (Suwandi, 2009: 61).

Data analysis was conducted using a qualitative descriptive approach. Qualitative descriptive analysis was conducted through interactive analysis. Data analyzed qualitatively descriptively through interactive analysis includes data reduction, data presentation, and drawing conclusions, which were conducted in an interactive form with data collection as a cyclical process. The indicators of the success of this research are: 1. Increased student scores in independent exercises given at the end of each learning cycle (75%). 2. Increased student skills through the application of concepts, principles, and problem-solving strategies given (75%)

RESULTS AND DISCUSSION

Before the study was conducted, the researcher conducted observations first regarding the learning implementation process with the aim of obtaining valid data. Initial observations showed that the majority of students did not pay sufficient attention to the teacher's explanation and showed low interest in learning mathematics. The initial condition of student learning outcomes at SMA Negeri 4 Palu before the study showed that there were 12 students (35.29%) who obtained scores above the KKM, while 22 students (64.71%) obtained scores below the KKM.

This study was conducted through two cycles. The following are the results of the Pre-cycle assessment of class XI students in Mathematics learning can be seen in the table below:

Table 1. Pre-Cycle Assessment Results of Students in Mathematics Learning Class XI

Minimum Completion Criteria (KKM)	Category	F	Presentation
> 75	Completed	12	35.29%
< 75	Not Completed	22	64.71%
Amount		34	100%

Cycle I

In the early stages of cycle I, the researcher prepared teaching modules along with teaching materials, Student Worksheets (LKPD), presentation media in powerpoint format, and assessment sheets for each meeting. In the second stage, the researcher carried out learning on the subtopic of reflection material, namely reflection on the x-axis, reflection on the y-axis, and reflection on the origin point $O(0,0)$. Learning was carried out in accordance with the teaching modules that had been prepared previously, with steps consisting of three stages: (1) preliminary activities, (2) core activities that include PBL syntax, and (3) closing.

In the first meeting of cycle I, the researcher started the learning process with preliminary activities, which included greetings, prayers, attendance checks, apperception, delivery of learning objectives, and motivation. Furthermore, in the core activities, the researcher carried out the PBL stage, namely (1) Directing students to the problem by presenting reflection material 1 (reflection on the x-axis to the y-axis) through a PowerPoint presentation and inviting them to understand the problem; (2) Organizing students to learn by grouping them into previously determined groups, and the results of the group division were displayed via PowerPoint. (3) guiding individual and group investigations; at this stage, the researcher monitored the activities of students in groups and provided guidance to students and groups who were facing difficulties. During the discussion process, the researcher identified students who did not actively participate in the discussion activities. (4) developing and presenting work results; at this stage, students present solutions to problems on the LKPD and present the results in public. (5) Analyzing and evaluating problem-solving results; at this stage, students provide responses to the results of the presentation group's work and/or ask questions to the presentation group. After students complete the presentation, the researcher provides reinforcement regarding the material that has been studied and facilitates students to ask questions. After the reinforcement process, students revise the LKPD that has been presented. In the closing activity, students and teachers formulate conclusions from the learning. Furthermore, students work on independent practice questions and students reflect on the learning process that has been carried out.

In the second meeting, the researcher carried out the learning according to the steps that had been set out in the teaching module. The activity began with an introduction that included greetings, praying, checking attendance, apperception, delivering learning objectives, and motivation. Furthermore, in the core activity, the researcher carried out the PBL stages by (1) orienting students to problems related to reflection material 1, (reflection on the origin point $O(0,0)$) through a PowerPoint presentation and inviting them to understand the problem; (2) organizing students for the learning process by creating conditions in which students were grouped according to previously determined divisions, and the results of the group division were presented through PowerPoint; (3) guiding individual and group investigations, at this stage the researcher supervised the activities of students in groups and provided guidance to students and groups who were facing difficulties. During the discussion process, the researcher identified students who did not actively participate in the discussion activities; (4) developing and presenting work results, at this stage students presented solutions to problems in the LKPD and presented the results in front of; (5) Conducting analysis and evaluation of the problem solving process, at this stage students provide responses to the results of the presentation group's work and/or ask questions to the presentation group.

After students complete the presentation, the researcher provides constructive feedback on the material that has been studied and facilitates a question and answer session for students. In the closing activity, students and teachers together formulate conclusions from the learning process that has taken place. Students work on independent practice questions then students carry out reflections on the learning that has been carried out.

The results of the learning process of students in cycle 1 did not run optimally due to the noise caused by the students themselves. Students spent quite a long time in the process of forming groups, and there was a significant lack of cooperation among group members. Students showed a low level of participation in question and answer activities, and there were group members who dominated the discussion, resulting in a less focused discussion. The learning outcomes of students showed that 16 students achieved completion with a percentage of 47.05% and 18 students did not achieve completion with a percentage of 52.95%.

Table 2. Cycle I Completion of Student Assessment Results in Mathematics Learning

Minimum Completion Criteria (KKM)	Category	F	Presentation
> 75	Completed	16	47.05%
< 75	Not Completed	18	52.95%
Amount		34	100%

Based on the results above, it can be concluded that the activities in cycle I have shown significant improvement, however, improvements are still needed in the next cycle because the results obtained are not optimal. Evaluation in cycle I is expected to be able to overcome existing problems, with the evaluation details as follows:

- a. Teachers provide comprehensive group guidance to students.
- b. The teacher asks questions to stimulate students' knowledge in solving problems.

Cycle II

Activities in cycle II were carried out in class XI of SMA Negeri 4 Palu. In this cycle II, teaching materials were delivered on reflection 2 (reflection on the line $y = x$, reflection on the line $y = -x$, reflection on the line $x = h$, and reflection on the line $y = k$). This cycle II was attended by 34 students. Learning in the classroom began with appreciation, which included greetings, prayers, checking student attendance, and providing learning motivation to increase student enthusiasm in participating in learning. After that, the teacher conveyed the learning objectives. Furthermore, the teacher reviewed the previously discussed material, namely reflection 1 (reflection on the x-axis, reflection on the y-axis and reflection on the origin point $O(0,0)$) using a communicative question and answer method to students. After that, the teacher conveyed an overview of the reflection 2 material (reflection on the line $y = x$, reflection on the line $y = -x$, reflection on the line $x = h$, and reflection on the line $y = k$). To increase the effectiveness of material delivery, students continue to use textbooks, teaching materials provided by teachers and other teaching resources provided by the school.

Next, the teacher instructs students to form groups of 4 to 5 members. The seating arrangement that has been done before the learning session allows for time efficiency, so that group members can immediately gather without significant delays. Each group receives a worksheet and students solve the problems presented in the worksheet. When students complete the questions, the teacher observes the students. In addition, the teacher also asks lead questions to encourage students to think critically and bring out the knowledge they have. The duration allocated to complete the worksheet is 40 minutes. After students complete the worksheet, they are asked to present their work in front of the class. Furthermore, a joint check is carried out on the answers that have been presented. Other students are allowed to express different opinions, and students are given the opportunity to ask questions. As in the previous round, students who actively participate will receive awards in the form of points. Next, students and teachers draw conclusions related to reflection learning 2 (reflection on the line $y = x$, reflection on the line $y = -x$, reflection on the line $x = h$, and reflection on the line $y = k$) so that learning objectives can be achieved. The next step involves the teacher giving a number of questions to be worked on independently by students.

When students complete the questions, the teacher makes observations around the class to assess the students' work. Once completed, the students' work is collected in front of the class. The teacher ends the learning session with a greeting.

The students went through the learning process calmly and orderly because they had begun to get used to the application of the Problem Based Learning method. From the implementation of the third round, in general, the learning situation was in accordance with the Problem Based Learning model. The students' knowledge has been displayed in solving problems in groups. The enthusiasm of students towards the results of other groups' presentations also increased. In cycle II, data was obtained regarding student learning outcomes, where 30 students obtained scores above the KKM with a percentage of 88.23%, and 4 students obtained scores below the KKM with a percentage of 11.77%. According to the results of the study in the second cycle, the percentage of student learning completion can be seen in the following table:

Table 3. Cycle II Completion of Student Assessment Results in Mathematics Learning

Minimum Completion Criteria (KKM)	Category	F	Presentation
> 75	Completed	30	88.23%
< 75	Not Completed	4	11.77%
Amount		34	100%

Table 3. Based on the results above, it can be concluded that learning activities in cycle II showed a significant increase, especially in student learning outcomes according to the indicators contained in this study. In this context, the Problem Based Learning model in the learning process has been implemented optimally and in accordance with the agreed plan.

Based on the learning process that has been implemented in the Pre-Cycle, Cycle I and Cycle II by applying the Problem Based Learning model, there is an increase in the ability to solve mathematical problems in class XI students of SMA Negeri 4 Palu in mathematics learning which can be presented in the following table.

Table 4. Completeness of Student Assessment Results in Mathematics Learning Cycle I and Cycle II

No	KKM	Category	Cycle I		Cycle II	
			Frequency	Presentation	Frequency	Presentation
1	<75	Not Completed	16	47.05%	4	11.77%
2	>75	Completed	18	52.95%	30	88.23%
Amount			25	100%	34	100%

From table 4, it can be analyzed that from 34 class XI students of SMA Negeri 4 Palu who were the research sample, the data can be described as follows:

- The percentage of students' mathematical ability completion after implementing the problem based learning method showed significant results. In cycle I, the completion category was recorded at 47.05%, while in cycle II, the figure increased to 88.23% for reflection material on geometric transformation.
- The percentage of students' ability completion in learning mathematics through the problem based learning method shows that the incomplete category reached 52.95% in cycle I, which then decreased to 11.77% in cycle II.

The data indicates that the number of students in the complete category has increased, namely 47.05% in cycle I, where the completion process occurred in 2 meetings with the material provided. Meanwhile, in cycle II, completion reached 88.23%, with the implementation of the research process almost similar to the first cycle. This study indicates an increase in overall class completion in cycle II of 88.23%, as well as individual completion achievement with student scores that are classified as good.

Discussion

Before implementing the Problem Based Learning model, the researcher conducted a diagnostic assessment of the students. The results of the assessment were still low, namely 52.17 with a KKM of 75. In the previous learning, the teacher carried out learning using a conventional model, namely the lecture method and the practice questions given were in the form of questions that only used ordinary arithmetic operations without providing contextual problems related to matrices. In fact, according to Lubis and Azizan (2018), the active involvement of students in problem-based learning through activities to construct material with real life in their learning environment greatly affects student learning outcomes. In cycle I of this study, the researcher presented contextual problems with a context that was close to the life around the students. The use of this context aims to ensure that students can truly understand the problems and benefits of matrices in everyday life. In line with Siregar, Suwanto, & Siagian (2021) who stated that every problem given should be a problem that has a close relationship with students so that students are interested in solving it based on their needs and curiosity, not just because of grade demands. In addition, according to Reski, Hutapea, & Saragih (2019), in learning mathematics, the learning process should begin with problems related to students' daily lives and then students are guided to explore understanding from the problems given so that they can find mathematical concepts from these problems.

In cycle I, there was a significant increase in student learning outcomes. However, in cycle I, the average score of students had not met the KKM, which was 64.16 at the second meeting. Of the 34 students, only 16 people achieved completion, so that the percentage of classical completion was recorded at 47.05%, which indicated that the completion target had not been met. In cycle II, there was a clear improvement at each meeting. This improvement occurred as a result of improvements made based on the analysis of the results of reflection in the previous cycle. In the planning stage of cycle II, the researcher conducted evaluations and improvements to the teaching modules, teaching materials, media, LKPD, and assessment sheets. These improvements were based on the findings and reflections from learning in the previous cycle, so that the learning process in this cycle could take place effectively. The data showed that classical completeness in cycle II, the second meeting, reached 88.23%.

The application of Problem Based Learning in this study provides students with the opportunity to develop problem-solving skills and understand the application of the material learned through the problems presented. Aufa, Saragih, & Minarni (2016) stated that the problem-based learning model is a learning approach that presents authentic and meaningful problems, which are relevant to students' lives. This model serves as a basis for students in conducting research, so that they can develop knowledge independently, and increase their independence and self-confidence. Ali (2019) stated that through Problem Based Learning, students can learn to work in groups, act as partners in the teaching and learning process. This allows them to learn effectively, face new situations, and develop the ability to learn throughout life. The application of the problem-based learning model provides new experiences for students, motivates them to learn, and increases learning activities and outcomes. This also contributes to the sharpening of students' inquiry skills.

From the analysis that has been done, it can be concluded that the application of the problem-based learning model has the potential to improve student learning outcomes. Research conducted by Lubis, Irwanto, & Harahap (2019) shows that the application of problem-based learning has high effectiveness in improving learning outcomes and critical thinking skills of students. Research conducted by Susanti et al. (2022) shows that there is an increase in student learning outcomes in each cycle resulting from the application of the problem-based learning model. Therefore, the application of the problem-based learning model has shown an increase in student learning outcomes in the reflection material (geometric transformation) in class XI of SMA Negeri 4 Palu.

CONCLUSION

The results of the study showed an increase in the percentage of student completion, with cycle I reaching 47.05% and cycle II reaching 88.23%. This indicates that the application of the Problem Based Learning model has a positive contribution to improving student learning outcomes on reflection material (geometric transformation) in class XI of SMA Negeri 4 Palu. The application of the Problem Based Learning model that focuses on real contexts that are relevant to students can facilitate understanding of mathematics lesson concepts more effectively. Solving real problems through the Problem Based Learning model is expected to prepare students to face realistic problems that they may face in the future.

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REFERENCES

- Akbar, P., Hamid, A., Bernard, M., & Sugandi, AI (2018). ANALYSIS OF PROBLEM SOLVING ABILITY AND MATHEMATICAL DISPOSITION OF GRADE XI STUDENTS OF SMA PUTRA JUANG IN THE MATERIAL OF PROBABILITY. *Journal Cendekia: Journal of Mathematics Education*, II, 144-153. doi:<https://doi.org/10.31004/cendekia.v2i1.62>
- Ali, S.S. (2019). Problem Based Learning: A Student-Centered Approach. *English Language Teaching*, 12, 73-78.
- Asmara, AS, & Junaedi, I. (2018). Paradigm Trends in Mathematics Education. *Scholaria: Journal of Education and Culture*, VIII, 309-314. doi:<https://doi.org/10.24246/j.js.2018.v8.i3.p309>
- Azman, N., & Shin, L. (2012). Problem-Based Learning in English for a Second Language Classroom: Students' Perspectives. *International Journal of Learning*, 109-128.
- Burhana, A., Octavianti, D., Anggrahaeni, LM, Ashariyanti, ND, & Mardani, PA (2021). Problem Based Learning (PBL) Model to Improve Critical Thinking of Elementary School Students. *SNHRP*, 302-307
- Brathatapa, IG (2021). Application of Problem Based Learning (PBL) Learning Model to Improve PPKn Learning Activities and Outcomes on the Material of Authority of State Institutions. *Journal of Education Action Research*, 5, 171-178.
- Islamiah, ID (2019). The Influence of Students' Learning Interests on Mathematics Learning Achievement at SMKN 1 Cihampelas. *Journal On Education*, 01, 451-457
- Larsson, J. (2001). Problem Based Learning: A Possible Approach to Language Education. Retrieved December.
- Lijie, Z., Zongzhao, M., & Ying, Z. (2020, November). THE INFLUENCE OF MATHEMATICS ATTITUDE ON ACADEMIC ACHIEVEMENT: INTERMEDIARY ROLE OF MATHEMATICS LEARNING ENGAGEMENT. *Scholar's Journal: Journal of Mathematics Education*, IV, 460-467.
- Lubis, MA, & Azizan, N. (2018). Implementation of Problem Based Learning Model to Improve Mathematics Learning Outcomes at SMP Muhammadiyah 07 Medan Perjuangan in the 2018/2019 Academic Year. *Logaritma: Journal of Educational Sciences and Science*, 150-163.
- Malmia, W., Makatita, SH, Lisaholit, S., Azwan, A., Maghfirah, I., Tinggapi, H., & Umanailo, MC (2019). Problem Based Learning as an Effort to Improve Student Learning Outcomes. *International Journal of Scientific and Technological Research*, 8(09), 1140-1143
- Masduriah, H. (2020). The Influence of Using PBL Learning Model on HOTS Skills of Elementary School Students. *Proceedings of the Basic Scientific Conference*, 277-285. Retrieved from <http://prosiding.unipma.ac.id/index.php/KID/article/view/1576>
- Nabillah, T., & Abadi, AP (2020). Factors Causing Low Learning Outcomes of Students. *Proceedings of Sesiomedica*, 659-663.
- Resmi, U., Hutapea, N., & Saragih, S. (2019). The Role of Problem Based Learning (PBL) Model

- International Journal on Advanced Science, Education and Religion (IJASER).
on Students' Problem Solving Ability and Learning Independence. Jurnal: Journal for
Research in Mathematics Learning, 49-57.
- Saputra, H. (2021). Problem Based Learning. Journal of Innovative Education, 5, 1-9.
- Siregar, R., Suwanto, & Siagian, MD (2021). Analysis of Students' Learning Difficulties in
Solving Matrix Problems. Journal of Mathematic Pedagogic, 31-38
- Suwandi, S. 2009. Classroom Action Research (CAR) and Writing Scientific Papers. Surakarta:
Mata Padi Presindo.