



IMPROVING WRITTEN COMMUNICATION SKILLS IN MATHEMATICS LEARNING THROUGH PROBLEM-BASED LEARNING IN GRADE XII STUDENTS

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Abstract

Communication skills are one of the main skills that must be mastered in the 21st century, especially in learning mathematics. The ability to express ideas, situations, and events using mathematical language and symbols is important. The purpose of this study is to improve written communication skills in class XII students of SMA Batik 2 Surakarta through the implementation of Problem-Based Learning. The method used in this study was Classroom Action Research. The results show that the application of mathematics learning with a problem-based learning model helps improve written communication skills at SMA Batik 2 Surakarta. It can be shown that in cycle II (94%), 30 out of 32 students reached the completion of written communication skills. From these results, there was an increase compared to cycle I, which was 5 out of 32 students (16%). The average increase in test scores from cycle I to cycle II was 57%, from 51.41 to 80.78.

Keywords:

Mathematics Learning, Problem-Based Learning, Student Worksheet

INTRODUCTION

Education is very important because it determines the ability and competitiveness of a nation. Education includes long-term investment in the life of every individual (Sebastian, 2022). Education is also closely related to human characteristics in the 21st century, namely the ability to think creatively, think critically, solve problems, the ability to communicate and collaborate (Septikasari & Frasandy, 2018). This ability can be possessed by students assuming educators can develop a lesson plan that becomes a challenge for students to think fundamentally when overcoming problems. The lesson plan made by educators should encourage students to be able to communicate and work together.

Mathematics can be said to be a universal science where it has an important role in various fields, improving human thinking skills, and all sciences are perfected with the help of mathematics (Hermawan & Hidayat, 2018). One important factor in learning mathematics is the development of students' mathematical abilities. According to the National Council of Teachers of Mathematics (NCTM) cited by (Siregar, 2019) NCTM applies standards of ability in the mathematics learning process such as problem-solving, reasoning and proof, communication, connection, and representation that learners should be able to have. However, one of the weaknesses of students' mathematical abilities is communication skills in mathematics learning. One aspect of mathematical communication skills is written communication which means mastery of vocabulary, mathematical structure, and notation can be seen through students' abilities and skills in problem-solving activities (Gini Permatasari & Turmudi, 2021). Lubis et al., (2023) Mathematical communication skills have several indicators and can be measured by: 1) expressing ideas, situations, and mathematical relationships through writing using real objects, graphs, algebra, and pictures. 2) Connect objects, images, or diagrams through real life to the form of mathematical ideas. 3) Describe real-life events using language or mathematical symbols.

The low communication ability of students in mathematics learning can certainly have an

impact, which will result in less than optimal student learning outcomes because students cannot have the ability to communicate in conveying ideas in mathematics learning and cannot understand the meaning of mathematical concepts. The low communication ability of students in learning mathematics has a root cause. When viewed from the teacher's side, mathematics teachers still implement conventional learning methods. This means that teachers only apply the lecture learning model where the learning approach becomes teacher-centered. Teachers seem to be active rather than students because students are only able to listen, take notes, and memorize formulas. In addition, students tend to have less effort and many students feel that mathematics is a difficult subject and bores students causing students to often avoid the lesson and feel anxious.

To improve students' communication skills, a strategy is needed that can later be implemented in mathematics learning, one of which is using Problem-Based Learning. Learning that emphasizes the process of involving students fully to be able to explore a material learned and relate to real life is called Problem-Based Learning (Janah et al., 2018). Some stages need to be considered in PBL, including orienting students to problems, organizing students in learning, directing students to solve problems together with their study groups, developing and presenting the results they have obtained, and in the last stage, evaluating problem-solving (Pasza, 2022). PBL is closely related to the reality of students' daily lives so that students feel directly the problems they learn and students' knowledge abilities do not depend on the teacher (Handayani & Koeswanti, 2021). With PBL, students will be helped in transferring factual knowledge into understanding contextual problems where it is also related to the material to be studied, students' thinking skills will increase, and later students will become responsible and independent learners (Puspitasari et al., 2020).

PBL can be used effectively in learning activities. This is supported by several other studies that use PBL to improve mathematical communication skills. Research conducted by Aprilyani (2022) It was found that PBL can improve the ability to connect in mathematics learning and teacher learning activities with students in the classroom. Then, research by Pasza (2022) It was found that there was an increase in learning outcomes using the PBL method, namely on geometry material. Then, research by Wahyuni et al., (2021) It was found that there was an increase in student learning outcomes from cycle I to cycle II. This happens because of the application of PBL in thematic learning. Researchers conducted research related to improving written communication skills using PBL which is expected to have a positive impact on students. Thus, the purpose of this study is twofold, namely to determine the application of PBL to improve written communication skills in mathematics learning in grade XII students. Then, to find out whether PBL can improve written communication skills in grade XII students. Students can develop their communication skills through interesting and meaningful discussions or learning activities.

METHOD

This study uses a type of classroom action research where the implementation is applied to a class with the aim of knowing the improvement that occurs after the action (Pasza, 2022). The purpose of PTK is to improve learning methods in schools so that later there will be an increase in learning (Nasikhatun et al., 2023). The implementation of Classroom Action Research (PTK) has 4 steps in its implementation, namely planning, action, observation and reflection (Zacchaeus, 2022).

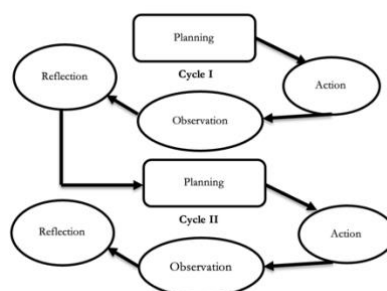


Figure 1. PTK Implementation Cycle

This research was conducted at SMA BATIK 2 Surakarta. Researchers collect data by applying observation methods, written tests, and documentation. The subject of research is the place where data for research variables are obtained (Zacchaeus, 2022). The subjects taken by the researcher were class XII students totaling 32 students. Meanwhile, the object of research is written communication skills in learning mathematics statistical material through Problem Based Learning.

RESULTS AND DISCUSSION

Result

Classroom action research is carried out in two cycles. Where in each cycle there are 3 meetings. The time allocation at each math learning meeting is 2 x 45 minutes. The implementation of the action begins on Tuesday, October 31, 2023 and ends on Friday, November 17, 2023. The implementation of the research was carried out under the class XII mathematics learning schedule, which is as follows.

Table 1. Schedule of Cycle I

Th Meeting	Day, Date	Time	Learning Objectives	Information
1.	Tuesday, October 31, 2023	07.00-08.30	Determine the size of group data centering (mean, median, mode)	Cycle I
2.	Friday, November 3, 2023	07.00-08.30	Troubleshoot group data centering size (mean, median, mode)	Cycle I
3.	Tuesday, 7 November 2023	07.00-08.00	-	End of Cycle I Test

Table 2. Schedule of Cycle II

Th Meeting	Day, Date	Time	Learning Objectives	Information
1.	Friday, November 10, 2023	07.00-08.30	Determine the size of group data placement (quartiles, deciles, percentiles)	Cycle II
2.	Tuesday, November 14, 2023	07.00-08.30	Troubleshoot group data placement size (quartiles, deciles, percentiles)	Cycle II
3.	Friday, November 17, 2023	07.00-08.00	-	End of Cycle II Test

The description of the results of research in each cycle is explained as follows.

Description of the results of the first cycle of research

1. First Cycle Action Planning

At this stage, researchers carry out the following activities.

- 1) Prepare a Learning Implementation Plan (RPP) using PBL related to group data statistics material that focuses on the size of group data concentration (mean, median, and mode).
- 2) Compile and prepare LKPD that will be used in learning activities.
- 3) Compile grids and test questions in the form of descriptions and assessment rubiks.
- 4) The instruments prepared were consulted with civil service teachers and DPL.

2. Implementation of Action and Observation cycle I

The implementation of actions in the first cycle, namely August 31, 2023. This action is carried out in accordance with the RPP prepared using PBL. Before starting learning, teachers and students prepare classes to facilitate the teaching and learning process by checking classrooms, student readiness and neatness. The teacher made the opening by delivering greetings, then praying together. After that, the teacher gives a quiet speech to associate the material to be learned with the student's experience in the previous material that has been mastered. Not to forget, the teacher provides motivation to students related

to the importance of learning statistics in everyday life, for example used in the population census and processing daily test score data of SMA BATIK 2 Surakarta students. Then, the teacher conveys the learning objectives to be achieved at each mathematics learning meeting.

After conveying the learning objectives, the teacher presents a problem that must be solved by students. Next, students are formed into study groups. Each group has a group member of 5 students. Group members are randomly selected. The next student activity is to collect relevant information to be able to solve problems in student worksheets. Then, they together with their study group solve problems in student worksheet D at each mathematics learning meeting. After conducting discussions together, students communicate the results of problem-solving through presentation activities in front of the class in groups. The other group provides input or feedback for the group making the presentation. Next, the teacher evaluates the problem-solving process with students. Then, the teacher delivered the learning material in outline and ended the learning with a greeting.

After carrying out learning using PBL, a cycle I test was held to determine the written communication skills of mathematics material on the statistics of group data given in cycle I. The time allocation in this cycle I test is 60 minutes on Tuesday, November 7, 2023. The following is a picture of students when taking the test in cycle I.



Figure 2. Students take the first cycle test

3. Reflection of Cycle I

From the results of the analysis of tests conducted in Cycle I, it was found that the average score of students was 51.41 where the score was in the category of low mathematical written communication skills with a completion percentage of 16%. So it has not met the success indicators in learning mathematics on group data statistics material. From the results of reflection, it was found that during the implementation of the first cycle of learning there were obstacles that occurred, which were described below.

- 1) Some students do not actively participate in group discussion activities because each group is 5 people, causing discussion activities to be less effective.
- 2) Most students are unable to identify the information in the questions and solve problems communicatively using coherent steps.
- 3) Lack of time effectiveness in working on student worksheets because students feel unaccustomed to solving problems communicatively and in a series of steps in solving problems.

From the results of reflection, follow-up will be carried out with improved actions to overcome obstacles that have occurred in Cycle I. The improvement plan to be carried out in Cycle II is outlined below.

- 1) Researchers will form a study group to discuss in a small scope, which is 2 students or deskmates.
- 2) Researchers inform students about the steps in solving problems by paying

attention to the instructions given to student worksheets.

- 3) For the student worksheet processing time to be more effective, students will be explained again related to the steps in solving coherent problems. Then, students will be given additional marks if they do the questions and collect answers promptly.

Description of the results of Cycle II

1. Action Planning Cycle II

In general, the action plan to be carried out in Cycle II is the same as the action plan in Cycle I, which is to prepare something needed before carrying out the actions carried out in class. The following is an activity plan designed by the researcher.

- 1) Prepare a Learning Implementation Plan using PBL related to group data statistics material that focuses on the size of group data placement (quartiles, deciles, percentiles).
- 2) Compile and prepare student worksheets used in learning activities.
- 3) Compile grids and test questions in the form of descriptions and assessment rubrics.
- 4) The instruments prepared were consulted with civil service teachers and expert

2. Implementation of Action and Observation Cycle II

The implementation of actions in the second cycle is November 10, 2023. The implementation of actions at this stage is focused on fixing problems or obstacles that occur in cycle I. Learning activities in cycle II use problem-based learning. In mathematics learning activities, students are informed to be more active. The hope is that communication skills in mathematics learning are more optimal. In the Problem-Based Learning learning method, students are presented with a mathematical problem related to the material of group data placement measures (quartiles, deciles, percentiles). Then, students are divided into small groups of 2 people or benchmates to discuss and do the questions in the student worksheet D given. Researchers inform students about the steps in doing the questions by paying attention to the instructions given in the student worksheet questions. Then, students can search for various kinds of literature sources to increase their insight or knowledge. If students can answer the questions and collect or present answers to the results of the discussion promptly, students will get additional points.

After the student presents the results of the discussion, the student makes a presentation with his group friends or bench. The other group that did not make the presentation responded to the results of the answers from the group that made the presentation. At the end of the learning activity, the teacher together with the students evaluates the problem-solving process. Then, the teacher together with the students concludes the results of learning activities that have been carried out in cycle II. Furthermore, the teacher conveys the material in outline to students to strengthen the knowledge or insight possessed by students. After completing the learning activities at the second cycle II meeting, the teacher informs the students at the next meeting a written test will be held to determine written communication skills in mathematics learning related to group data statistics material that has been given in cycle II. The following is a picture of students when carrying out the test in cycle II.



Figure 3. Students take the second cycle test

3. Reflection Cycle II

Overall, the implementation of cycle II actions is better than cycle I. The improvement plan in cycle II has been implemented well so that the problems that arise in cycle I do not repeat themselves in cycle II. Most students can identify the information in the question and solve the problem communicatively using coherent steps. Discussion activities carried out by students together with their small groups of 2 people become more effective because they participate in discussion activities. Based on the results of the test analysis in cycle 2, an average test score of 80.78 was obtained, which means written communication skills in mathematics learning in the high category with a completeness level of 94%

Based on the analysis of tests conducted in cycles I and II, data taken from 32 grade XII students showed an improvement in mathematical written communication skills marked by test score results. The improvement of written communication skills in mathematics learning is shown by the average test results in cycles I and II. The following is a comparison diagram of the average test scores from cycles I and II.

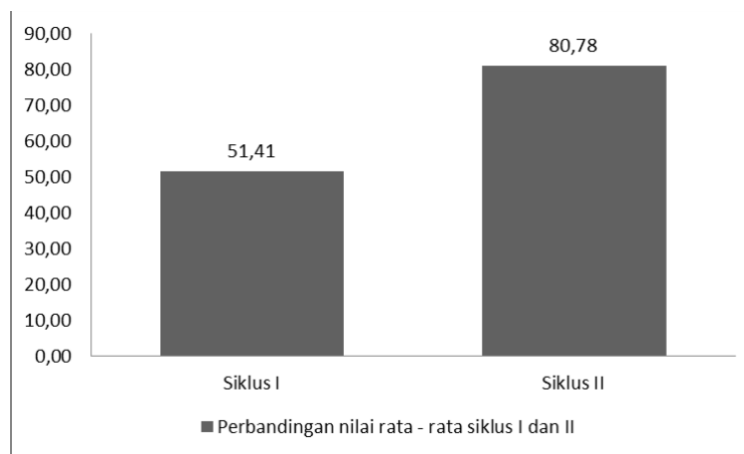


Figure 3. Comparison diagram of the average values of cycles I and II

The increase in written communication skills in student mathematics learning is also shown by increasing the percentage of student completeness in tests conducted in cycles I and II. The following is a comparison diagram of the percentage of student completion in cycles I and II.

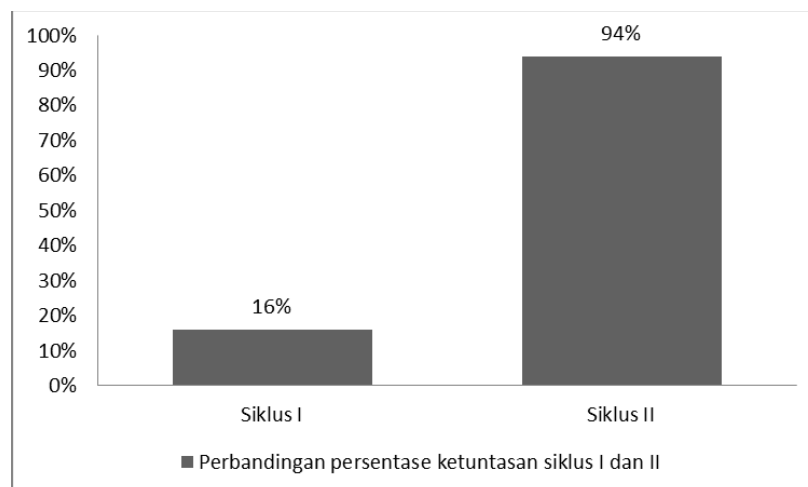


Figure 3. Comparison diagram of the percentage of completion of cycles I and II

From the diagram above, it can be seen that the average test score increased from 51.41 in cycle I to 80.78 in cycle II. The level of completeness of written communication skills in

mathematics learning also increased from 16% in cycle I to 94% in cycle II. The average value in cycle I is lower than the average value in cycle II. The level of completeness of written communication skills in mathematics learning in cycle I is also lower than the completeness value in cycle II.

Discussion

Mathematical communication skills help students demonstrate their understanding of mathematical concepts. This ability is an important thing that students must have when learning mathematics (Samsudin et al., 2023). By communicating their ideas, students can embed the concept strongly. Communicating ideas means that students are developing their abilities in a better direction. The standard of mathematical communication activities in learning is a benchmark for students in carrying out their activities. In discussion activities, students will channel their opinions through communication. This is unconsciously part of mathematical communication. By expressing ideas or concepts in other matters related to mathematics is a measure of mathematical written ability. Improving written communication skills in mathematics learning is the impact of the application of the PBL learning model, where the model provides active learning conditions for students (Lubis et al., 2023). The same thing in research by Zahrotin et al., (2020) that students who carry out mathematics learning using PBL can improve their communication skills. The series of PBL learning steps emphasizes the ability to solve problems with students' ideas, helps students easily remember, and not forget, and can train and improve students' mathematical communication skills through problem-solving (Hafely et al., 2018). The PBL model helps students understand the subject matter which can ultimately develop their thinking skills (Fauziah et al., 2018).

From the results of observations and assessment records in the first cycle, it is known that the a lack of effectiveness of group work activities if a group consists of 4 to 5 people. This can be seen in each group, namely, there are one or two students who are passive in group work activities. By dividing into small groups in cycle II totaling 2 students, learning discussion activities improve students' ability to communicate mathematical ideas. Zacchaeus (2022) explained that pair discussions allow students to express their opinions more openly and create a feeling of responsibility in themselves in solving problems in student worksheets with their groups.

PBL is a learning that has innovation because in this learning it can optimize students' thinking skills through group discussion activities so that students' thinking skills can continue to grow. Zahrotin et al., (2020) revealed that PBL is learning related to real problems to gain knowledge well. In this case, students seek information by building their knowledge to solve a problem and the teacher has the role of a guide. PBL can be understood as solving problems related to students' real lives so that students' communication skills become good as well as learning outcomes (Samsudin et al., 2023). The PBL model was chosen because it has several advantages, namely students are encouraged to be able to solve problems in real-life situations, students can develop their knowledge through learning activities, scientific activities take place between students through group work, students can evaluate their learning abilities, students who have learning difficulties can overcome them individually through group work in the form of *Peer Teaching* (Aprilyani, 2022).

CONCLUSION

Based on the results of research and discussion, it can be concluded that the application of mathematics learning with a problem-based learning model helps improve written communication skills at SMA BATIK 2 Surakarta. It can be shown that in cycle II (94%), as many as 30 out of 32 students achieved complete written communication skills. From these results, there was an increase compared to the first cycle, which was as much as 5 out of 32 students (16%). The average increase in test scores from cycle I to cycle II was 57%, from 51.41 to 80.78.

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