BIS EDUCATION

Volume 1 2025 | DOI: 10.31603/bised.172
6th Borobudur International Symposium on Humanities and Social Science (BIS-HSS) 2024

UNIMMA PRESS
Universitas Muhammadiyah Magelang

Learning from real problem: How the students develop their mathematical communication skills

Wahyudi[1*], Nurul Hidayati[2], Dwi Avita Nurhidayah[1], Jumadi[1]

[1] Mathematics Education, Universitas Muhammadiyah Ponorogo, Ponorogo, Indonesia
[2] SMAN 1 Babadan Ponorogo, Ponorogo, Indonesia
[*]Corresponding author's email: wahyudi@umpo.ac.id

Abstract

In learning mathematics, real problems become one of the means for students to connect mathematics with everyday life, while developing strong and structured communication skills. One way to help develop math communication can be through a problem-based learning approach. This study focuses on the problem-based learning (PBL) model in mathematics education and its impact on students. The research involved 36 students from an Indonesian high school. Data collection methods included observation sheets and test questions. The study found that PBL in mathematics learning involves several stages: directing students to solve linear program problems, organizing student learning, facilitating individual and group investigations, developing and presenting student work, and analyzing and evaluating the problem-solving process. The research highlights that problem-based learning helps students connect mathematics with real-life situations and fosters the development of strong communication skills. The study provides valuable insights into the effectiveness of problem-based learning in mathematics education. The positive impact can be seen from 86.11% of students who were able to fulfill most of the indicators of mathematical communication skills, such as explaining or asking questions related to the mathematical model or graph/table given. However, some aspects that need to be improved include the ability to identify variables correctly, accuracy in modeling mathematical situations in the form of pictures, tables, or graphs, and determining the area of the solution set. These shortcomings are allegedly derived from the students' lack of habit in applying mathematical skills to solve problems. Overall, problem-based learning proved to be effective in helping the development of students' mathematical communication skills.

Published:
April 15, 2025

Selection and Peer-review under the responsibility of the 6th BIS-HSS 2024 Committee

Keywords

Problem based learning, Mathematical communication skills, Linear program

Introduction

Several efforts by educators in providing the best services in education continue to be carried out until now, especially after the COVID-19 pandemic even though it passed four years ago, the impact on education is still profound, one of which is students'

mathematical communication skills. During the pandemic, learning activities were carried out online, both face-to-face and through e-learning, as a student learning space. With this model of learning activities, it changes the way students interact with the subject matter which requires students' mathematical communication skills. One of the biggest weaknesses in online learning is the lack of direct interaction between educators and students or fellow students. Especially in online mathematics learning, students' mathematical communication must always be considered and improved [1]. According to [2] mathematical communication ability is one of the abilities that students must have because communication is an essential part of the mathematics learning process. This is because, in the learning process, students can convey their ideas or ideas.

One of the learning models that can be implemented to generate, improve, and maintain students' mathematical communication in online learning is the problem-based learning (PBL) learning model. According to [2] and [3] said that to improve students' mathematical communication skills, one of the appropriate learning models is PBL. [4] Based on the results of their research, recommended the Problem-Based Learning learning model as a lesson used by teachers to facilitate the improvement of mathematical communication skills. Based on the problem at SMAN 1 Babadan, namely during online learning, students are less enthusiastic in learning mathematics. This results in the limitation of students to improve mathematical communication skills in mathematics learning activities. With the partnership activities of educational personnel education institutions (LPTK) lecturers and partner teachers of SMAN 1 Babadan, collaborate and cooperate in improving mathematics learning at SMAN 1 Babadan.

Mathematics learning activities are carried out using the concept of lesson study. In its implementation, there are roles of model teachers and observers. One of the objectives of lesson study implementation is to improve the pedagogical ability and professionalism of educators, as well as to encourage increased student activity in the classroom. To achieve this goal, collaboration is the main key, and the implementation of lesson study is an important step in realizing it. According to [5] lesson study is one method that can be used by teachers to improve professionalism in teaching. This opinion is supported by [6] and [7], who state that lesson study is an effective approach to improving the quality of learning while developing educators' competencies.

Method

This research is included in qualitative descriptive research. This research design analyzes students' communication skills in learning mathematics with a problem-based learning model. [8] said that the main purpose of descriptive research is to provide an in-depth description of a phenomenon and its characteristics. This research focuses more on the "what" aspects that occur, rather than exploring "how" or "why" the phenomenon takes place. This research was conducted in class XI MIPA 4 SMAN 1 Babadan Ponorogo with a total of 36 students. Each subject will be observed by several

observers from the beginning until the learning with the problem-based learning model ends.

According to the narrative in the introduction, this research activity begins with planning learning by the team. Furthermore, the implementation of learning activities with a problem-based learning model that focuses on students' mathematical communication skills by conducting classroom observations and as evaluation material the team coordinates and discusses. The research instruments used were test questions and observation sheets (for observers) as well as videos of learning activities in the classroom. Data analysis in this study by reducing data, presenting data, and drawing conclusions.

Result and Discussion

Results

To ensure that the problem-based learning model supports honing students' communication skills, Table 1 presents the integration of the problem-based learning (PBL) model to hone mathematical communication skills.

Table 1. The Integration of PBL Model to Hone Mathematical Communication Skills

PBL Syntax	Main Activities	Indicator
Problem orientation	Presenting contextual and challenging problems to motivate students to think	Explain ideas orally and in writing about the problem at hand
Learning Organization	Understand the problem and plan a solution strategy	Write down the results of problem identification mathematically
Problem Investigation	Gather information, analyze data, explore various solution strategies	Explains the steps of problem solving in a clear and structured manner
Development and Presentation of Results	Present the results of problem solving	Present solutions in written form either with tables, graphs, or relevant mathematical models
Process Analysis and Evaluation	Jointly evaluate the results and problem-solving process	Provide clear arguments regarding the solution found

Based on the results of the work done by the subjects, 31 subjects were able to fulfill several indicators of mathematical communication skills. This means that 86.11% of subjects such as explaining or asking questions related to the mathematical model or graph/table given. However, some aspects that need to be improved include the ability to correctly identify some information in the problem, accuracy in modelling mathematical situations in the form of pictures, tables, or graphs, and determining the size of the solution set. These deficiencies are thought to stem from students' lack of habit in applying mathematical skills to solve problems. Overall, problem-based learning proved to be effective in assisting the development of students' mathematical communication skills.

Figure 1 is an illustration of the work of the research subjects who have not fulfilled several indicators of students' mathematical communication skills. In Figure 1, it can be seen that the subject has been able to explain ideas orally and in writing about the

problem at hand, but has not been able to write the results of problem identification mathematically. It can also be seen that the research subject has not been able to explain the steps of problem-solving in a clear and structured manner and has not been able to present solutions in written form either with tables, graphs, or relevant mathematical models. In addition, they have also not been able to provide clear arguments regarding the solutions found.

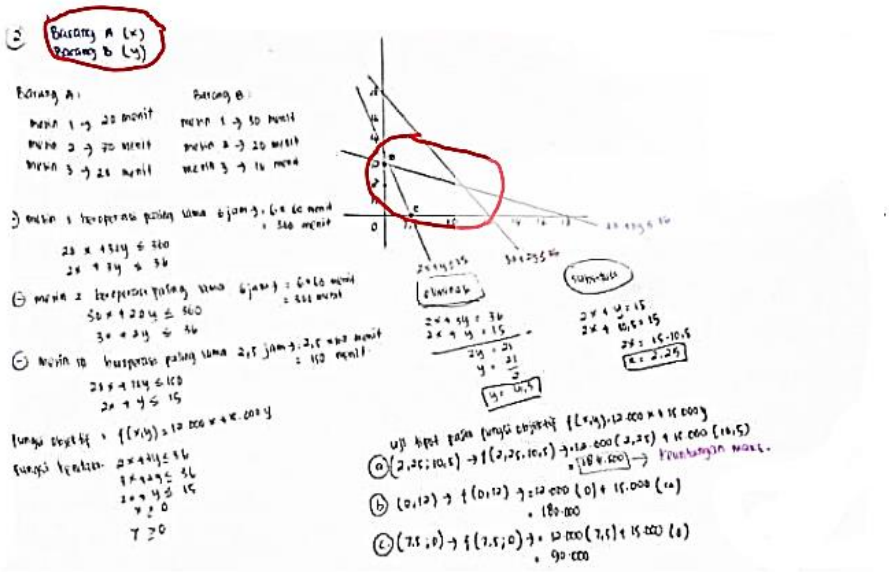

Figure 1. Overview of the Research Subject's Work

In Figure 1, it can be seen that the research subject has not determined the area of the solution set which results in inaccuracy in determining the solution to the problem given. Moreover, students have not been able to provide arguments for each of what the research subject says in the answer or the results of his work. The subject certainly needs to plan the steps of problem-solving well, begin to understand the problem well according to the instructions given, and provide arguments from the solutions found.

Thus, mathematical communication skills are very necessary to be possessed by all students, because in learning mathematics, students do not solve problems and find the right answers, but what is more important is how students can provide their arguments as they think to get solutions to the given mathematical problems. With some indicators of mathematical communication skills in Table 1 such as conducting discussions, presenting work results, providing some arguments, and accepting other friends' opinions, this has a good impact on improving mathematical communication skills.

Discussion

Overall, the mathematical communication skills of the research subjects provide a fairly good picture of the existence of mathematics learning with the PBL model. The results of this study are also to the opinions of [9] and [10] who state that PBL can improve students' mathematical communication skills. Thus, it can be seen that the application of the PBL learning model can improve students' mathematical communication.

Table 1 also follows [11] which explains that PBL also plays a role in developing student independence. In the PBL approach, the teacher functions to provide questions, facilitate questions from students, and support the student learning process. Thus, PBL supports the indicators of students' communication skills, namely in the indicator that students can provide clear arguments regarding the solutions found. In addition, students can explain ideas orally and in writing about the problem at hand, can write the results of problem identification mathematically, and are also able to explain the steps of problem-solving in a clear and structured manner.

Based on the opinions of [12] and [13] students mathematical communication skills are very good when learning mathematics using the PBL model. [14] also confirmed that to hone students' mathematical communication skills through the PBL model. [15] also added that mathematics learning activities with the PBL model cannot be separated from the role of the teacher as a facilitator in honing students' communication skills. Thus, it can be seen that each step or we are familiar with the syntax of the PBL model is very supportive in honing students' communication skills and this activity cannot be separated from the role of the teacher as a facilitator in mathematics learning activities.

Conclusion

Based on the above explanation, it can be concluded that 86.11% of the research subjects met most of the indicators of mathematical communication skills in mathematics learning with the PBL model. This includes students' ability to explain or ask questions related to the mathematical model, graph, or table provided. This ability shows that students are starting to be able to connect mathematical concepts in a more applicable and communicative way. However, although these results provide satisfactory results, there are still some aspects that need more attention. Some students still have difficulty in identifying variables appropriately, as well as in accurately modeling mathematical situations, both in the form of images, tables, and graphs. In addition, the accuracy in determining the area of the solution set is also a challenge that must be improved. These shortcomings are most likely caused by students' lack of habit in applying mathematical skills consistently in solving problems, which affects their accuracy and understanding of the material.

Acknowledgement

We would like to thank LPPM UMPO for providing the opportunity to conduct research until the publication of the results of this study.

References

1. Sari, M. Blended Learning, Model Pembelajaran Abad Ke-21 Di Perguruan Tinggi. *Ta'dib* **2016**, *17*, 126–136.
2. Sufi, L.F. Meningkatkan Kemampuan Komunikasi Matematis Siswa Melalui Model Pembelajaran Problem Based Learning. Prosiding Konferensi Nasional Penelitian Matematika Dan Pembelajarannya (KNPMP I 2016, 260.

3. Andini, D.; Mulyani, N.; Wijaya, T.T.; Supriyati, D.N. Meningkatkan Kemampuan Komunikasi Matematis Dan Self Confidence Siswa Menggunakan Pendekatan PBL Berbantuan Geogebra. *J. Deriv. J. Mat. dan Pendidik. Mat.* **2018**, *5*, 82–93.
4. Dewi, R.S.; Sundayana, R.; Nuraeni, R. Perbedaan Peningkatan Kemampuan Komunikasi Matematis Dan Self-Confidence Antara Siswa Yang Mendapatkan DL Dan PBL. *Mosharafa J. Pendidik. Mat.* **2020**, *9*, 463–474.
5. Rahayu, P.; Mulyani, S.; Miswadi, S.S. Pengembangan Pembelajaran IPA Terpadu Dengan Menggunakan Model Pembelajaran Problem Base Melalui Lesson Study. *J. Pendidik. IPA Indones.* **2012**, *1*.
6. Susilo, H. Lesson Study Sebagai Sarana Meningkatkan Kompetensi Pendidik. In *Makalah) disajikan dalam Seminar dan Lokakarya PLEASE*; 2013; pp. 28–34.
7. Sudrajat, A.K. Meninjau Lesson Study Sebagai Sarana Pengaplikasian Kurikulum 2013. In *Seminar Nasional Pendidikan IPA 2017*; 2017; Vol. 2.
8. Nassaji, H. Qualitative and Descriptive Research: Data Type versus Data Analysis. *Lang. Teach. Res.* **2015**, *19*, 129–132.
9. Duskri, M.; Maidiyah, E.; Risnawati, R.; Ilham, S. Penerapan Model Problem Based Learning Untuk Meningkatkan Kemampuan Komunikasi Matematis Dalam Pemecahan Masalah Di Kelas IX-6 SMPN 8 Banda Aceh. *Al Khawarizmi J. Pendidik. dan Pembelajaran Mat.* **2017**, *1*, 75–101.
10. Daulay, L.A.; Asnawi, A.; Letisa, R. Pengaruh Model Pembelajaran Problem Based Learning (PBL) Dan Think Pair Share Terhadap Kemampuan Komunikasi Matematis Siswa. *Suska J. Math. Educ.* **2020**, *6*, 129–134.
11. Sudia, M.; Muhammad, A.P.A. A PBL Model to Improve Students' Mathematical Communication Abilities: Self-Regulated Learning. *Int. J. Innov. Creat. Chang.* **2020**, *12*, 537–554.
12. Anam, K.; Sudarwo, R.; Wiradharma, G. Application of the Problem Based Learning Model to Communication Skills and Mathematical Problem Solving Skills in Junior High School Students. *JTAM (Jurnal Teor. Dan Apl. Mat.* **2020**, *4*, 155–165.
13. Pratiwi, G.; Sova, F.; Putra, F.G.; Putra, R.W.Y.; Kusuma, A.P.; Rahmawati, N.K. The Influence of Project-Based Learning (PjBL) and Learning Style Om Mathematics Communication Skills of Junior High School Students. *J. Phys. Conf. Ser.* **2020**, *1467*, 12064.
14. Batubara, I.H.; Saragih, S.; Simamora, E.; Napitupulu, E.E.; Nuraini, N.; Sari, D.N.; Syafitri, E. Improving Student Mathematics Communication Ability through Problem Based Learning Assisted by Augmented Reality Based on Culture. *AIP Conf. Proc.* **2022**, *2659*.
15. Arbo, J.B.; Ching, D.A. Problem-Based Learning Approach in Developing Mathematical Skills. *Int. J. Sci. Technol. Eng. Math.* **2022**, *2*, 26–47.