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IMPROVING STUDENTS' MATHEMATICAL COMMUNICATION ABILITY THROUGH PROBLEM-BASED LEARNING ASSISTED BY BAAMBOOZLE

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ABSTRACT

Mathematical communication ability is a must-have ability for students but several studies show students' communication ability are still low. This study aims to improve students' mathematical communication ability through Problem-Based Learning assisted by Baamboozle in opportunity material. Baamboozle is an learning media that helps teachers to present an outline of material concepts, increases students' sense of cooperation to gain knowledge and makes learning activities more enjoyable. The subject of this study was located at one of the South Jakarta State Senior High Schools in class X-4 with a total of 33 students. The classroom action research method was chosen as a research method that adapts the Kemmis and Taggart methods. Data were collected using tests, and analyzed descriptively qualitatively. The results of the study revealed a rise in the percentage of students who had high-level of mathematical communication ability in each cycle, in the first cycle recording 63.64% and in the second cycle recording 78.79%. Therefore, Problem-Based Learning assisted by Baamboozle can improve ability of mathematical communication and make learning activities more active and fun.

Keywords : Baamboozle, Mathematical Communication Skills, Problem-Based Learning

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PRELIMINARY

Mathematics has the most important factor for developing and training individual ways of thinking in social life. Mathematics is an important field of study that touches all aspects of life, from science to technology (Syahril et al., 2021). The concept of mathematics subject requires sufficient activity to learn and understand it. Mathematics is also a means of logical, analytical and systematic thinking.

The importance of mathematics does not make students happy to learn mathematics. In fact, mathematics is still a subject that students fear (Nidayanti & Bernard, 2022). Students feel afraid of being wrong if they can't solve problems, get bad grades or get scolded by the teacher. Fear will make them difficult to express their thoughts and opinions in their own language when learning mathematics (Domo & Mujib, 2022).

In learning mathematics students are trained to think mathematically. During the process of learning, the teacher is no longer just a person who provides information but also directs and provides opportunities for students to be able to construct their own knowledge and understanding of mathematics such as communicating mathematics.

The ability to communicate when learning mathematics plays an important role so there is a requirement to enhance the mathematical communication abilities of the students (Anim et al., 2022). The sharing of ideas and articulating comprehension of mathematical concepts is a communicative strategy utilized in the process of learning (Yunita & Siswanto, 2023). Students who are proficient in communicating mathematically will be skilled in applying mathematical ideas (Yuliani et al., 2022). Having good verbal and written mathematical communication abilities will make it easier for them to organize and interpret their thoughts to solve problems (Noer et al., 2022). Mathematical communication skills refer to the ability to express solutions to a given scenario or problem based on information obtained through oral and written communication using graphics, symbols or diagrams (Nufus et al., 2022).

Improving mathematical communication ability is important, but there are several studies show that multiple researches indicate that the math communication abilities of students are still inadequate. Not understanding mathematical concepts is a major factor in the impairment of mathematical communication ability (Lingga & Wardani, 2023). Another cause is because students do not understand problem solving indicators (Mardiyah & Kadarisma, 2021). The inadequate mathematical communication abilities of students can be attributed to their lack of enthusiasm for learning (Marniati et al., 2021). The teacher remains the center of learning which results in inadequate communication skills because students tend to imitate the problem-solving methods provided by the teacher, thus hindering the growth of their own concepts during learning (Rusmana et al., 2022).

The researcher made observations and collected data on students' mathematical communication ability in class X-4 at one of the South Jakarta State Senior High Schools. The researcher obtained Table 1 data from the results of students' mathematical communication ability tests which were used as pretest results. The researcher uses the guidelines for the category of students' mathematical communication ability from (Shofiyah & Hendriana, 2021).

Table 1. Results of Mathematical Communication Ability in Class X-4

Ability Category	Student Population	Percentage
High	10	30,3%
Medium	12	36,36%
Low	11	33,34%

Table 1 shows that the majority of students in the medium to low category mathematical communication ability. Only 10 students (30.3%) with high mathematical communication ability. From these data indicate that there are problems during the learning process. Observations in class show that various factors contribute to the emergence of problems, such as: (1) teachers who do not use visual aids or other media during learning that involve students directly, causing them to be disinterested and inactive in class; (2) students only copy the information conveyed by the teacher without giving feedback; (3) students' reluctance to ask questions, engage in discussions, and debate topics they find challenging; (4) students' lack of confidence in presenting their solutions; and (5) a large number of students had difficulty maintaining their focus during the study session.

According to the conditions described, improvements are needed to the learning model. Problem-Based Learning (PBL) is an instructive approach to learning that encourages students to engage with various challenges that have been designed to focus on the learning process (Husna & Kurniasih, 2023). A learning model that can enhance the exchange of students' concepts by implementing Problem-Based Learning (Lubis & Dewi, 2023). PBL is a teaching model that puts the focus on students and allows them to take charge of their learning process. (Navarro-Durán et al., 2023). They are encouraged to determine the knowledge needed to understand and deal with the issues presented during learning (Orfan et al., 2021). PBL approach is an effective way to enhance the math communication skills of students (Mirna et al., 2023). The PBL model is problem solving based learning and can train students' independence and communication skills in groups (Kamah & Mardiani, 2022). Problem-Based Learning can maximize students' mathematical communication ability and students' attitudes become more positive where they can communicate their ideas when solving problems (Sitopu et al., 2022).

The utilization of interactive learning media enhances the efficiency of learning models (Gumiandari & Ratnawati, 2021). Learning media is a means of presenting information that helps teachers to present an outline of material concepts, increases curiosity and encourages students to acquire knowledge (Akramunnisa et al., 2023).

One of the interactive learning media is Baamboozle. The media is used not when presenting the core material the teacher uses after all the material has been conveyed when

reviewing the material. Baamboozle is an educational tool in the form of a web-based game that offers interactive and interesting quiz games as this platform can deliver amusement (Saud et al., 2022). Baamboozle serves as an learning media that presents group quizzes without requiring students to establish an account (Sa'diyah et al., 2020). Baamboozle is an interactive game website that allows students to work well together so that a sense of responsibility for the success of the group arises (Mariani et al., 2022). Baamboozle can make the learning model more effective because the use of online games in groups when learning will balance the material taught by the teacher, train and develop a sense of responsibility and teamwork, attract student interest in learning and improve students' ability to communicate. So, Baamboozle can be used as an option in arousing student enthusiasm for learning.

There are several studies that have proven that the use of Problem-Based Learning (PBL) can improve students' mathematical communication ability, including: (1) The use of Problem-Based Learning models can improve students' communication ability and independence well compared to conventional learning classes (Aprila & Fajar, 2022); and (2) Problem-Based Learning shows better results on students' communication ability and independence in groups and student-centered learning will be created (Wati & Loviana, 2022). It has been previously explained that there has been research related to PBL being able to improve mathematical communication ability, but there has been no research using learning media such as Baamboozle.

Based on the problems above, it is necessary to find the best solution so that the students' mathematical communication ability in class X-4 at the State Senior High School in South Jakarta can be improved. One solution that can be done is to use the Problem-Based Learning. The advantages of learning media such as Baamboozle are expected to make learning activities more effective and more enjoyable. Thus the aim of the study was to improve students' mathematical communication ability through Problem-Based Learning assisted by Baamboozle in opportunity material.

METHODS

The research approach utilized in this study is classroom action research. The stages of this study were adapted according to the patterns suggested by Kemmis and Taggart, namely: (1) Planning: The researcher preparing learning tools, making observation sheets of learning activities, making Student Worksheets, preparing post tests, setting up the quiz on Baamboozle; (2) Implementation: researchers carry out learning activities in accordance

with the stages that have been prepared; (3) Observation: observers and researchers observe and record important things and obstacles during learning activities; and (4) Reflection: analyzing the actions taken during learning activities.

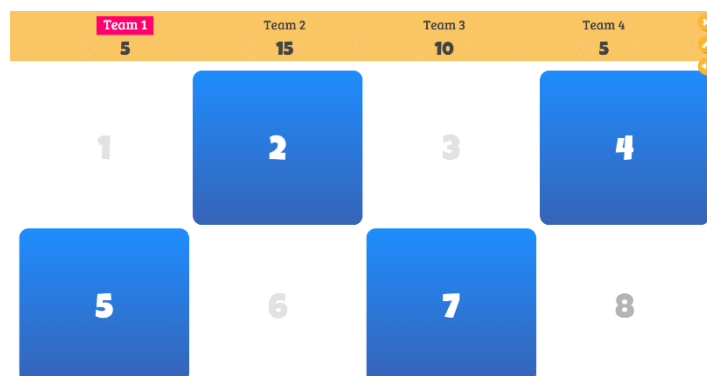


Figure 1. Quiz On Baamboozle

In this study the steps of the activities carried out in the first and second cycles were the same. Learning begins with (1) preliminary activities, including: the class leader leading a prayer, the teacher greets students and checks the completeness of the uniforms, then the teacher asks about student attendance, the teacher guides students to clean the class, and the teacher conveys the purpose and mechanism of learning; (2) the core activities, including: the teacher showing videos of contextual problems about the opportunities after that students raise questions and opinions on these problems, students are formed in groups to complete worksheets which later one of the groups will present the results of their answers, the teacher will guide and assess the discussion process during students complete worksheets in groups, and then the teacher displays several problems as exercises through Baamboozle where students in their group solve the problems given, students conclude today's learning material according to the input given by the teacher and the responses of other groups; (3) closing activities, including: the teacher giving students the opportunity to ask questions, the teacher gives 20 minutes for students to do the test in each cycle, then the teacher directing students to study the next material, and learning is closed by praying together.

Classroom action research in this study was carried out in two cycles. This study was conducted in class X-4 with a total of 33 students in the period from March to April 2023, to be precise in the month of Ramadan. The place for this research is located South Jakarta Senior High School. The object of this study is the opportunity material.

Research success indicator in classroom action research are benchmarks in determining whether the research carried out is successful or not. If 75% of the total students achieve research success indicator then the cycle in research can be stopped (Arikunto et al., 2007). Data on students' mathematical communication abilities in the form of test results are

used to see how well students complete the opportunity material. The test is given twice, namely once in the first cycle and once in the second cycle (in each cycle has different test question). This is done to identify whether there is an increase of more than 75% of the total students who have high category mathematical communication ability.

Data collection techniques are carried out using test and non-test instruments that have been validated by experts. Test instruments such as essay test sheets in each cycle and non-test instruments such as observation sheets of learning teacher's and students's activities. Data were collected using tests, and analyzed descriptively qualitatively. This data was obtained based on the data of cycles I and II. The data in this study is an increase in student's mathematical communication ability from test results and activity percentage in each cycle. The steps to analyze the data ar as follows:

The test scores are calculated based on the formula (Shofiyah & Hendriana, 2021) as follows:

$$Score = \frac{\text{the total score of each indicator}}{\text{maximum total score}} \times 100 \dots (1)$$

To determine the category of students' mathematical communication ability, it is obtained by matching the percentage of descriptive values contained in Table 2.

Table 2. Mathematical Communication Ability Category

Mathematical Communication Ability Category	Test Scores
High	≥ 72,82
Medium	50,10 < x < 72,82
Low	≤ 50,10

Source: (Shofiyah & Hendriana, 2021)

The average percentage score of teacher's and student's activities are calcultes based on the formula (Annabila et al., 2018) as follow:

$$Score = \frac{\text{the total score obtained}}{\text{maximum total score}} \times 100\% \dots (2)$$

To determine the category of teacher and student activity obtained by matching the percentage of descriptive values contained in Table 3 and Table 4.

Table 3. Teacher Activity Percentage Score Category

Percentage (%)	Category
87,5–100	Excellent
75–87,49	Good
50–74,99	Enough
0–49,99	Less

Table 4. Student Activity Percentage Score Category

Percentage (%)	Category
81–100	Excellent
61–80	Good

Percentage (%)	Category
41–60	Enough
0–40	Less

Source: (Annabila et al., 2018)

RESULT AND DISCUSSION

As reported by the test in the first and second cycles outcomes, classroom action research in class X-4 with the learning process carried out using Problem-Based Learning assisted by Baamboozle with the aim of knowing the increase in students' mathematical communication ability on opportunity material. In student learning activities an increase in learning outcomes in each cycle can be seen in Table 5.

Table 5. Test Results in Cycle I and II

Ability Category	Cycle I		Cycle II	
	Student Population	Percentage	Student Population	Percentage
High	21	63,64%	26	78,79%
Medium	6	18,18%	4	12,12%
Low	6	18,18%	3	9,09%

The assessment at the end of each cycle can be seen in Table 5 showing that the data on students' mathematical communication ability which are in the high category have increased. In cycle I, the total percentage of students who had high mathematical communication ability was 63,63% (21 students) and this percentage increased in cycle II with a result of 78,70% (26 students). Meanwhile, the medium to low category experienced a decrease from cycle I to cycle II. For the category of medium mathematical communication ability in cycle I of 18,18% (6 students) to 12,12% (4 students) in cycle II and for the category of low mathematical communication ability in cycle I of 18,18% (6 students) to 9,09% (3 students). The data explains that more than 75% of all students have high mathematical communication skills in cycle II. This proves that through the Baamboozle-assisted Problem Based-Learning it can have an impact on increasing the mathematical communication ability of X-4 students on opportunity material.

This situation is similar to various researches on the proficiency of students in conveying mathematical concepts that can be enhanced by Problem-Based Learning (PBL). PBL shows better results on communication ability than compared to conventional learning (Layliyyah et al., 2022). Improving mathematical communication ability after applying the PBL model has a positive effect for students (Kristina et al., 2023).

Problem-Based Learning assisted by Baamboozle will improve mathematical communication ability and also increase learning activities. The use of Baamboozle is

considered effective in increasing student motivation, as evidenced by the enthusiasm of students in following the learning, students are more active and interactive in communicating, and many students are enthusiastic in participating all learning activities. The use of interactive media such as Baamboozle makes learning mathematics more fun and attracts students' attention.

There is a reflection material from cycle I that must be repaired, including: (1) the use of time that has not been maximized; (2) there are still certain students who remain inactive while learning math. Based on the conclusions of interviews with three students, they said the reason they were not active during learning because they were not focused and had reduced concentration in learning due to fasting. One of the causes of disruption of learning concentration is because they have not eaten so that students' concentration is disturbed (Dewi et al., 2020); and (3) there are students who are shy and not brave to present their answers. If students feel shy and afraid when presenting their work, it will cause their communication skills to not be optimal (Purnamasari & Afriansyah, 2021). After analyzing the actions taken during the learning activities, the researcher obtained reflection materials to correct deficiencies in cycle II.

Based on those considerations at the reflection stage of cycle I, the researcher corrected the deficiencies that occurred and maintained the things that were already good. Solutions from learning activities in the first cycle, including: (1) make planning and learning schemes better; (2) the teacher provides an understanding of the importance of consuming food prior to fasting; (3) the teacher practiced the ice breaking technique when the students started to lose concentration. The application of ice breaking technique during the learning process will make students excited again, increase concentration and feel refreshed (Muharrir et al., 2022); (4) giving added value to students who dare to argue or present answers. Giving rewards will trigger students to increase their self-confidence (Nurbayanti, 2023).

Observation and assessment of learning will be carried out by researchers and mathematics teacher (observers). The math teacher and researcher will evaluate the activities by giving scores and notes on the observation sheet of teacher and students.

Table 6. Percentage Results of Teacher Activity Observation Sheets

<u>Meeting</u>	<u>Score</u>	<u>Criteria</u>
Cycle I	68%	Enough
Cycle II	80%	Good

Table 8 shows an increase in teacher activity. In the first cycle, 68% of teachers with sufficient criteria then increased in cycle II to 80% with good criteria in carrying out the research stages.

Table 7. Percentage Results of Student Activity Observation Sheets

Meeting	Score	Criteria
Cycle I	75,57%	Good
Cycle II	85%	Excellent

Table 9 shows an increase in student activities. In the first cycle, 75,57% of students with good criteria took part in learning, then increased in cycle II to 85% of students in participating in learning with excellent criteria.

CONCLUSION

As reported by the results and discussion, it has been established students in X-4 grade, studying at a Senior High Schools located in the South Jakarta are known to have significantly improved their mathematical communication skills through Problem-Based Learning assisted by Baamboozle. This indicates the percentage of students with high mathematical communication skills from pre-test to the second cycle. The pretest results were only 30.3% of all students in the category of high mathematical communication ability, then increased to to 63.64% in cycle I and 78.79% in cycle II.

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