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Analysis of the Preliminary Study of Mathematical Communication Ability of Grade VII Students

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Abstract

This study aims to determine students' mathematical communication ability in solving mathematical problems. This was descriptive research. The research subjects comprised 32 students in class VII-I SMP Negeri 39 Semarang. Data collection consists of a written test and an interview. Written tests were conducted to measure the achievement of indicators of mathematical communication ability, and interviews were conducted to obtain more in-depth data from students regarding mathematical communication ability. The results showed that in the first indicator, namely the ability to write to explain ideas or solutions in their own language, students achieved the very good category with a percentage of 93.75%. The second indicator, the ability to describe an idea or solution in the form of a diagram, table, or graph, is in the sufficient category with a percentage of 62.5%. The third indicator, the ability to express problems into mathematical models, obtained a low category with a rate of 43.75%. The fourth indicator, the ability to identify known information, what is asked, and the completion step, is in the category of sufficient, with a percentage of 56.25%. Meanwhile, the fifth indicator, namely the ability to draw conclusions, is in the poor category with a rate of 37.5%. These findings indicate that although the ability to write mathematical ideas is excellent, improvements are still needed in the indicators of mathematical model preparation and the conclusions drawn.

1. Introduction

The learning outcomes will reflect whether or not the learning goals are achieved. However, in an effort to achieve satisfactory learning results, a learning process is needed. One of the subjects that runs in educational institutions is mathematics (Anjarwati et al., 2021). Mathematics is one of the subjects that functions to develop the ability to calculate, measure, and use mathematical formulas that can be applied in life.

According to Hanipah & Sumartini (2021), in mathematics learning, there are several mathematical abilities that must be possessed by students. One of them is the ability to communicate mathematically. According to the National Council of Teachers of Mathematics (NCTM) (Hanipah & Sumartini, 2021), the standard mathematics learning process consists of problem solving, reasoning and proof, communication, connection in mathematics, and representation. Mathematical communication is essential for students because it can affect many things, including daily life.

Mathematical communication is defined as a conversation that occurs in a classroom environment. The conversation is about the math material learned in class. Mathematical communication is a way of understanding, so that through communication, ideas can be developed through a process to build meaning and explain the idea. Mathematical communication is the ability to express mathematical ideas, understand, interpret, assess, or respond to mathematical ideas, and use terms, notations, and symbols to present mathematical ideas (Kamid et al., 2020). Mathematical communication abilities are a very important ability for students, because they can affect many things, including in daily life (Yaniawati et al., 2019).

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Based on the results of observations on several students at SMP Negeri 39 Semarang, it was found that students still had difficulties in understanding the meaning of the story and translating it into mathematical language. This is in line with the opinion of Rapsanjani and Sritresna that mathematical communication abilities are important. However, the facts show that students' communication abilities are still relatively low (Rapsanjani & Sritresna, 2021). From this, students often have difficulty in expressing mathematical ideas both verbally and in writing, as well as demonstrating and visualizing them. Based on the exercises the teacher gave, only a few students can express their writing using mathematical terms or notation. (Hidayati et al., 2020).

Students learn mathematics as if they were talking and writing about what they are doing. Students are actively involved in math when asked to think about their ideas or talk to and listen to other students about various ideas, strategies, and solutions (Kusyaini & Junaedi, 2021). It is not uncommon for students to understand the material well but cannot apply it to more complex problems, thus indicating that students are experiencing problems related to mathematical communication abilities. (Hanipah & Sumartini, 2021). Good communication abilities will allow students to be active in learning and make it easier to reason with the information. When learners communicate their thoughts to others verbally, it helps improve comprehension, creating commonalities and a deeper language for expressing mathematical ideas. It contributes to conceptual understanding, problem-solving, and correcting misconceptions about mathematical concepts. (Kamid et al., 2020).

According to the National Education Association (2012), communication is one of the four most important fundamental abilities that must be present in every individual to be able to engage effectively with the global community. It is mandatory for each individual to be able to communicate effectively to receive honest and accurate information from other individuals who communicate (Arifuddin & Ihsanudin, 2024). The purpose of learning mathematics is for students to be able to communicate ideas with symbols, tables, diagrams, or other media related to the mathematical objects that have been studied. This shows that mathematical communication abilities are abilities that must be mastered by students.

Mathematical communication abilities are the ability to thoroughly, critically, and evaluatively receive mathematical ideas or ideas from others, then understand them profoundly to improve understanding of mathematics, and convey mathematical ideas, theories, or ideas well both orally and in writing (Arifuddin & Ihsanudin, 2024). Students who are skilled in communication have a greater chance of understanding mathematics in depth. The reason is communication abilities that allow students to play an active role during learning, not just as passive spectators. This is confirmed by Kamid et al., (2020) research, communication abilities are also an important requirement in connecting and understanding the meaning of math problems, as well as being able to transform them into the context of learning that is being pursued. Based on this, mathematical models, diagrams, graphs, or other elements can be built that strengthen the use of mathematical communication in solving mathematical problems that students want to get solutions to, so that students are able to solve all the problems they face.

The indicators of mathematical communication abilities used in this study are indicators of mathematical communication abilities according to Sunaryo et al. (2024), they are as follows: 1) able to write (*written text*), that is, explaining ideas or solutions to a problem or picture using one's own language; 2) be able to draw, that is, explain ideas or solutions from mathematical problems in the form of drawings, tables, diagrams, or graphs; 3) be able to perform mathematical *expressions*, i.e. state everyday problems or events in the language of mathematical models; 4) be able to identify what is known, be asked, and explain how to find answers; and 5) able to draw conclusions from a problem.

Based on the description above, this study was conducted as an in-depth preliminary research on mathematical communication abilities before being given treatment to improve mathematics learning objectives.

2. Methods

This study used a qualitative approach, and the data were analyzed descriptively. This descriptive method includes the presentation of conclusions through a systematic presentation and simple graphs.

2.1. Research Venue and Subject

This research was conducted at SMP Negeri 39 Semarang, Jl. Sompok Lama No.43A, Peterongan, Kec, South Semarang, Semarang City, Central Java. The subject of this study is students in grades VII-I, consisting of 32 students. The subject was taken by purposive sampling, which was selected based on the goal to be achieved, namely, describing the mathematical communication abilities of grade VII students.

2.2. Data Collection Techniques

Data collection consists of a written test and an interview. A written test was conducted to measure the ability to communicate asymptotically based on 5 indicators of mathematical communication ability, and interviews were conducted to obtain more in-depth data on the students' mathematical communication abilities. Written tests were given to 32 students in grades VII-I, and interviews were conducted with six students according to the need to obtain more in-depth data on mathematical communication abilities.

2.3. Data Analysis Techniques

In descriptive analysis, each student's answers are analyzed to understand the level of students' mathematical communication abilities based on predetermined indicators. This analysis was carried out by paying attention to the number of achievements in each indicator for all students. The formula used to calculate the percentage of achievement on each indicator is as follows.

$$P = \frac{x}{N} \times 100\%$$

Information:
P = percentage of achievement
x = many students achieve this indicator
N = total of all students

Table 1. Percentage Achievement Criteria

Percentage	Criterion
$85\% \leq P \leq 100\%$	Excellent
$70\% \leq P < 85\%$	Good
$50\% \leq P < 70\%$	Enough
$P < 50\%$	Less

3. Results & Discussions

Based on the results of the mathematical communication ability test, data was obtained that 5 students were able to solve problems using 5 indicators of mathematical communication skills, 8 students were able to solve problems using 4 indicators of mathematical communication abilities, 3 students were able to solve problems using 3 indicators of mathematical communication abilities, 12 students were able to solve problems using 2 indicators of mathematical communication abilities, and 4 students were able to solve problems using 1 indicator of mathematical communication abilities. The full results can be seen in Table 2 below.

Table 2. Number of Students Who Are Able to Complete Test Questions in Accordance with Mathematical Communication Ability Indicators

Total Indicators of Mathematical Communication Ability that Students Are Able to Complete	Many Students
1	4
2	12
3	3
4	8
5	5

Table 3. Percentage of Students' Achievement in Completing Test Questions

Indicator	Number of Students Achieving Indicators	Percentage	Criterion
1	30	93.75%	Excellent
2	20	62.5%	Enough
3	14	43.75%	Less
4	18	56.25%	Enough
5	12	37.5%	Less

The percentage of students' achievement in each indicator in completing the test questions is explained in Table 3. Table 3 shows that students' achievement in completing the test questions of each indicator of mathematical communication ability is quite good, with an average of 50%. The results of the test showed that the achievement of students in completing the test questions based on each indicator of mathematical communication abilities in the initial research was quite good.

Based on the results obtained from the mathematical communication ability indicator, it can be concluded that the first indicator shows excellent performance with 30 students (93.75%) successfully achieving the indicator, which is categorized in the very good category. This shows that most learners are able to either convey mathematical ideas or solutions in writing or through other representations. The second to fifth indicators, although still achieved by many students, are in the sufficient category. In the second indicator, 20 students (62.5%) managed to achieve it, while in the third indicator, 14 students (43.75%) managed to achieve it. Likewise with the fourth and fifth indicators, followed by 18 (56.25%) and 12 students (37.5%), respectively, which shows that although many students are able to achieve these indicators, there is still room for improvement, especially in terms of understanding and ability to solve problems in a more effective and thorough way. Overall, although most learners were able to achieve indicators of mathematical communication abilities, some indicators showed achievement that was still in the sufficient category, indicating the need for more attention to improve students' understanding and abilities in these areas.

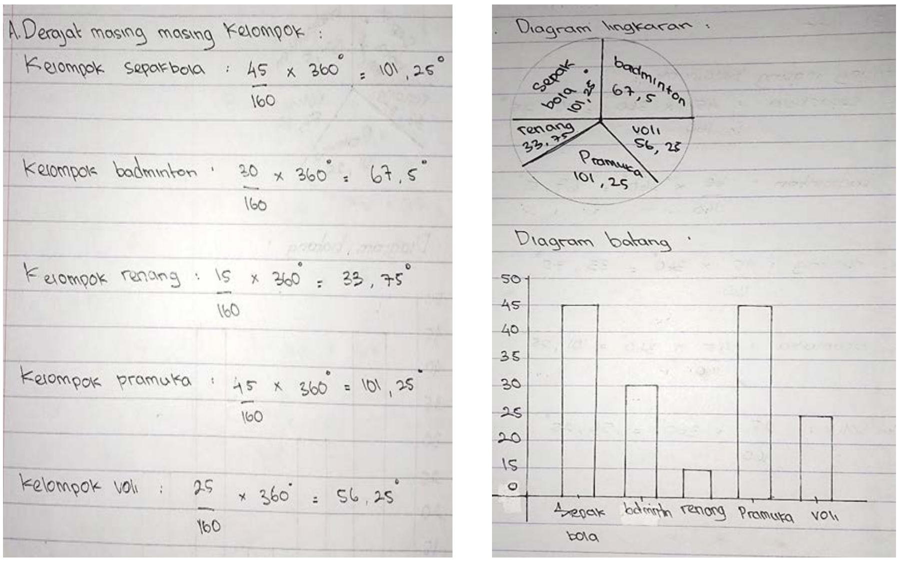


Figure 1. Subject T1 Work Results Question No. 1b and 1c

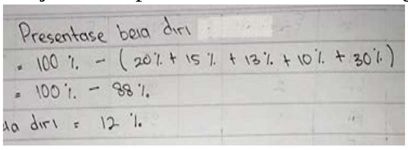
Based on this, interviews were conducted with 6 students to obtain more in-depth data on mathematical communication abilities consisting of 2 students who were able to complete 4 to 5 indicators of mathematical communication abilities, 2 students who were able to complete 3 indicators of mathematical communication abilities, and 2 students who were able to complete 1 to 2 indicators of mathematical communication abilities. The results of interviews with 6 students showed variations in the achievement of their mathematical communication abilities.

Question items 1b and 1c are questions that measure the second indicator, namely being able to draw ideas or solutions from mathematical problems in the form of pictures, tables, diagrams, or graphs. The results of the mathematical communication ability test of T1 subjects are presented in Figure 1.

Figure 1 shows that T1 subjects can draw ideas or solutions to mathematical problems in the form of pie charts and bar charts. Subject T1 can solve the problem. Labeling each part in pie charts and bar charts is also appropriate. However, the depiction of the scale bar diagram used on the Y axis to express the frequency is not accurate because the scale varies. Likewise, with the depiction of a pie chart, the making of juring for each part is still not appropriate because it is not adjusted to the size of the angle according to the previous calculation.

The analysis shows that subject T1 was able to meet all indicators of mathematical communication abilities for all given questions. In questions 1b–1c, T1 clearly rewrote the problem in their own words, then converted it into an appropriate mathematical model with consistent notation and symbols. The solution steps were written systematically and logically, with reasoning provided at each stage, even though there were minor numerical errors that did not affect the correctness of the answer. Visual representations in the form of tables and diagrams were accurate, and the final answer was connected to the problem context, demonstrating comprehensive understanding.

Question items 3b and 3c are questions that measure the third indicator, namely being able to perform mathematical expressions (*mathematical expression*) expressing problems or everyday events in the language of mathematical models. In this indicator, the focus is on the accuracy of using the formula according to the solution to the problem. The results of the mathematical communication ability test of T1 subjects are presented in the following Figure 2.



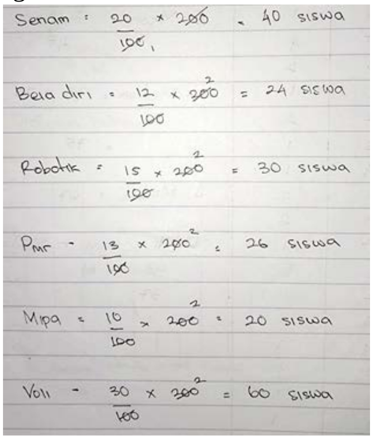
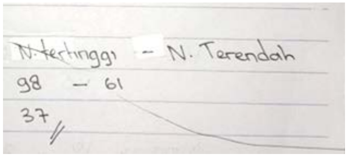


Figure 2. Subject T1 Work Results Question No. 3b and 3c

Based on Figure 2, it shows that T1 subjects can perform mathematical expressions well and use formulas correctly, so that T1 subjects can work on problems 3b and 3c.

Question items 2d and 2e are questions that measure the fourth indicator, which is being able to identify what is known, ask, and explain how to find answers. The results of the mathematical communication ability test of T1 subjects are presented in the following Figure 3.



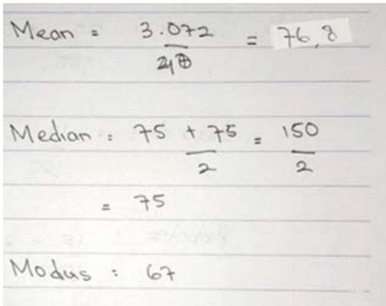


Figure 3. Subject T1 Work Results Question No. 2d and 2e

Figure 3 shows that subject T1 can identify what is known, ask, and explain how to find the answer according to the question order, so that subject T1 can work on questions 2d and 2e.

Question item number 4f is a question that measures the fifth indicator, which is being able to draw conclusions from a problem. The results of the mathematical communication ability test of T1 subjects are presented in the following Figure 4.

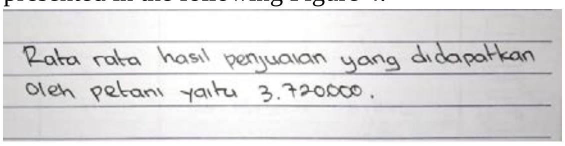


Figure 4. Subject T1 Work Results Question No. 4f

Figure 4 shows that subject T1 can draw conclusions from a problem based on the results of calculating average sales, so that subject T1 can work on problem number 4f. Based on the interview results, it is known that the T1 subject can answer well when asked the conclusion of the question by mentioning the average sales results and the months with the most and the least results. From the observation results, the T1 subjects answered well. Based on the results of tests, interviews, and observations of T1 subjects, it can be concluded that T1 subjects are able to draw conclusions from a problem.

For questions 2d–2e, T1's mathematical communication abilities were also clearly evident. The subject rewrote the problem appropriately, constructed a suitable mathematical model, and performed calculations in an orderly manner without significant errors. The visual representations supported the explanation, and the final answer was interpreted correctly in the context of the problem. A similar pattern was observed in questions 3b–3c, where T1 explained the problem in their own words, created a correct model, and presented step-by-step calculations. The visual representations were relevant, and the final answers were correct and contextual. In the more complex question 4f, T1 maintained high consistency. All indicators were met: the problem was well reformulated, the mathematical model was accurate, the solution steps were systematic, the visual representations were correct, and the final answer was linked to a real-world situation. Thus, T1's mathematical communication abilities can be categorized as high because all indicators were fulfilled across all questions.

Items 1b and 1c are questions that measure the second indicator, namely the ability to draw (drawing) an idea or solution to a mathematical problem in the form of a picture, table, diagram, or graph. The results of subject S1's mathematical communication ability test are presented in Figure 5 below.

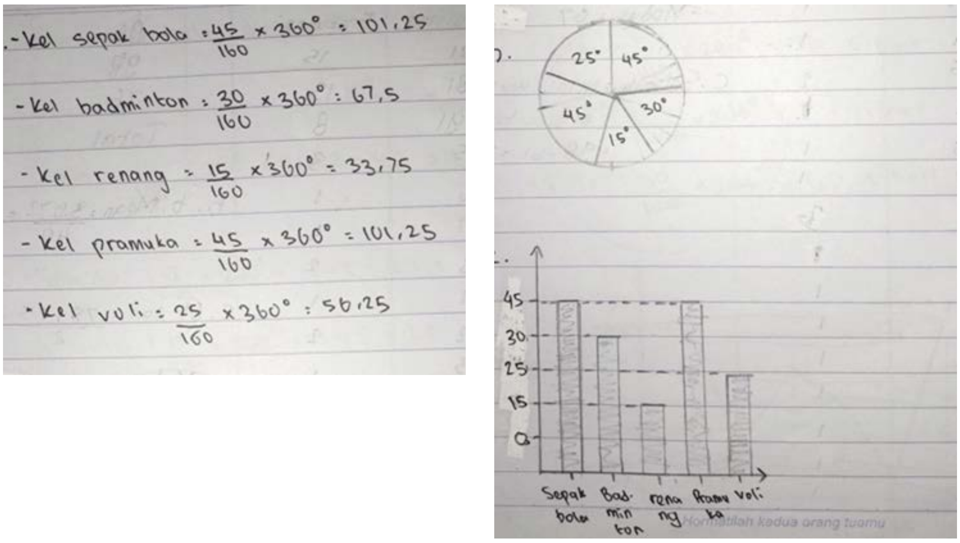


Figure 5. Work of Subject S1 on questions 1b and 1c

Figure 5 shows that subject S1 has not yet been able to draw ideas or solutions to mathematical problems in the form of a pie chart and a bar chart. Subject S1 was able to complete the question, but there were still mistakes. It can be seen in the diagrams that the subject did not fully understand how to provide labels for each part, and in drawing the bar chart, the scale used on the Y-axis to represent frequency was inaccurate because the scales were inconsistent. Similarly, in drawing the pie chart, the creation of sectors for each part was still incorrect because they were not adjusted to the angles according to the previous calculations.

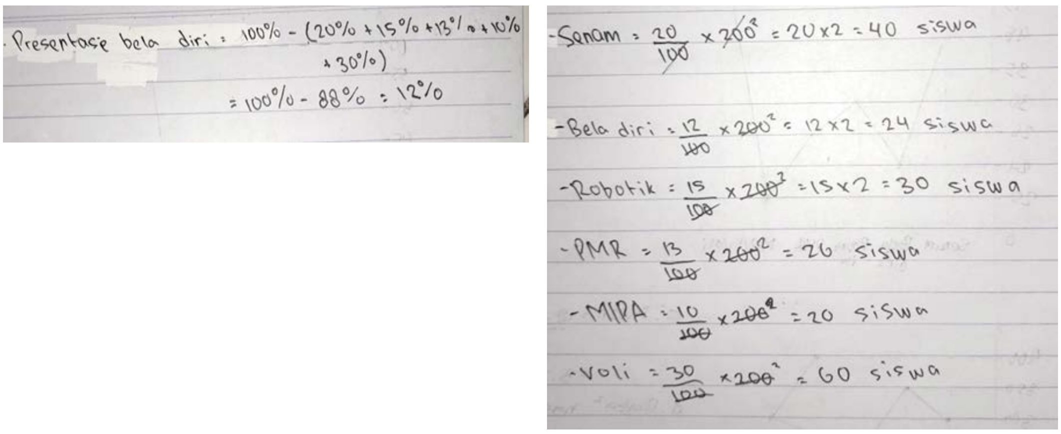


Figure 6. Work of Subject S1 on Questions 3b and 3c

Subject S1 was able to meet most indicators of mathematical communication abilities, although the quality of achievement was not optimal. In questions 1b–1c, S1 rewrote the problem, but the explanations were brief and lacked detail. The mathematical model was fairly accurate, but the use of notation was inconsistent. Calculations were correct, but not all steps were written, making the process appear jumpy. Visual representations were simple and somewhat inaccurate, and the final answer was correct but lacked contextual explanation.

Items 3b and 3c are questions that measure the third indicator, namely the ability to perform mathematical expression (mathematical expression) — expressing problems or daily events in the language of mathematical models. In this indicator, the focus is on the accuracy of using formulas in accordance with the solutions to the problems. The results of subject S1's mathematical communication ability test are presented in Figure 6. Figure 6 shows that subject S1 is able to express mathematics using the correct formulas according to the given problems, so that subject S1 was able to solve question 4a.

Based on the interview results, it is known that subject S1 was able to explain the mathematical expression and could correctly explain the ideas or solutions to the problem. From the observations, subject S1 answered well. Based on the test results, interview, and observations of subject S1, it can be concluded that subject S1 is able to write down ideas or solutions to problems using their own words.

Items 2d and 2e are questions that measure the fourth indicator, namely the ability to identify what is known, what is asked, and explain the method to find the answer. The results of subject S1's mathematical communication ability test are presented in Figure 7 below.

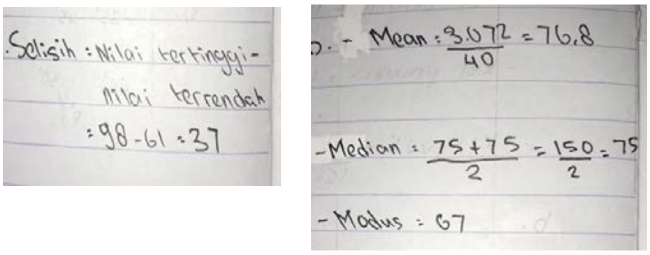


Figure 7. Work of Subject S1 on Questions 2d and 2e

Figure 7 shows that subject S1 is able to identify what is known, what is asked, and explain the method to find the answer according to the question, so that subject S1 was able to solve questions 2d and 2e.

Based on the interview results, it is known that subject S1 can identify what is known, what is asked, and explain the method to find the answer when given guidance. For example, in the analysis of data centralization, subject S1 still asked about the meaning of the question. However, subject S1 responded well. Based on the test results, interview, and observations of subject S1, it can be concluded that subject S1 is able to identify what is known, what is asked, and explain the method to find the answer.

Item 4f is a question that measures the fifth indicator, namely the ability to draw conclusions from a problem. The results of subject S1's mathematical communication ability test are presented in Figure 8.

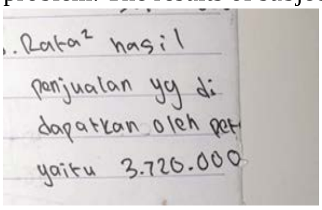


Figure 8. Work of Subject S1 on Questions 4f

Based on Figure 8, it shows that subject S1 is able to draw conclusions from a problem, so subject S1 was able to solve question 4f.

Based on the interview results, it is known that subject S1 is able to draw conclusions from a problem in accordance with the results obtained from the calculations of the previous questions. From the observations, subject S1 answered well. Based on the test results, interview, and observations of subject S1, it can be concluded that subject S1 is able to draw conclusions from a problem.

From the above analysis, it can be concluded that subject S1 has mastered mathematical communication abilities. This can be seen from subject S1's work, which demonstrates mastery of four indicators of mathematical communication abilities.

In questions 2d–2e, S1 was able to construct a mathematical model, but the solution steps were not written systematically, making them difficult to follow. The visual representations were incomplete, and the final answer was presented only as a number without contextual interpretation. In questions 3b–3c, S1 rewrote the problem in a simple way, created a fairly accurate model, and performed calculations correctly, but again did not show all steps clearly. Visual representations were less supportive, and the final answer was not fully connected to the context of the question. In the more complex question 4f, S1 encountered more difficulties. The mathematical model was inconsistent, several solution steps were skipped, visual representations were inaccurate, and the final answer was only approximately correct without adequate explanation. Thus, S1’s mathematical communication abilities can be classified as moderate: most indicators were met, but weaknesses remained, particularly in visual representation, calculation sequencing, and contextual explanation.

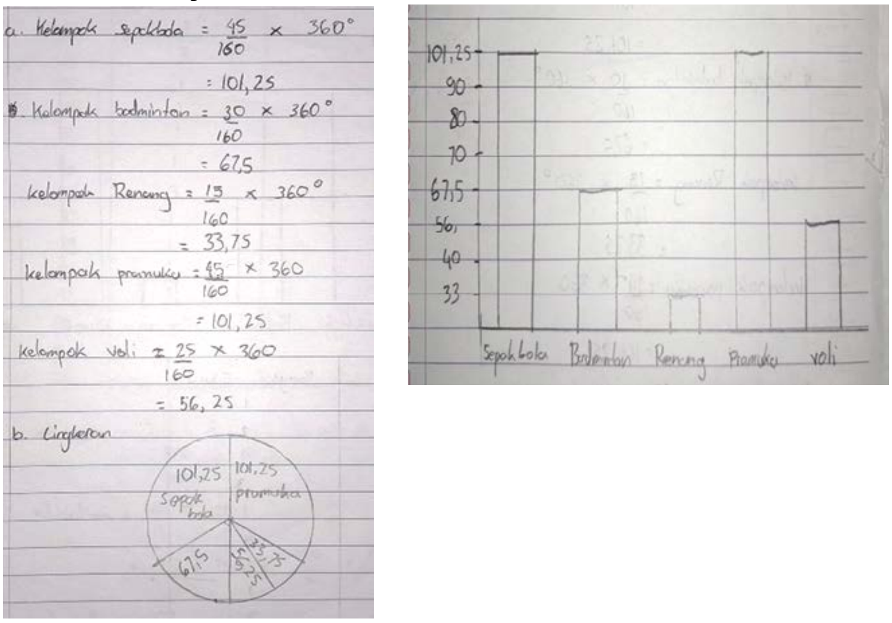


Figure 9. Work of Subject S1 on Questions 1b and 1c

Based on the interview with subject S1, it was shown that subject S1 is able to understand the indicators of mathematical communication abilities, although in some parts initial guidance was needed before subject S1 could continue the explanation independently. From the interview, it was obtained that the student was able to master four indicators of mathematical communication abilities. This is proven by the student’s work, which shows mastery of four indicators of mathematical communication abilities. The results of the logical–mathematical intelligence test also indicate that the student has logical–mathematical intelligence in the medium category. The following is the triangulation data of subject S1.

Items 1b and 1c are questions that measure the second indicator, namely the ability to draw ideas or solutions to mathematical problems in the form of pictures, tables, diagrams, or graphs. The results of subject R1’s mathematical communication ability test are presented in Figure 9.

Based on Figure 9, it shows that subject R1 has not yet been able to draw ideas or solutions to mathematical problems in the form of a pie chart and a bar chart. Subject R1 was able to complete the question, but there were still errors. It can be seen in the diagrams that the subject did not fully understand how to provide labels for each part, and in drawing the bar chart, the scale used on the Y-axis to represent frequency was inaccurate because the scales were inconsistent. Similarly, in drawing the pie chart, the creation of sectors for each part was still incorrect because they were not adjusted to the angles according to the previous calculations.

Based on the interview results, it is known that subject R1 has not yet been able to represent ideas or solutions to mathematical problems in the form of pie and bar diagrams. From the observations, subject R1 was not able to answer well and did not understand how to construct the diagrams. Based on the test results, interview, and observations of subject R1, it can be concluded that subject R1 has not yet been able to draw (drawing) ideas or solutions to mathematical problems in the form of diagrams.

Items 3b and 3c are questions that measure the third indicator, namely the ability to perform mathematical expression — representing problems or daily events in the language of mathematical models. In this indicator, the focus is on the accuracy of using formulas according to the solutions of the problems. The results of subject R1's mathematical communication ability test are presented in Figure 10 below.

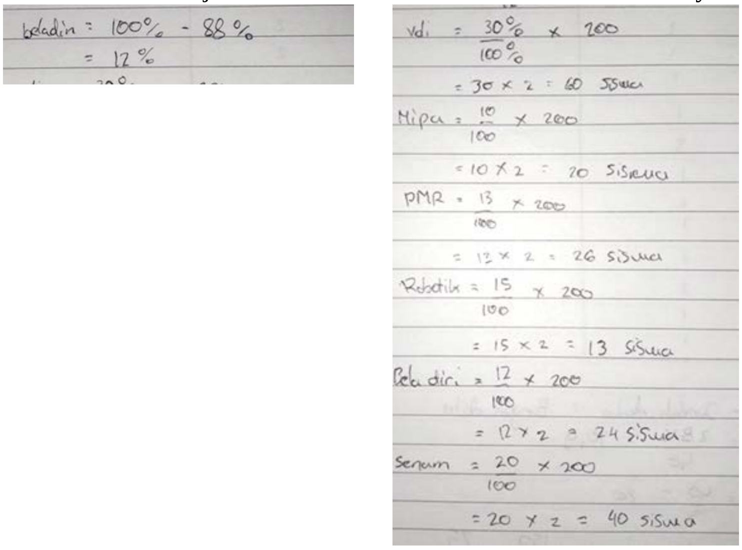


Figure 10. Work of Subject S1 on Questions 3b and 3c

Figure 10 shows that subject R1 is able to perform mathematical expressions, namely representing problems or daily events in the language of mathematical models, particularly through the use of formulas and the writing of formulas.

Based on the interview results, it is known that when subject R1 was asked about the problem, the subject did not understand, because the work produced was not entirely from subject R1's own thinking but rather copied from a classmate's work. Even when guided to find the answer, it was still quite difficult for subject R1. From the observations, subject R1 did not respond well. Based on the test results, interview, and observations of subject R1, it can be concluded that subject R1 was not able to perform mathematical expressions.

Items 2d and 2e are questions that measure the fourth indicator, namely the ability to identify what is known, what is asked, and explain the method to find the answer. The results of subject R1's mathematical communication ability test are presented in Figure 11. Based on Figure 11, it shows that subject R1 was able to answer question 2e but did not answer question 2b.

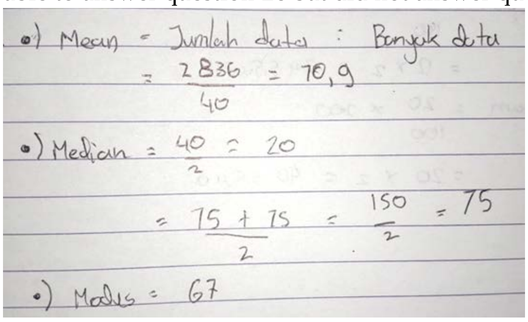


Figure 11. Work of Subject S1 on Questions 2e

Based on the interview results, it is known that subject R1 did not fully understand what was being asked in the question, since when attempting to answer, the subject appeared confused. Therefore, from the observations, it can be seen that subject R1 has not yet been able to master this indicator.

Item 4f is a question that measures the fifth indicator, namely the ability to draw conclusions from a problem. On this selected question, subject R1 did not provide an answer. This indicates that subject R1 has not yet been able to master the indicator of drawing conclusions from a problem.

Based on the above analysis, it can be concluded that subject R1 has not mastered mathematical communication abilities. This can be seen from subject R1’s work, which shows an inability to master the five indicators of mathematical communication abilities and a failure to answer several selected questions.

From the interview, it was obtained that the student has not yet been able to demonstrate mathematical communication abilities. This is evident from the student’s performance on the mathematical communication abilities test according to the indicators. Based on the logical–mathematical intelligence test results, it was also shown that the student has logical–mathematical intelligence in the low category. The following is the triangulation data of subject R1.

Unlike T1 and S1, subject R1 showed significant limitations in almost all indicators of mathematical communication abilities. In questions 1b–1c, R1 tended to copy the content of the question without interpreting it in their own words. The mathematical model created was incomplete and incorrect, the calculation steps were not systematic and contained many errors, and visual representations were absent. The final answer, presented as a number, was also incorrect and not linked to the problem context.

In questions 2d–2e, R1 could not interpret the problem properly, resulting in an incorrect mathematical model. Calculations were random and contained many conceptual and technical errors. Visual representations were absent, and the final answer was irrelevant to the problem. A similar pattern occurred in questions 3b–3c, where R1 failed to rewrite the problem, could not create a correct mathematical model, and performed incorrect calculations. Attempted visual representations were irrelevant and did not aid understanding. The final answers were incorrect and lacked contextual interpretation. In the more complex question 4f, R1 faced even greater difficulties. The subject could not create a mathematical model, did not complete calculations correctly, did not make visual representations, and the final answer was far from the context of the problem. This indicates that almost all indicators of mathematical communication abilities were not met by R1.

The comparison of research results shows differences in mathematical communication abilities among the three subjects. Subject T1 was able to meet all the mathematical communication indicators for each question, from rewriting the problem in their own words, creating an appropriate mathematical model, performing calculations systematically, presenting accurate visual representations, to providing a final answer that aligns with the context of the problem. This indicates that T1 possesses comprehensive mathematical communication abilities in written form, symbolic form, and visual representation.

Subject S1 was also able to meet most of the indicators, but the quality of achievement was not as high as T1. S1 rewrote the problem, although briefly, created a fairly accurate mathematical model, and performed calculations correctly but not always systematically. The visual representations produced were less detailed and sometimes inaccurate, while the final answers were explained only briefly, so their connection to the context was weak. Therefore, S1’s mathematical communication abilities fall into the moderate category.

In contrast, subject R1 showed limitations in almost all mathematical communication indicators. R1 did not clearly rewrite the problem, the mathematical model created was often wrong or incomplete, calculation steps were not systematic and contained many errors, and visual representations were rarely made or irrelevant. The final answers provided were also incorrect and not connected to the problem’s context. This shows that R1’s mathematical communication abilities are very low compared to the other two subjects.

4. Conclusion

The results of this study show that the mathematical communication abilities of students in grades VII-I at SMP Negeri 39 Semarang are generally in the sufficient category. Students showed variations in achievement across the five indicators, with the writing ability indicator in the very good category, the drawing and identifying information indicators in the sufficient category, and the indicators for preparing mathematical models and drawing conclusions in the lacking category. Students with high scores demonstrated a deep understanding, were able to explain the completion steps thoroughly, and could draw logical conclusions. Students with moderate scores tended to be strong in certain aspects such as writing and drawing but faced difficulties in compiling mathematical models, while those with low scores were only able to achieve 1–2 indicators and experienced obstacles in solving problems and evaluating results. These findings indicate the need to strengthen learning strategies to improve students’ mathematical communication abilities, particularly in aspects related to developing mathematical models and making logical conclusion.

Based on these findings, mathematics learning is recommended to integrate the Problem Based Learning (PBL) and REACT approaches. PBL encourages students to solve real problems critically, while REACT relates mathematical concepts to experience, application, cooperation, and knowledge transfer to new situations. The combination of these two approaches is expected to be able to improve critical thinking abilities, mathematical model building abilities, and accuracy in drawing conclusions, so that students' mathematical communication abilities develop optimally.

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