Analysis of Student Learning Difficulties in Solving Mathematical Communication Tasks Related to the Topic of Fraction

Anggi[1*], Sufyani Prabawanto[2]

[1,2]Elementary Education, Indonesian University of Education, Bandung, Indonesia

*anggi100007194126420@gmail.com

Abstract. Mathematical skills will help students understand and solve mathematical problems related to fractions by conveying mathematical ideas verbally and in writing. Considering that most students still have difficulty modeling problems, from story problems about fraction operations to mathematical modeling. This study aims to comprehensively describe the difficulties regarding mathematical communication in fraction material experienced by one of elementary school students in one of the villages in Bangka Belitung who has the highest mathematics score in his class. The method used in this study is descriptive qualitative with a case study design. Data collection was carried out by conducting observations, tests, and interviews. The results of this study indicate that students' mathematical communication skills could be more optimal. Students still need help understanding information in questions, difficulty in interpreting mathematical terms, difficulty in explaining information, and difficulty in making mathematical presentations. Encouraging students to practice more often with different types of problems and providing constructive feedback will help improve their mathematical communication skills in the future.

Keywords: Learning Difficulties, Mathematical Communication, Fractions

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INTRODUCTION

Mathematics is one of the fields of science that plays a vital role in everyday life. In essence, the position of science and mathematics is to make human life easier (Zalukhu et al., 2023). Applying mathematics daily helps solve human problems (Kenedi et al., 2018). In addition, mathematics is fundamental as an inspiration for various developments in other branches of science (Sadewo et al., 2022). This is why mathematics must be studied in elementary, secondary, and college.

Mathematics is a science closely related to human daily life, especially in improving abilities and thinking patterns in responding to problems in everyday life (Siregar & Dewi, 2022). This aligns with the objectives of studying mathematics in schools, namely, so that students can use mathematics to solve mathematical problems in the form of questions related to everyday life (Yayuk, 2019). In addition, mathematics learning in elementary schools is also expected to train students to communicate ideas using symbols, tables, diagrams, or other media to clarify situations or problems, especially in writing scientific papers (Kemendikbud, 2016). Likewise, one of the goals expected by the National Council of Teachers of Mathematics (NCTM) in mathematics learning is the development of communication skills (NCTM, 2000).

Students need Communication skills to face 21st-century life (Aswita et al., 2022). In 21st-century life, students must have critical thinking skills and problem-solving, creative thinking, collaborating with others, and communicating well (Widodo & Wardani, 2020). These skills and abilities must be accompanied by a character that never gives up, is adaptable, has curiosity,

has leadership and initiative, and is social and cross-cultural. These skills, abilities, and characters provide students with provisions to develop knowledge, skills, and attitudes in the future (Andriani, 2022)

In fact, communication is not only limited to the use of words but also exists in mathematics, which can be called mathematical communication (Ansari, 2016). Of course, this mathematical communication ability is one aspect that must be developed in learning mathematics. Particularly when solving abstract mathematical problems such as fractional material (Islami et al., 2022).

Related to the above, Baroody and Coslick (in Lubis, Meiliasari, & Rahayu, 2023) stated that there are at least two main reasons why developing students' mathematical communication skills is essential. First, mathematical communication is organizing and integrating various thoughts using mathematical language. So, mathematics is not just a tool for thinking, finding specific patterns/rules, solving problems, and drawing conclusions, but also for communicating various ideas concisely and precisely (Maggie et al., 2024). In brief, it is a means of expressing ideas, thoughts, and feelings to others (Ahdhianto et al., 2020). Second, learning mathematics is a social activity. Mathematics is a place to interact and exchange thoughts or ideas between fellow students and between teachers and students. Also, the media presents various social issues through graphics and symbols, which are required. Mathematical competence is needed to understand the meaning of acting responsibly in society (Lopes, 2022).

In the context of fractions, mathematical communication is crucial in understanding and solving fraction problems, as it involves interpreting the problem, selecting the appropriate operation, and explaining the solution.

As previously discussed, fractions are an abstract mathematical concept. They are also complex mathematical concepts (Ma'ruf et al., 2024). Fractions describe parts of a whole, which must be the same size. Fractions are usually written in q/b (a per b), with the condition that a and b are integers but [b] not equal to zero (0). A is called the numerator, and b is the denominator.

Given that the concept of fractions is part of a whole that is the same size, the denominators must first be the same when carrying out addition and subtraction operations. However, students often need help with the concept of equal size, and solving mathematical problems related to fractions becomes challenging (Indriyanti et al., 2021). Not only students but also many adults still have difficulty. Adults may be able to perform rote procedures, such as converting codes from verbal representations to symbolic representations, but are very impaired in fraction number lines, fraction concepts, and fraction arithmetic (Bhatia et al., 2024).

Based on the interview results, the reality in the field shows that many students have difficulty in mathematics, especially fractions. For instance, students tend to memorize the steps to solve the example questions given by the teacher; when the question sentences are different for the same question or vice versa, different questions for the same question, students have difficulty in solving them. In addition, students also need help answering story problems. For example, a student might struggle to determine the problem, the stages that must be selected in finding the solution, and the patterns that can be explored. A specific instance could be a student who, when faced with a fraction word problem, struggles to identify the key information and the operation to be performed. Students prefer to be given questions in the form of symbols and numbers so that they immediately know what to look for without interpreting the question first. Another area for improvement is the need for more collaboration between students in sharing knowledge.

Other research results also show that most students need help modeling problems like story problems about fraction operations in mathematical modeling (Swaratifani & Budiharti, 2021). Students also seem hesitant to write down their solutions, as seen from the many scribbles on the answer sheet. When asked to explain their work verbally, some students seem shy and need to be more precise in mentioning symbols or symbols in their explanations. This condition aligns with Hariati, Sinaga, and Mukhtar (2022) and (Maulyda et al., 2023), who state that students' mathematical communication skills are still low.

There are two factors that are the main problems in mathematical communication (Wahyuni & Rejeki, 2022). First, students often face difficulties changing problems in the form of questions related to everyday life into mathematical language. This reflects students' need to understand how mathematical concepts can be applied in authentic contexts. (Fazriansyah, 2023) . Students who face everyday situations or problems involving mathematical calculations or analysis often need clarification and help to convert the situation into mathematical terms. This not only hinders students' understanding of the material but also reduces students' ability to interact with theory and practice, which are essential in learning mathematics. (Apriani & Sudiansyah, 2024) .

Second, students also need help connecting images or visual representations with relevant mathematical ideas. (Mujiasih et al., 2022) . This inability indicates that students must fully understand how to use visual information to support mathematical thinking. It is not uncommon that when given a diagram or graph, students cannot grasp its mathematical meaning, so they fail to analyze or solve related problems. In fact, the skill of visualizing mathematical concepts is crucial. Many aspects of mathematics involve strong visualization. (Suzana et al., 2023) . Without this ability, students will not only have difficulty in mathematical communication but will

also be hampered in mastering more complex concepts in the future. Thus, these two factors significantly hinder the development of students' overall mathematical communication skills.

Based on the description of the paragraph above regarding the importance of communication skills and the gap between expectations and field facts, it is necessary to research and analyze this variable comprehensively. Through this research, the students to experience difficulties in learning will be found and understood in depth, and these will be reviewed from the perspective of mathematical communication skills. Thus, it will be more efficient in finding the right solution to overcome the difficulties experienced by students.

METHODOLOGY

This study aims to comprehensively describe the difficulties regarding mathematical communication in fraction material experienced by one of elementary school students in one of the villages in Bangka Belitung who has the highest mathematics score in his class. The type of research used and by these objectives is descriptive qualitative research with a case study approach. Data collection techniques are carried out through tests and interviews. The test given is in the form of 4 story questions, and then a semi-structured in-depth interview is conducted with the research subjects. The interview in this study aims to obtain information related to students' mathematical communication that may not be explained only through student answer sheets or to confirm unclear student answers. The data that has been collected will be analyzed using the Miles and Huberman model data analysis technique (Sugiyono, 2019). In detail, the data analysis steps are carried out by reducing data by analyzing student answers supported by data from in-depth interviews to clarify the stages of students in answering questions. Then, the data is presented as narrative text and conclusions; the last step is drawing conclusions based on data obtained from the data reduction and data presentation stages. Data analysis in this study was carried out using indicators of written mathematical communication skills expressed by Nuralam & Yani (2019), namely 1) creating mathematical situations by providing ideas and explanations in written form; 2) using appropriate mathematical language and symbols; 3) describing problem situations and stating problem solutions using pictures, charts, tables or algebraically; 4) logical, interesting conclusions in written form.

Table 1. Mathematical communication indicators

No.	Indicator	Description
1.	Creating mathematical situations by providing ideas and explanations in written form	State the known elements.
		Stating the elements being asked
2.	Using proper mathematical language and symbols	Stating the use of formulas to perform mathematical procedures
3.	Describe the problem situation and state the solution to the problem using pictures, charts, tables, or algebra.	Stating the problem situation and providing solutions in algebraic operations or pictorial form
4.	She was drawing logical conclusions in written form.	State a logical conclusion by providing reasons and steps for resolution.

RESULTS AND DISCUSSION

The findings of this study are in the form of a comprehensive presentation of the difficulties experienced by elementary school students in one of the villages in Bangka Belitung, especially in the context of mathematical communication on fraction material. Mathematical communication skills refer to students' ability to convey mathematical ideas orally and in writing. In this study, various difficulties experienced by students were analyzed in depth as evaluation and comparison materials to gain a deeper understanding of the challenges faced by students when learning or solving mathematical problems in the form of story problems. The questions used in analyzing student difficulties are as follows.

1. Mr. Aji has a plot of land for plantation land. Half of the land will be planted with rambutan trees, and a quarter will be planted with duku trees. However, Mr Aji plans to replace it with land planted with rambutan and durian. So;

a. How much of the plantation land will be planted with durian?

b. How much of the plantation land needs to be planted?

2. Andi bought two sacks of rice weighing 25 kg each. He wanted to donate the rice using plastic bags. Each plastic bag would contain $\frac{3}{2}$ kg of rice. How many plastic bags of rice could Andi distribute?

3. Uncle Jek brought rambutan fruit as souvenirs. The souvenirs were given to Kokom $\frac{1}{4}$, Dila $\frac{4}{7}$, and the rest to Aida. How many rambutans did Aida get!

4. Anin bought young mangoes 2 days in a row. On the first day, as much as 2.5 kg, and on the second day, as much as $4\frac{3}{4}$kg. Then, the mangoes were used to make pickles as much as $3\frac{1}{4}$kgkg. How many kg of young mangoes are left that have yet to be used?

The analysis was conducted based on the indicators of mathematical communication skills in Table 1 above. The following are the results of the analysis of the difficulties experienced by R and D in solving the problems.

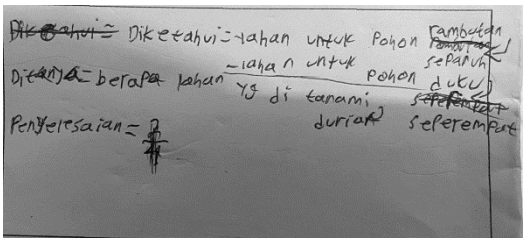

Figure 1. R's answer, Question number 1

Based on Figure 1, it can be seen that R has recorded the information known from the problem on the explanation sheet. In the notes, R wrote the terms "half" and "quarter" in the form of words without using more formal mathematical symbols or in the form of fractions. This suggests that R may be more comfortable using everyday terms than mathematical notation, which can hinder mathematical communication. In addition, R needs to include important information about the durian plant that should be there to provide a more complete context to the problem. Although R has recorded the elements sought, one additional element has yet to be written, reflecting a gap in understanding the problem instructions.

When entering the completion stage, R seemed confused in answering questions. In the interview, R revealed that he did not fully understand the meaning of the questions. This limited understanding indicates the need for more in-depth teaching on analyzing and understanding mathematical problems, especially those involving terms that can be interpreted differently. Therefore, teachers must provide more straightforward explanations of the terms in the questions and train students to use the correct mathematical symbols and notations. With this approach, it is hoped that students like R can overcome confusion in solving mathematical problems, thereby improving their overall mathematical communication skills.

Next, R's answer to question number 2 can be seen in Figure 2.

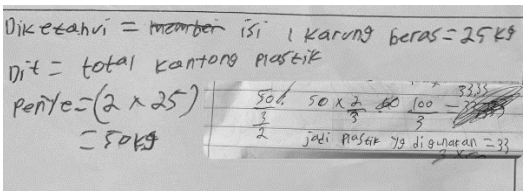

Figure 2. R's answer, Question number 2

Based on Figure 2, it can be seen that R only wrote down one known element from the problem, whereas there should be three essential elements that need to be noted: the number of sacks, the weight of rice per sack, and the load of the plastic bag. This indicates that R may have yet to fully understand the importance of including all relevant information to solve the problem accurately. However, in the indicator stating the elements asked, R has noted these elements, although not using the correct mathematical symbols. These everyday words can limit R's understanding of more complex mathematical concepts.

On the other hand, at the completion stage, R managed to provide the right solution and draw appropriate conclusions from the results of the solution. This shows that despite the shortcomings in mentioning the elements, R can apply his knowledge to solve problems. The results of the interview with R revealed that he felt very confident and optimistic when writing the answer. This positive confidence can motivate R to continue learning and improve his understanding of mathematics. However, to support this development, teachers need to encourage using appropriate mathematical symbols and notations so that R can be more effective in communicating his mathematical ideas in the future.

R's answer to question number 4 can be seen in Figure 3.

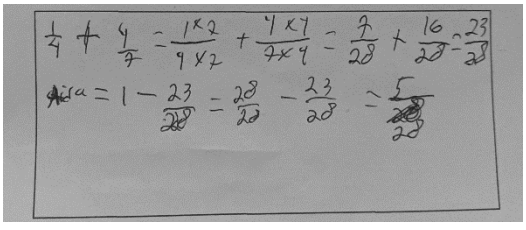

Figure 3. R's answer, Question number 3

Based on Figure 3, it can be seen that R did not include the known elements or the elements asked in the problem-solving process. R immediately continued by adding the parts distributed to Kokom and Dila, then subtracting one whole part from the addition result. Although R managed to provide the right solution and calculate the results correctly, he needed to conclude the solution that had been carried out. This conclusion is necessary to maintain the overall understanding of the solving process because concluding is essential in confirming the results obtained.

In the interview, R revealed that he felt confident and optimistic when writing the answer. This confidence is undoubtedly positive, but R hurried to write and missed the necessary steps to record the known and asked elements. This haste can be a barrier to mastering the concept, considering that recording relevant information is the key to comprehensively understanding and solving the problem. Therefore, teachers need to emphasize the importance of accuracy in each step of the solution and encourage R to be more careful and organized in the writing process, including exciting conclusions from the results that have been achieved.

Next, the answer to the last question can be seen in Figure 4.

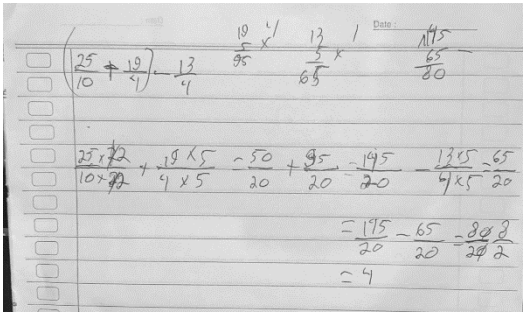

Figure 4. R's answer to question number 4

Based on Figure 4, it can be seen that R does not include known elements or elements that are asked about in solving the problem. R immediately added the mangoes purchased over the two days, then subtracted this amount from those used to make pickles. Even though R provides the right solution with accurate calculation results, it does not directly equalize the denominator for the third number. This suggests that R may still need to understand the importance of systematic steps in solving math problems. Apart from that, R also needs to conclude from the results obtained regarding the solution, which can reduce the overall understanding of the problem at hand.

In the interview, R stated that he felt confident and optimistic when writing the answer. This confidence is a positive thing, but R was in a hurry when writing, so he finished recording the known elements, the elements asked of, and the conclusions of the solution. This haste can hinder a deeper understanding of the studied concept because recording relevant information and drawing conclusions from the results is crucial in learning. Therefore, teachers must reinforce the importance of accuracy and systematic steps in solving problems and encourage R to be more careful and organized in writing answers.

Mathematical communication has a significant influence on solving mathematical problems. Mathematical communication involves students' ability to articulate and understand mathematical ideas clearly and accurately (Hanipah & Sumartini, 2021). Mathematical communication requires reading, understanding, and describing mathematical problems

correctly. Using appropriate mathematical language, students can identify relevant information and clearly understand what is being asked in the issue. Through mathematical communication, students can express and explain the problem-solving strategies used (Pambudi et al., 2021). By communicating about the steps to be taken, students can get input from others and improve strategies that may need to be more effective. Mathematical communication also involves using mathematical representations, such as diagrams, graphs, or mathematical formulas (Susanti et al., 2019). Students can communicate their understanding more clearly by visually depicting mathematical ideas and facilitating problem-solving. Mathematical communication allows students to explain the steps to solve problems and the results obtained. By communicating about the resulting solution, students can convey the correctness and adequacy of the solution and make corrections if necessary.

CONCLUSION

Based on the study and discussion results, students' mathematical communication skills are still not optimal. Students are not used to solving story problems and need help understanding them. However, students can already express mathematical ideas verbally and in writing, explain the mathematical representations made, and explain the relationship of ideas in solving problems. Students can also explain the plan for solving the issues being worked on. This shows that although understanding and applying mathematical concepts can be challenging, students' communication and explanation potential can be further developed through a more systematic learning approach and more intensive practice solving word problems. Encouraging students to practice more often with different types of problems and providing constructive feedback will help improve their mathematical communication skills in the future.

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