Profile of Primary School Students' Mathematical Communication Skill

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Abstract. Mathematical communication skills are one of the skills that students need. This skill must be practiced to develop the student's abilities. This study aimed to describe levels of mathematical communication skills. The study was qualitative. The subjects of this study consisted of her 12 students from SD Kanisius Kedawung. Samples were collected by a purposive-sampling sampling technique. Data collection techniques were observations, interviews, and tests. Data were analyzed using a flow analysis model. Mathematical communication skills were classified into four categories: very good (A), good (B), fair (C), and poor (D). The results of this study showed a mean overall score of 9.92. The score was fair (C). This study can be concluded that the level of students' mathematical communication skills is still relatively low. Researchers suggest that teachers should pay attention to students' mathematical communication skills. Teachers need to be creative and innovative in designing learning activities to improve a student's mathematics communication skills.

Keywords: Mathematics, Communication Skill, Primary School

1 Introduction

The development of technology demands students a lot of competencies. The competencies of the students vary widely, not only in ability and knowledge but also in cognitive competence, functional competence, interpersonal competence, and ethical/moral competence [1]. The competencies are known as 21st Century Skills or 4C-Critical Thinking, Communication, Collaboration, and Creativity (Partnership of 21st Century Skills, 2006). One of the skills developed in 21st Century education is communication.

Generally, communication is defined as a method of conveying a message from a courier to the recipient of the message to convey an opinion or action, whether directly orally or indirectly through the medium [2]. Communication cannot be separated from the learning process, because the learning process occurs as a result of communication, whether it is intrapersonal (thinking, remembering, and making perceptions) or interpersonal (the process of delivering ideas or information to others, respecting others'

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opinions, and listening to the arguments presented by others) [3]. The children must apply communication skills in their education field, especially in mathematics [4].

In mathematics learning, communication is called mathematical communication. Mathematical communication skill is the ability to express ideas and mathematical understanding orally or in writing using numbers, symbols, pictures, graphics, diagrams, or words [5]. On the other hand, Prayitno, et al.[6] mention that mathematical communication skill is a method for students to tell and interpret their thoughts about mathematics orally or in writing in the forms of pictures, tables, diagrams, formulas, or demonstrations. From these arguments, mathematical communication skills are defined as the ability to express or interpret mathematical ideas using numbers, symbols, pictures, tables, graphs, diagrams, words, formulas, or demonstrations in orally or in writing.

Mathematical communication skill is very important because it is the central force of the student to formulate the concept and the strategy of mathematics. Mathematical communication skill is a "vessel" for the students to obtain information, share their thoughts or discoveries, and assess or sharpen their ideas [7]. Mathematical communication skill also plays an important role in building the connection between informal and intuitive aspects of abstract languages of mathematics, such as symbols, and between the descriptions with the mental pictures of mathematics ideas [8]. Mathematical communication skill helps the students to express, explain, imagine, and listen to the teachers, so they can deeply understand mathematics [9]. Without communication in mathematics, there is little information, data and facts about students' understanding of mathematics processes and applications [10].

In fact, the mathematical communication skill of the students is still far from the expectation and objective of our education system. Hariyanto [11] showed that students' mathematical communication skills are still low. Students are said to have either failed to communicate mathematical ideas well or failed to provide thorough arguments grounded in mathematical principles and concepts. Pramesti [12] argues that most of the mistakes students make are in using mathematical symbols to solve problems or in drawing pictures of solutions.

There are indicators to see students' mathematical communication skills. The indicators of mathematical communication skills proposed by Sumarmo [2] are as follows: 1) Expressing real objects, situations, and everyday events into mathematical models (pictures, tables, diagrams, graphs, mathematical expressions); 2) Explain mathematical ideas and models (pictures, tables, diagrams, graphs, mathematical expressions); 3) Explain and create mathematics questions; 4) Listening, discussing and writing about mathematics; 5) Reading with understanding a written presentation; dan 6) Making conjectures, constructing arguments, formulating definitions and generalizations. On the other hand, the education ministry of Ontario [13] states the indicators of mathematical as follows: 1) Written text, to provide answers using your language, model situations or problems using orally, written, concrete graphics, and algebra, explaining and making questions about studied mathematics, listening, discussing and writing about mathematics, making conjectures, compiling arguments and generalizations; 2) Drawing, reflecting real objects, pictures, and diagrams into mathematical ideas; 3)

Mathematical expressions, namely expressing mathematical concepts by expressing everyday events in mathematical language or symbols.

Based on the information above, mathematical communication skill is significant for students. Therefore, the researchers are interested in analyzing students' mathematical communication skills. The purpose of this research is to describe the students' mathematical communication skill level and things to improve mathematical communication skills.

2 Methods

The researchers used a descriptive qualitative approach. The research was conducted in the first semester of the 2021/2022 school year at SD Kanisius Kedawung. The subjects of the research are twelve V-grade students. The subjects were taken using purposive sampling. The data were collected using observation, tests, and interviews. The test consists of 5 questions as the representation of the indicators of mathematical communication skills. The indicator of mathematical communication skills in this research is developed by some researchers, such as Sumarmo [2] and Hendriana, et al [13]. The researchers adopted the opinions of those researchers and find the indicators of mathematical communication skills that are, as follows: 1) To relate the real objects to the mathematics model (pictures, tables); 2) To explain their ideas or models using their language; 3) To use terms, notations, or mathematics symbols and structures to perform their ideas; 4) To represent their daily life problems into mathematics models; 5) To construct their arguments using their languages.

The data analysis technique was using Flow Analysis Model by Miles and Huberman. This technique was used because this research focused on only one issue. The analysis consisted of three components: data reduction, data display, and conclusion drawing/verification. At the data reduction stage, the researcher analyzed the answers students are assisted by conducting interviews to determine the stages of students in answering the question. At the data display stage, the results of the analysis are presented in the form of narrative text and tables of analysis results. The conclusion-drawing stage is taking the conclusion of the data obtained from the process of data reduction and presentation.

To determine the scores of each indicator of the test, we can see the scores guideline in the table below.

Table 1. Guidelines for Scoring the Mathematical Communication Skill Test

Answer	score
No answer	0
Incomplete steps, incorrect response, incorrect answer	1
Complete steps, correct response, and incorrect answer	2
The correct response, correct answer, but incomplete steps	3
Complete steps, correct response, and answer	4

Based on table 1, the student will get a score of 0 if the student does not answer. The student will get a score of 1 if a student can answer but the answer is Incomplete steps, incorrect response, incorrect answer. The student will get a score of 2 if the answers are complete steps, correct response, and incorrect answer. The student will get a score of 3 if the answer is the correct response, correct answer, but incomplete steps. The student will get a score of 4 if the answer is complete steps, correct response, and answer.

The researchers determined the total score average and categorized the results of the test into four categories, such as Very Good (A), Good (B), Fair (C), and Poor (D). The criteria for each category are presented in table 1 as follows.

Table 2. Criteria of Mathematical Communication Skill Level

Category	Score
Very Good (A)	15,1-20
Good (B)	10,1-15
Fair (C)	5,1-10
Poor (D)	0-5

Table 2 is the criteria for mathematical communication skill level. The value used a range of 0 to 20. The value is the total average score of each indicator. The value determined the level of mathematical communication skills.

3 Results And Discussion

In this part, the researchers will reveal the results of the data collection. The data of this research were taken from the test, observation during the learning activities, and interviews related to mathematical communication skills. The tests for mathematical communication skills were developed by comparing the indicators of mathematical communication skills from the former researchers. Following are the test questions and some results of the student's answers.

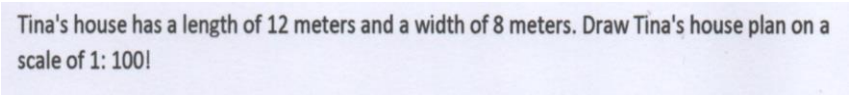

Fig. 1. Question 1 for Indicator "to Relate the Real Objects to the Mathematics Model (Pictures, Tables)"

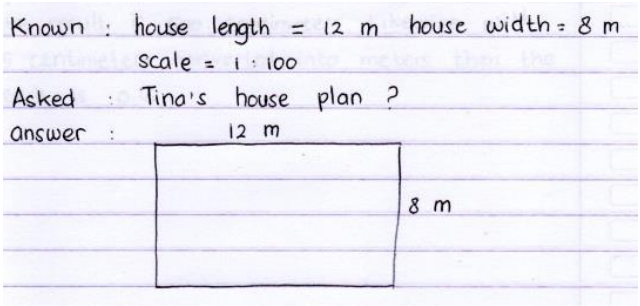

Fig. 2. Student Answer for Question 1

Figure 1 was question number 1 as the representation indicator "to relate the real objects to the mathematics model (pictures, tables)". In Figure 2 known that the student responded to the question correctly and the steps are complete but the answer was incorrect. The student drew the picture correctly, but the size and picture information was incorrect. So, a student achieved a score of 2.

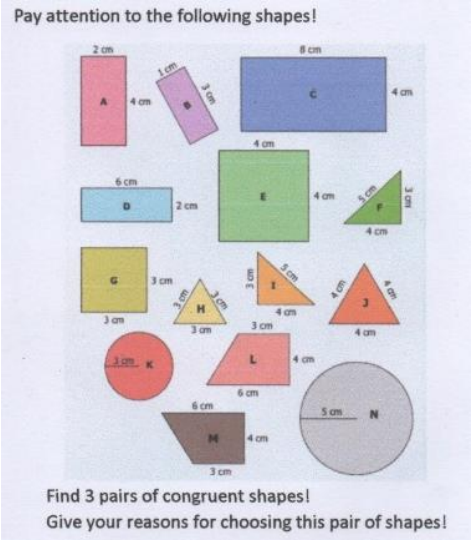

Fig. 3. Question 2 for Indicator "to Explain Mathematics Ideas or Models Using Their Language"

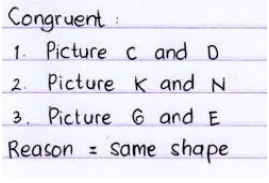

Fig. 4. Student Answer for Question 2

Figure 3 was question number 2 as the representation indicator "to explain mathematics ideas or models using their language". On figure 4 students almost answer the question correctly at points 2 and three. But the reason was not correct. Students only pay attention to the same shape and were not pay attention to the size ratio in each shape. So, a student achieved a score of 2.

The image of a house has a scale of 1:300. The length of the house in the picture is 5 centimeters and the width is 4 centimeters. Calculate the actual area of the house!

Fig. 5. Question 3 for Indicator "to Use Terms, Notations, or Mathematics Symbols and Structures to Perform Their Ideas"

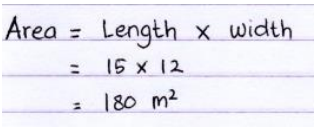

Fig. 6. Student Answer for Question 3

Figure 5 was question number 3 as the representation indicator "to use terms, notations, or mathematics symbols and structures to perform their ideas". On figure 6 students can answer the question correctly. The student also can use mathematics symbols. But the student did not write the steps. So, a student achieved a score of 2.

Mr. Bambang will make a circular fish pond right in the middle of his garden. Before working on the pool, Mr. Bambang made a picture first. Pak Bambang Park has a length of 12 meters and a width of 8 meters. Pak Bambang wants to build a pond with a diameter of 4 meters. Make a picture of the garden and fish pond design, Mr. Bambang!

Fig. 7. Question 4 for Indicator "to Represent Their Daily Life Problems into Mathematics Models"

Fig. 8. Student Answer for Question 4

Figure 7 was question number 4 as the representation indicator "to represent their daily life problems into mathematics models". On figure 8 student responded to the question correctly. But the student was not paying attention to the size. The student did not include the scale. So, the student achieved a score of 2.

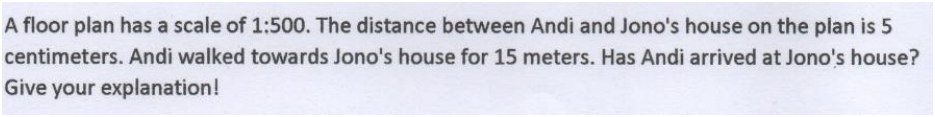

Fig. 9. Question 5 for Indicator "to Construct Their Arguments Using Their Languages"

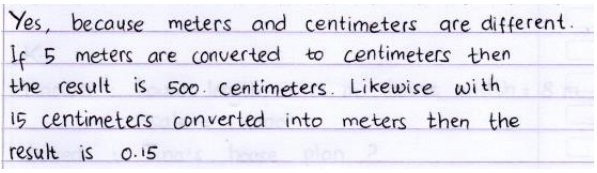

Fig. 10. Student Answer for Question 5

Figure 9 was question number 5 as the representation indicator "to construct their arguments using their languages". On figure 10 student's response is correct, but the answer was false. The reason for the answer was not appropriate. So, the student achieved a score of 2.

The test result showed various scores. The student's score achievement on each indicator can be seen in table 2.

Table 3. The student's score achievement on each indicator

Student	Indicator				
	To relate the real objects to the mathematics model (pictures, tables)	To explain mathematics ideas or models using their language	To use terms, notations, or mathematics symbols and structures to perform their ideas	To represent their daily life problems in mathematics models	To construct their arguments using their languages
s-1	0	1	1	0	1
s-2	3	4	3	2	3
s-3	2	3	2	2	2
s-4	2	2	2	2	2
s-5	2	3	2	1	2
s-6	3	4	2	2	2
s-7	4	4	3	3	3
s-8	0	2	1	0	0
s-9	3	3	2	1	2
s-10	3	2	2	0	2
s-11	3	3	3	1	2
s-12	1	2	1	0	1
Average	2.17	2.75	2.00	1.17	1.83

According to table 3, the indicator "to relate the real objects to the mathematics model (pictures, tables)", two students achieve a score of 0, one student achieves a score of 1, three students achieve a score of 2, five students achieve score 3, one student

achieve score 4 and the scoring average is 2.17. On the indicator "to explain mathematics ideas or models using their language", no student achieves a score of 0, one student achieves a score of 1, four students achieve a score of 2, four students achieve a score of 3, three students achieve a score 4 and the scoring average is 2.75. On indicator "to use terms, notations, or mathematics symbols and structures to perform their ideas", no student achieves a score of 0, three students achieve a score of 1, six students achieve a score of 2, three students achieve a score 3, no student achieve score 4 and the scoring average is 2.00. On the indicator "to represent their daily life problems into mathematics models", four students achieve a score of 0, three students achieve a score of 1, four students achieve a score of 2, one student achieves a score of 3, and no student achieve score 4 and the scoring average is 1.17. On the indicator "to construct their arguments using their languages", one student achieve a score of 0, two students achieve a score of 1, seven students achieve a score of 2, two students achieve a score of 3, and no student achieve score 4 and the scoring average is 1.83. The total score from the average is 9.92. This score is compared to table 2 and is categorized as Fair (C).

Researchers convert the data into percentages to see the distribution of student performance on each indicator. Table 4 shows the percentage data of student performance for each indicator for all scores.

Table 4. Percentage of Achievement on Each Indicator

Indicator	Score (%)				
	0	1	2	3	4
To relate the real objects to the mathematics model (pictures, tables)	16.67	8.33	25	41.67	8.33
To explain their ideas or models using their language	0	8.33	33.33	33.33	25
To use terms, notations, or mathematics symbols and structures to perform their ideas	0	25	50	25	0
To represent their daily life problems in mathematics models	33.33	25	33.33	8.33	0
To construct their arguments using their languages	8.33	16.67	58.33	16.67	0
Average	11.67	16.67	40.00	25	6.67

From the above data, we can see that the average percentage of student achievement is 40.00% and is dominated by score of 2. It shows that students can answer the test question incompletely step, with a correct response but incorrect answers.

The second data was taken from the interview with the homeroom teacher of V-grade students of SD Kanisius Kedawung. The following is an excerpt from the interview with the teacher:

In my opinion, mathematical communication skills are important. help students in solving problems and understand mathematics. However, the material presented was too much. So, it's easier to explain directly. In addition, the 2013 curriculum is still

relatively new to me. Very different from the previous curriculum. So, I still need to find the right method to teach.

The interview results show that the teacher realized that the mathematical communication skill of the students is very important for the learning activities, but in reality, we cannot focus on the implementation of mathematical communication skill only. There are many materials to teach so the teacher uses direct explanations to the students. Besides, the new curriculum needs the right strategy to implement because the new curriculum is very different from the old one. The interview with the students shows that they feel the problem given was very difficult to be solved.

Other than the tests and the interview results, the observation during learning activities shows the low trust of the teachers in the students in doing their mathematics tasks. The teachers did not give the students chance to solve the math problems in front of the class. The teachers guided the students to solve the mathematics problems while writing on the blackboard and the student matched their results with the ones that is written on the blackboard. The learning activity does not vary much.

Based on the test, interview, and observation results, shows that the mathematical communication skill of the students of SD Kanisius Kedawung is still low. This is in line with research conducted by Hodiyanto [14] and which states that students' mathematical communication skills are still low.

There are several reasons for students' poor mathematics communication skills. One of them is the lack of change in the learning strategies used by teachers. [15]. Conventional (teacher-centered) learning models, wrong answers, inconsistent and poorly organized calculation steps, and the inability to express a situation or problem in the form of symbols, diagrams, or mathematical models are all contributing factors to the low mathematical communication skills of students [11]. Another cause is the teacher only give example to solve the test. Student study by listening and looking at the teacher doing mathematics then the teacher solve the mathematics problem by themselves. When teaching, the teacher only explains the learning topics and then gives examples for the exercise [16]. It shows that student does not have the opportunity to be involved actively in the learning process.

Mathematical communication skills are influenced by several factors, one of which is linguistic intelligence. The higher the student's linguistic intelligence, the more indicators of mathematical communication skills they can acquire [17]. Mathematical communication skills are also influenced by students' self-efficacy. Students with high self-efficacy have high confidence and motivation in mathematical communication, while students with low self-efficacy have low confidence and motivation and need teacher guidance to optimize their skills. [18]. Other factors that influence mathematical communication such as gender [19], student thinking style [20], and learning style [21].

The difficulties of mathematics problems surely affect the student's ability to communicate their mathematics ideas [22]. The mathematical communication skill of the students needs to be improved for the students to understand mathematics not only as a symbol without meaning but also as a language to facilitate them solving their problems in real life [23]. Students will have higher mathematical communication skills if teachers use a contextual approach to learning. A contextual approach is an approach that

involves the real world in understanding learning material so that the students can understand symbols, expressions, or images that exist in learning material. This approach is not teacher-centered which makes the students being passive in learning. Using a contextual approach, students can develop their thinking and issue a variety of different thoughts. Social skills and students 'thinking skills that occur through interaction can optimize students' mathematical communication skills. Students not only actively hone their ability to express ideas through writing but also can express ideas through oral [24].

By applying an innovative learning model, teacher can also improve your mathematical communication skills. One learning model is Think Pair Share. This Think Pair Share model is necessary for students to improve communication skills and share ideas in math during math class [25]. Additionally, the Think Talk Write Model can be used in the classroom. Using this model, students can think, speak and write where they can develop their own mathematical ideas and thinking. [26]. Another learning model for improving mathematical communication skills are the cooperative learning type Team Assisted Individualization [27][28] and Team Games Tournament learning model [29] [30] [31]

We can also carry out learning with a realistic mathematical approach. Using realistic math-based materials is more effective than government e-books in terms of mathematical communication [32]. The use of the Realistic Mathematics Education approach also develops mathematical communication skills because, in addition to students having to interact with their group mates, students also must be able to model the mathematical problems, which means bringing mathematics problems from the concrete level into the formal level knowledge of mathematics [14].

4 Conclusion

Research results show that students have poor mathematical communication skills. The average total score for Mathematics Communication Skills is 9.92 or fair (C). Mathematical communication skills can be improved through innovative learning. Researchers suggest that teachers pay attention to their students' mathematical communication skills. Teachers need to be creative and innovative in designing learning activities to improve their students' mathematics communication skills.

The results of this study give messages to the teacher about the importance of mathematical communication skills. Teachers must be creative and innovative in designing the learning process. The teachers must conduct learning that stimulated the student actively so that they can think analytically. Thus, the students can develop their mathematical communication skills. Researchers provide suggestions to other researchers who will follow up on this research to improve and reduce weaknesses so that the research results obtained are more accurate.

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