

Analysis of Written Mathematical Communication Skills of Elementary School Students

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Abstract: 21st-century education emphasizes 4C skills, one of which is communication skills. Mathematical communication skills are important for students to master because they will affect other mathematical skills. The purpose of the study was to describe the level of written mathematical communication skills of fifth-grade elementary school students. The research approach used is a descriptive qualitative approach. Data were collected from 25 students and guardians of the fifth grade of the Public Elementary School of Mojosoongo 2. Samples were taken by purposive sampling technique. Data collected through tests, observations, and interviews. Findings data were analyzed using the flow analysis model. Data analysis of student test results was categorized into four categories: very good (A), good (B), enough (C), and less (D). The results showed that the written mathematical communication skills of fifth-grade elementary school students were still low with an average total score of 49.3 in the C category (enough). These results indicate that the written mathematical communication skills of fifth-grade elementary school students need to be improved.

Keywords: *written mathematical communication, elementary school*

INTRODUCTION

In the development of the 21st century, life has become more advanced and more competitive. There are three types of skills that every person must have in 21st century life. These skills are life and career skills; learning and innovation skills (4Cs); and information, media, and technology skills (Triling & Fadel, 2009). Developments in the world of education are one of the effects of 21st century progress. At present, the curriculum is designed in depth by the Center for Curriculum Redesign (CCR) through a holistic approach by offering a complete framework on four dimensions of education: knowledge, skills, character, and metacognition (Bialik & Fadel, 2015). On the skill dimension, there are four aspects such as creativity, critical thinking, communication, collaboration. One of the skills developed and must be possessed in 21st century education is communication skills.

According to Yu (2019), communication is defined as the way humans walk through the process of human development. Besides that, Jafar, Hardjo, & Natasya (2018) explained that communication skills are important for everyone. That is because with good communication a person will be easier to overcome the problems that are around him. Communication has the meaning of "giving information, messages, or ideas to others with the intention that other people have the same information, messages or ideas with the sender of the message (Lanani, 2013). This aspect of communication is not only important to the world of literature or language. However, communication is also important in the world of mathematics.

In the Regulation of the Minister of National Education Number 22 of 2006, it is explained that one of the goals of mathematics learning is that students can communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. Besides, In the Regulation of the Minister of Education and Culture Number 21 Year 2016 concerning Content Standards for primary and secondary education units, one of the skills targeted in mathematics learning is communicative skills. The National Council of Teachers of Mathematics (NCTM)

(Mitgett & Eddins, 2001) mentions four standard processes in mathematics consisting of problem-solving, reasoning, communication, and connections. It shows that communication skills in learning mathematics are important.

Communication in learning mathematics is called mathematical communication. Greenes & Schulman explained that mathematical communication is the capital in completing, exploring, and investigating mathematics which is used as a forum for social activities with friends, sharing thoughts and discoveries, brainstorming, evaluating and sharpening ideas to convince others (Hendriana et al. 2018). The purpose of mathematical communication is to encourage students to be able to encourage, share support about mathematics (Kaya & Aydin, 2014).

Communication can be divided into two types namely oral communication (talking) and written communication (Ansari, 2018). Indicators of writing communication are expressing mathematical ideas in real-world phenomena through graphics/tables, tables, algebraic equations, or in everyday language. Also, several aspects can be used to measure mathematical communication skills, namely through the activities of explaining, justifying, guessing, writing, questioning, debating, listening, and talking about mathematics (Kosko & Gao, 2017).

Some research findings (Lanani, 2013; Yuniarti, 2014; Pratiwi, 2015; and Wijaya et al. 2016) explain the important reasons for mastering mathematical communication. Some reasons for the importance of mastering mathematical communication skills are because mathematical communication skills can support other mathematical abilities; exploiting and exploring mathematical ideas from various perspectives; sharpen the way of thinking; measuring growth in understanding; improve students' knowledge and development of mathematical problems.

Jafar, Rahardjo, & Natasya (2018) revealed that written communication is the process of delivering one's thoughts to others by writing. In writing activities, someone will convey ideas to the reader by arranging sentences correctly. Therefore, someone will have more challenges in conveying information in writing. The importance of this mathematical communication requires that aspects of students' written mathematical communication abilities to be considered in learning activities. That was, aimed at making students able to develop their written mathematical communication skills.

The reality in the field shows that written mathematical communication skills have not been well developed. Data from the Research and Development Agency of the Indonesian Ministry of Education and Culture (2015) shows the results of the TIMSS mathematics of elementary school students in 2015 are in a low category. Indonesia was ranked 45 out of 50 participants with a score of 397. At a national seminar, an analysis of the results of the TIMSS of Indonesian elementary school students was presented. The analysis shows the majority of elementary school students in Indonesia have not been able to combine several facts, integrate concepts, apply, and also communicate the results of reasoning (Rahmawati, 2015).

The problem of low mathematical communication skills, if allowed to continue, will have an impact on student achievement. Besides, the development of mathematical communication skills will also not affect students' understanding of a concept. Mahmud & Hartono (2014) states that mathematical communication skills will have an impact on a good understanding of concepts and improvement of student learning outcomes. Therefore, an in-depth research is needed about the written mathematical communication skills of elementary school students and the efforts that need to be made to improve the written mathematical communication skills of elementary school students.

Based on the description above, this research was conducted by focusing on aspects of written mathematical communication skills of elementary school students. The purpose of this study is to determine the level of written mathematical communication skills of elementary

school students and the things that need to be done to improve the mathematical communication skills of elementary school students.

METHOD

The research approach used is a descriptive qualitative approach. Descriptive research is research that aims to describe a situation or phenomenon as it is without manipulating the research object (Sukmadinata, 2017). Data were collected from 25 students and guardians of the fifth grade of the Public Elementary School of Mojosongo 2. Samples were taken by purposive sampling technique. Purposive sampling is a sampling technique with certain considerations (Sugiyono, 2016). Data collected through tests, observations, and interviews. The test instrument consisted of 5 breakdown questions that represented 5 indicators. Hodiyanto (2017) explains that to measure mathematical communication skills students can use essay questions, such as explorative, transfer, elaborative, and applicative problems. These indicators are induction researchers from the study of Hendriana, et al. (2018); Sumarmo (Susanto, 2014) and Kosko & Gao (2017). The findings data were analyzed using a flow model of analysis. Researchers took this technique because this research only focused on a single problem. According to Miles and Huberman, the stages in this data analysis are data reduction, data display, and verification and confirmation of conclusions (conclusions drawing and verification) (Sutopo, 2002). Data analysis of student test results is categorized into four categories are very good (A), good (B), enough (C), and less (D).

RESULTS AND DISCUSSION

In this section, we will present the results of the data calculation as well as the discussion that has been linked to various kinds of literature. The data of this study were obtained from the results of student mathematics tests, observations of the learning process, and interviews with research subjects related to mathematical communication skills written. This written mathematical communication ability test consists of 5 problem descriptions. This test was developed from indicators of written mathematical communication skills obtained by examining several expert opinions.

In analyzing this data, researchers grouped the results of students' answers into 4 categories: very good (A); good (B), enough (C), and less (D). The criteria for categorizing these categories are shown in table 1 and table 2.

Table 1. Criteria for Students' Written Mathematical Communication Skills

Value	Category
75,1 – 100,0	Very Good (A)
50,1 – 75,0	Good (B)
25,1 – 50,0	Enough (C)
00,0 – 25,0	Less (D)

Table 1 is a criterion for determining the level of students' written mathematical communication skills. The value used uses a range of 0 to 100. The value is the overall value achieved by students in working on problems related to students' written mathematical communication skills. Table 2 is the achievement criteria for each indicator developed to determine students' mathematical communication skills.

Table 2. Criteria for Achieving Indicators

Value	Category
15.1 – 20.0	Very Good (A)
10.1 – 15.0	Good (B)
5.1 – 10.0	Enough (C)
0.0 – 5.0	Less (D)

Grouping the criteria in table 2 is done to group the criteria for each indicator. In each indicator, the researcher gives a point of 20. Based on this point the researcher then divides into several indicators that can be seen in table 2.

Based on the analysis that has been done, student test results have varying categories. The results of the analysis can be seen in table 3. The distribution of achievement of the average score of students of each indicator and the overall results can be seen in table 3.

Table 3. Average Achievement Value of Each Indicator and Results of Written Mathematical Communication Skills

No.	Indicator	Category				Average
		A	B	C	D	
1.	Connecting concrete objects into mathematical models (pictures, tables)	17,25	13,80	9,14	4,67	11,2
2.	Explain mathematical ideas and models (pictures, tables) into their own language	18,00	13,71	9,17	4,50	11,3
3.	Asking questions to the learned mathematics using their own language	17,20	11,00	8,88	3,60	10,2
4.	State daily problems or events in the mathematical model	0,00	12,50	7,45	4,33	6,1
5.	Arrange arguments using your own language	17,60	12,20	8,14	4,25	10,5
Total						49,3

Based on table 3 it can be seen that the average student achievement score on indicator 1 reaches a score of 11.2 out of a total score of 20. On indicator 2 the average student achievement score is 11.3. The average achievement score on indicator 3 is 10.2. On the 4 indicators, the average student achievement score is 6.1, while the average achievement score on indicator 5 is 10.5.

Based on table 3 it can be seen that the achievements on each indicator are different. Besides, it is also known that the average total for the achievement of written mathematical communication of students of the Public Elementary School of Mojosongo 249.3. This value is included in enough category (C). This value shows the average achievement of written mathematical communication skills of students of the Public Elementary School of Mojosongo 2 is still low and needs to be improved. To see the distribution of student achievement on each indicator, the researcher then transforms the data from the first analysis into the percentage of student achievement for each indicator. The results of the transformation of the data can be seen in table 4. In table 4 presented data on the percentage of student achievement on each indicator in all categories.

Table 4. Percentage of Achievement of Each Indicator

No.	Indicator	Category			
		A (%)	B (%)	C (%)	D (%)
1.	Connecting concrete objects into mathematical models (pictures, tables)	28,28	28,28	26,23	17,21
2.	Explain mathematical ideas and models (pictures, tables) into their own language	25,09	33,45	38,33	3,14
3.	Asking questions to the learned mathematics using their own language	22,22	30,56	40,08	7,14
4.	State daily problems or events in the mathematical model	0,00	43,27	44,23	12,50
5.	Arrange arguments using your own language	36,67	17,08	32,08	14,17
	Average	22,45	30,53	36,19	10,83

Based on the data above, it is known that student achievement in each indicator is evenly distributed. Percentages are almost scattered with balanced weights in each category on each indicator. However, it can be seen in table 3 that the average percentage of student achievement is dominated by the C category (enough) at 36.19%.

In indicators connecting concrete objects to the form of mathematical models (pictures, tables) student success is almost evenly distributed on each indicator. However, the category of student achievement on this indicator is dominated by categories A and B. That means students can communicate the results of problem analysis in the form of images properly. Indicators explaining mathematical ideas and models (pictures, tables) into their own language are dominated by category C. This shows that students are still having trouble translating information from tabular / picture forms. Students are only accustomed to presenting situations in the form of data descriptions, so students have difficulty communicating information summarized in figures or tables.

In asking indicators questions, achievement indicators are dominated by category C. It shows that the ability of students to communicate problems in the form of questions is still lacking. Students are not accustomed to being trained to propose and formulate problems. Students are only accustomed to being trained to solve problems. The indicator states the problem in the form of a mathematical model is dominated by category C which means that students' abilities are still in a sufficient category. In the indicators compiling arguments, the category of student achievement is dominated by categories A and C. That means the ability of students to state the reasons is good. However, it is still dominated by enough categories which means there are still some students who are still having difficulty expressing reasons related to solving existing problems.

That means students still have to improve their written mathematical communication skills. Presentation of the above test results, also supported by the results of interviews with fifth-grade teachers and fifth-grade elementary school student representatives.

The results of the interview with the fifth-grade teacher of the Public Elementary School of Mojosongo 2:

- Mathematical communication skills are important for students. However, in its implementation, it has not been able to focus on that aspect. Learning is still focused on material completion and student understanding regarding material concepts. Learning is done with explanations directly to students. It was considered the most effective and efficient to be carried out to teach the material to students. Besides, the use of the new

curriculum requires the right strategy used to teach the material to students because the presentation of new curriculum material is very different from the old curriculum.

The results of interviews with several fifth-grade students at Mojosongo 2 Elementary School:

- Students consider the questions raised by researchers difficult. Questions that are usually done by students are not as proposed by researchers. Students are accustomed to directly counting with available numbers (all elements in the question have been presented in the problem).

In addition to the results of tests and interviews, the observation of learning activities can be seen that there is no trust of the teacher towards students. In the activity matching the results of the work, the teacher appoints one student to display the answer in front (on the board). However, in this activity, the teacher has not fully entrusted the students. The teacher guides the things that students must write down first, even though students have brought their own work to the front.

Based on the results of the analysis above, it can be seen the level of students' mathematical written communication skills and the things that affect the development of students' written mathematical communication skills. Therefore, solutions can be found to overcome things that can affect the development of mathematical communication skills.

Based on the analysis of the results of tests that have been done, it can be said that the mathematical communication skills of elementary school students are still low. This is indicated by the average score of student achievement results of 49.3 and the distribution of students is dominated by the C category (enough) with a percentage of 36.19%. Thus, the written mathematical communication skills of elementary school students need to be improved. This situation is in line with research conducted by Fatmawati (2018); Amir (2014); Nuraeni & Luritawaty (2016) which states that aspects of mathematical communication skills are still low. This is a serious problem in the field and needs to be developed.

The lack of mathematical communication skills will affect students' understanding of a concept. Mahmud & Hartono (2014) states that mathematical communication skills will have an impact on a good understanding of concepts and improvement of student learning outcomes. This low ability will also cause the message or information conveyed to be less meaningful. This was explained by Ludlow & Kadunz (2016) that, "... communication is essentially message exchange that depends, among other things, on: ... the means of human interaction (voice-intonation, diagrams, and graphs, writing, and inscriptions); and the visual means of their delivery..." Also, the low mathematical communication skills show students' analysis of the problem is still low. This is shown by the inability of students to ask questions which are part of the discussion. Discussion (discussing) is a means to express and reflect students' minds (Amir, 2014). The benefits of the discussion include speeding up an understanding of the material, helping to analyze, and solving problems wisely (Amir, 2014).

Based on the data obtained, the low mathematical communication skills of students are caused by several things. One of them is the teacher's lack of confidence in students to express their learning outcomes in front of the class. As you know, the teacher has a great influence on the success of learning in the classroom. The magnitude of the influence of the low ability of written mathematical communication to other aspects requires teachers to pay close attention to aspects of written mathematical communication skills. The teacher has a key role in creating a communicative classroom environment (Kaya & Aydin, 2014). The creation of communicative classes is expected to be able to lead to discussions about developing students' higher-order thinking skills and understanding of mathematics through speaking, sharing, asking questions in class and conveying reasons (Kaya & Aydin, 2014).

Learning that is done should require students to investigate. Thus, students will do meaningful and memorable learning. In the investigation process, students formulate problems, plan solutions and interpret information, conclude answers, communicate what they have learned, and formulate problem expansion independently (Yuniarti, 2014).

The problems presented should be problems relating to the daily lives of students. The thing to remember is that stating the problems of daily life into mathematical models is one of the activities in communication that can improve students' thinking abilities (Nuraeni & Luritawati, 2016). So, if the presentation of problems in learning using everyday problems is expected to improve students' written mathematical communication skills.

Also, improvement in written mathematical communication skills can be done through innovative learning activities. One of them is through the Think Talk Write (TTW) learning model. According to the research results of Nuraeni & Luritawati (2016), the TTW learning model can improve students' mathematical communication skills. Some other models that can be used are the RME approach (Trisnawati, et al., 2018; Ahmad & Nasution, 2018), expository assessment strategies (Santos & Semana, 2015), TAI type cooperative learning (Tinungki, 2015), type cooperative learning TGT (Veloo, 2016), Problem Posing (Juano & Pardjono, 2016). Also, it can use learning media such as research conducted by Wilkinson, et al. (2018). Wilkinson, et al. (2018) uses narrative videos to improve students' mathematical communication skills.

CONCLUSIONS

Based on the results of data analysis and discussions that have been carried out, it can be concluded that the level of written mathematical communication skills of fifth-grade elementary school students is still low. This is evidenced by the low achievement of the average score of the test results which showed 49.3 or included in category C (enough). The things that need to be done by the teacher to develop students' written mathematical communication skills is to do innovative and exploratory learning. Learning is done with a model that develops aspects of communication and problem-solving.

The results of this study give messages to teachers to pay more attention to aspects of written mathematical communication. Teachers should be creative and innovative in developing and designing learning. The teacher must conduct learning that engages students so that students are stimulated to think analytically so that students' written mathematical communication skills can develop.

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