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# AN ANALYSIS OF MATHEMATICAL COMMUNICATION SKILLS OF THE STUDENTS AT GRADE VII OF A JUNIOR HIGH SCHOOL

*Research Article*

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**Abstract**

The study aims at (1) describing the mathematical communication at class VII junior high school in solving problems of the system of equations and linear inequalities of one variable, (2) analyzing the factors that cause students to correct problems in system material and linear inequalities of one variable. The data were collected in the form of text, images and words. The study adopted the descriptive research design based on qualitative data collected from the participants who were selected using purposive sampling model. Subjects were selected by selecting one student for each category with high, medium, and low ability, in total three participants. On the subject of high ability, in order to determine the participants, the criteria were writing texts well, drawing well and the level of reflecting good mathematics as well. Medium ability subjects were supposed to meet the criteria in the aspects of writing well, although still relatively low. Low ability subjects on the criteria of aspects of writing and expressing mathematics, classified at a very low level. The factors causing the students' mathematical communication abilities were found to be the use of vocabulary and mathematical language, the students' learning style and the ability to express their ideas.

*Keywords:* mathematic communication, mathematical communication aspects, equation and inequality linears of one variable

## 1. Introduction

Education is one of the needs that must be fulfilled throughout human life. So important, education is used aimed at improving the quality of life in order to continue to make the human person better. Because it is through education that a person can be able to achieve what he aspires and in order to develop abilities and skills to be even better as a provision of life that can benefit for himself, society and even the country. Talk about formal education, especially in schools. There are various fields of study that aim to develop students' abilities. One of them is the field of mathematics studies.

Mathematics is one of the fields of study taught at every level of education such as school. This field of mathematics study is expected to be able to make a good contribution to develop students' systematic critical thinking skills. The same opinion was obtained from Rosdiana (2018) who said that mathematics can be useful as a provision for students to have the ability

to think systematically, logically and analytically so that it helps students to solve everyday problems. Mathematics is also a language, not only as a tool used to help in thinking of finding patterns and solving problems, but also as a way to communicate ideas in a systematic, practical and efficient manner. In this case, mathematics is also seen as a very powerful, sure, and not confusing communication tool. The ability possessed by students in particular to express ideas about problem solving as well as mathematical strategies and solutions by oral and written means is called mathematical communication skills (Pratiwi, 2015).

Mathematical communication skills are really needed in understanding the field of mathematics studies, this is in line with the opinion of Asikin in (Hendriana & et al, 2017) which is to help sharpen students 'thinking and as a tool to measure students' understanding and reflecting mathematical understanding. Mathematical communication has a very important role in mathematics learning, because through mathematical communication it can organize and consolidate students' mathematical thinking (Supriadi, 2015). Mathematical communication skills can generally be divided into two categories, the first category is verbal communication (talking) and the second category is written communication (writing). Verbal communication skills can be in the form of verbal expressions and explanations of mathematical ideas such as speaking, listening, and discussion while written communication skills can be in the form of pictures, tables, graphs, questions and other forms of answers in written form (Syahri, 2017).

If communication is done poorly, then the development of mathematical understanding will be hampered. This is in accordance with the learning objectives of the Ministry of National Education (Wijayanto, 2019) including so that students have the ability to communicate ideas with symbols, tables, diagrams or other media to clarify a situation or problem. Currently students' mathematical communication skills are still relatively low, it can be seen when students have difficulty in making conclusions in solving math problems given by the teacher. Other research by (Widjajanti, 2013)and (Sian & et al, 2016) from Brunnei Darrusalam, students still have difficulty in expressing mathematical ideas into symbols or notations correctly. This is also in line with the opinion given by Yudianto in (Fitriyani , Sri, & Aan, 2018) that the geometry ability of students when in elementary school has not been maximized.

Based on these descriptions, at least mathematical communication skills possessed by students need to be possessed properly in order to solve the problem problems that exist in the field of mathematics studies as well as the tasks given by the teacher. Mathematical assignments are designed so that students can experience mathematical processes themselves, such as the process of identifying general classes of problems they are working on (Rahman & al, 2012). In this study the indicators of mathematical communication skills that will be used are as stated by the Ontario Ministry of Education in 2015 (Hendriana & et al, 2017), as follows:

Table 1. Mathematical Communication Capability Indicator

| Aspect | Description |
|---|---|
| **1.** Written Text,<br>Make an explanation of mathematical ideas in writing | a. Able to provide answers using their own language.<br>b. Identify what is asked about the problem.<br>c. Discuss and write about ideas for resolving strategies in your own language.<br>d. Can explain ideas using mathematical terms |

| | | |
|---|---|---|
| **2.** | Drawing,<br>Can pour mathematical ideas in the form of pictures, tables or diagrams. | a. Reflect real objects such as pictures into mathematical ideas.<br>b. Reflecting situations, ideas or solutions to mathematical problems in the form of images clearly. |
| **3.** | Mathematical Expressions,<br>Able to explain the problematic situation of images or real objects into symbols, mathematical models / mathematical expressions. | a. Can present ideas and situations using mathematical models correctly and completely.<br>b. Can present ideas using language symbols / mathematical notation correctly.<br>c. Use all the information in the problem appropriately.<br>d. Draw conclusions precisely. |

## 2. Research Method

### 2.1. Research Design

The research utilized the qualitative descriptive approach, the type of research conducted with the aim of making a systematic, factual, and accurate description of the facts. Descriptions were in the form of words and did not emphasize numbers. In this case the researcher did a description of students' written mathematical communication skills in working on the system of equations and the linear inequality of a variable and the factors that allegedly influenced it.

There are three stages in the process of good mathematical communication namely, (1) written text, able to make mathematical ideas by pouring them in writing, (2) Drawing, can make mathematical ideas in the form of pictures, tables or diagrams, (3) Mathematical Expressions, able to explain the problem situation of images or real objects into symbols, models / mathematical expressions. This research was conducted at SMP Negeri 1 Ceper Klaten in January 2020 with the consideration that the material to be studied was taught to students. The subjects used were grade VII students of SMP Negeri 1 Ceper in Klaten Regency.

### 2.2. Participants

In the study, three students participated and the participants were selected via purposive sampling technique, by selecting one student who has a high mathematical disposition in good mathematical abilities, one student with moderate mathematical abilities, and one student with low mathematical abilities. Subject selection is done in consultation with the subject teacher. The subjects with high mathematical ability were given the H code, the subjects with moderate mathematical abilities were coded M, and the subjects with low mathematical abilities were given the L code.

### 2.3. Data Collection and Data Analysis

The data were collected by means of tests and non-tests, so besides researchers as research instruments, several assistive instruments were used to support data acquisition, namely interviews and test sheets. The test instrument was developed according to the material that had been taught, namely the material system of equations and linear inequalities of one variable. The triangulation technique was utilized to obtain the valid data. Triangulation of this technique was based on the data obtained from analysis of test results and interviews.

The test instrument used serves to collect data in writing obtained from the subject under study, thus helping researchers in obtaining data. Then drawing conclusions by paying

attention to the assignment sheet and interview results to find the characteristics of the subject in accordance with the indicators used. The test used as many as one question related to the material system of equations and linear inequalities of one variable.

## 3. Results and Discussion

Based on research that has been done the results of analysis of student answers include 3 aspects that correspond to the indicators used. It can be observed that students with high mathematical abilities. The following are the results of research conducted in accordance with 3 aspects used and one of the questions worked as follows:

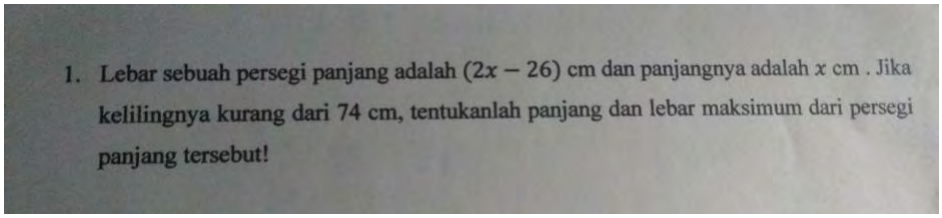
1. Lebar sebuah persegi panjang adalah $(2x - 26)$ cm dan panjangnya adalah $x$ cm . Jika kelilingnya kurang dari 74 cm, tentukanlah panjang dan lebar maksimum dari persegi panjang tersebut!

*Figure 1. Questions for students*

The results of the work on the subject H produced that mathematical communication skills in aspects (1) Writing (Written Text) is so high that it can be observed very well. Subject H is able to explain ideas such as information that has been known and asked for the problem so well. Similarly, in explaining to others in writing so that it can be understood by others so clearly. While aspects (2) Drawing (Drawing) on this subject has been able to explain ideas or solutions to existing problems in the problem can be seen in visual form clearly and correctly. So it can be said that subject H has fulfilled the Drawing aspect (Drawing) well. The third aspect (Mathematical Expression) possessed by subject H can capture ideas and communicate their ideas related to the situation and problems contained in the problem into mathematical ideas well. This can be seen that the ability to use the language of symbols and mathematical models to express ideas and solutions chosen for the problem with a good understanding and be able to draw conclusions that are relevant to the problem at hand. The results of the work on the subject H can be seen as follows:

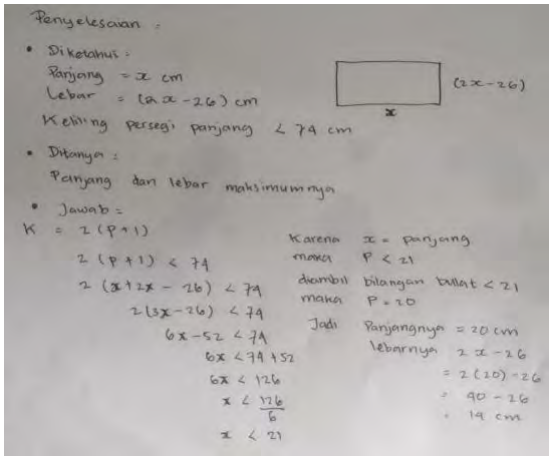


*Figure 2. The results of the work of the subject type H*

This can also be seen from the excerpts of the results of interviews on subject H. Excerpts of conversation P as researchers and H are subjects studied with high mathematical abilities. The results of the conversation can be seen that the subject is able to grasp the ideas contained in the problem well.

P: "What do you know about this problem?"
H: "What is known as a rectangle with length x centimeter and width of 2x-26 centimeter"
P: "Then what else?"
H: "Then we know that the circumference is less than 74 cm"
Q: "What then is the question asked about?"
H: "What is asked about that is the maximum length and width of the rectangle"
Q: "Can you describe the information obtained from the problem?"
H: "Yes, sir"

On the results of the work of Subject M on aspects (1) Writing (Written Text) can be fulfilled properly. It can be seen that the writing skills of students with moderate abilities can be observed well in knowing the information contained in the problem well. The subject is able to explain the ideas that exist in his mind and then poured into writing even with clear and understandable language and delivery. Aspects (2) Drawing (Drawing) which is owned by subject M there are no signs of the subject's desire to pour out his ideas in visual form, so the subject has not been able to communicate them in the form of drawings, diagrams or tables. The third aspect (Mathematical Expression) which is owned by subject M is still inaccurate in explaining ideas that will be used to solve problems in the problem and not understanding the problem well. It is seen that the subject has not been able to solve the problem or the solution correctly and correctly to solve the problem and there are still errors in the workmanship, so the subject is still considered less able to explain mathematical ideas in the form of notations, symbols, and mathematical models even though at the beginning it seems correct and able to understand the information in the problem. The results of work on subjects with type M can be seen as follows:

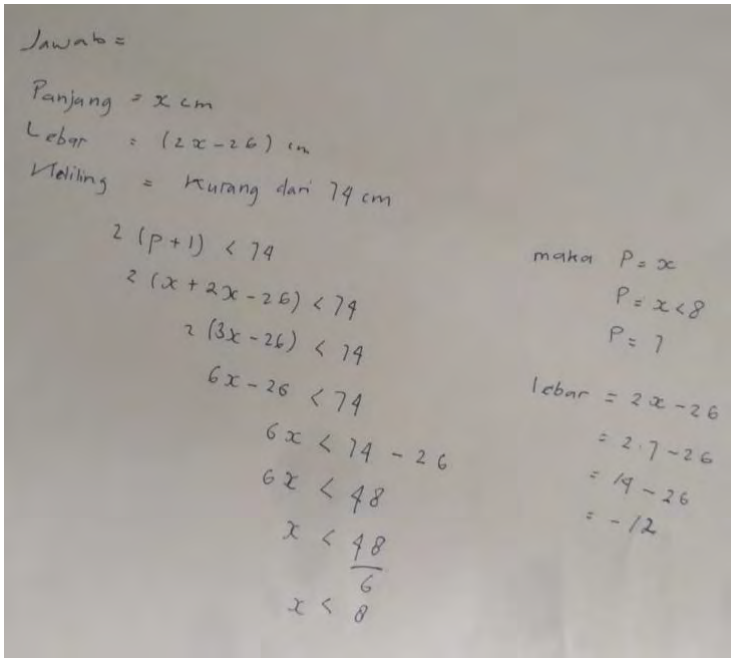


*Figure 3. The results of the work subject M*

The results of the interview with subject M can be seen that the subject is still confused in illustrating the picture of the problem.
P: "Can you illustrate this problem in the form of pictures?"
M: "(like confusion) I don't know"

P: "What are the steps you will take first when going to work on the problem?"
M: "The first way I did was by inserting what was known in the problem into the formula around the rectangle sir"
P: "Why use that formula, not using another formula?"
M: "Because of the problems around it"

The workmanship of the results of answers made by subject L seen from the ability of mathematical communication through (1) written aspects is still very low, it can be seen that subject L still feels confused in understanding the information contained in the problem, so there is no writing can be seen related to understanding information on the problem. On the ability of mathematical communication in aspects (2) drawing (drawing) is also still very low. The subject still felt confused in pouring ideas into visual form plus the subject felt not yet understood about the existing problems. The aspect (3) of mathematical expressions (Mathematical Expression) possessed by subject L is still very low in terms of ability to express ideas in the form of notations and mathematical symbols and models. The subject still looks difficult to work on the problem, so the subject needs understand the problem first, subject L still needs to improve the answer even though the student is able to remember the formulas needed to answer the problem. The results of the work on the subject L can be seen as follows.

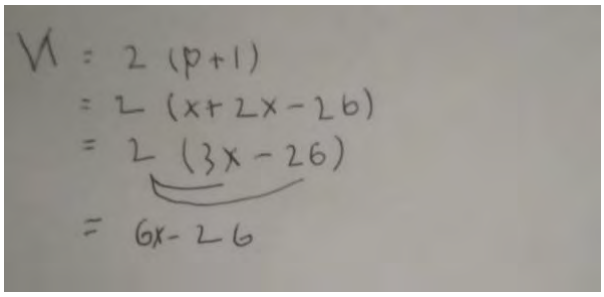


*Figure 4. The results of the work subject L*

While the results of interviews obtained from subject L indicate that subject L is still confused in capturing the ideas contained in the problem.
P: "Can you describe the information in the problem?"
L: "(silent for a long time) don't know sir"
P: "What are the steps you will take the first time when you are going to work on the problem?"
L: "Using the formula around the rectangle"
P: "Why use that formula, not using another formula?"
L: "Because in the matter, there is written around it"
P: "Then what's the next step?"
L: "The next step is to enter the known length and width into the circumferential formula"
P: "So what?"
L: "Continue to do the calculation"
P: "Does that end there?"
L: "Yes, sir"

Research conducted by (Hikmawati & et al, 2019) also gives results that subjects with high ability fulfill all aspects according to the indicators used. Subjects with moderate and low ability still find it difficult to express mathematical ideas, but are dominant in the writing and drawing aspects.

Mathematical communication skills are indeed very necessary. This is needed by students to gain a good understanding. Students who already have this ability are expected to be able to communicate mathematical ideas so that they are easily understood by others. (Huggins & Maiste, 1999) suggests that one form of mathematical communication is speaking. This is identical to the discussion (discussing) proposed by (Baroody, 1993). Students 'speaking ability in discussing with others is thought to be one of the factors in the ability of students to communicate well or not, so the teacher is expected to choose the learning model appropriately to improve students' discussion skills such as groups. While the second factor is the ability to write. This is consistent with the opinion of Silver et al. (Kosko & J, 2012) state that the ability to write a mathematical communication is considered more capable of helping individuals to think about and explain in detail about an idea. The written mathematical communication skills will help students to express their thoughts to explain the strategies used, increase knowledge in writing algorithms, and generally be able to improve students' cognitive abilities. In addition, (O'Halloran, 2005) states that "mathematical discourse involves language, mathematical symbolism and visual images". The initial ability possessed by students in the form of vocational symbols in mathematics is very important in improving mathematical communication. If students have a large vocabulary of mathematical symbols. Then students are expected to be able to read pictures such as diagrams, variables, constants, and be able to express mathematical ideas better.

## 4. Conclusion

Communication skills possessed by students with high ability can be said to be very good from their ability to communicate mathematical ideas well into three aspects of mathematical communication, namely aspects (written text), aspects of drawing (drawing), and aspects of mathematical expression (mathematical expression). The communication skills of students with moderate ability only dominate on two aspects, namely the written aspect which is able to explain ideas from the information contained in the problem. Aspects of mathematical expressions (mathematical expressions) even with a lack of understanding. Students who have low ability have aspects of mathematical communication skills on all aspects at a very low level this causes students to be difficult in solving existing problems

## 5. Suggestions

Based on the research results obtained, the researcher provides the following suggestions: 1) Junior high school students should be specially trained in mathematical communication skills, 2) Further research is needed regarding the achievement and improvement of mathematical communication skills, and 3) teachers should be able to evaluate the learning that has been done so that they can apply it to better learning.

## 6. Conflict of Interest

The authors state that there is no conflict of interest.

## 7. Ethics Committee Approval

The authors confirm that the study does not need ethics committee approval according to the research integrity rules in their country.

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