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by Sugeng Sutiarso

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The analysis of mathematical communication skills in junior high school students

S W Ningtias[1], S Sutiarso[2] and Caswita[2]

[1]Mathematics Education, Postgraduate Program, Lampung University, Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung 35141, Indonesia
[2]Mathematics and Education Department, Lampung University, Jl. Prof. Dr. Sumantri Brojonegoro No.1, Bandar Lampung 35141, Indonesia

E-mail: sintawidya.ningtias7@gmail.com

Abstract. This study aims to determine the students' mathematical communication skills in the system of two-variable linear equations material. The subjects in this study were 8th grade students who were selected by purposive sampling technique. The method used in this research is descriptive. The data obtained from the students' mathematical communication skills test consisting of 2 essay items including 3 indicators of mathematical communication skills, namely, drawing (expressing ideas into the form of images, graphs or diagrams), written text (providing the mathematical explanations in the correct language), and mathematical expression (making mathematical expressions). The test was given to 30 students of 8th grade at SMP Muhammadiyah 3 Bandar Lampung. The data were analyzed quantitatively and qualitatively to get a comprehensive picture related to the students' mathematical communication skills. The results showed that the percentage of the achievement in each indicator of students was classified as low. This can be seen from the percentage of the achievement of the students' mathematical communication indicators interpreted as follows, namely 1) drawing at 22%, 2) written text at 55%, and 3) mathematical expression at 12%.

1. Introduction

Mathematics as a symbolic language that allows communication carefully and precisely as well as a means of the communication. The process of thinking mathematics in learning includes five main standard competencies, namely problem-solving ability, reasoning ability, connection ability, communication ability and representation ability [1]. Communication skills are one of the most important competencies for world citizens in the 21st century. The National Council of Teachers of Mathematics (NCTM) states that "communication is an essential part of mathematics and mathematics education" which means communication is an important part of mathematics and mathematics education. Through the communication process, the students can exchange ideas and at the same time clarify the understanding and knowledge they have gained in learning. Besides communication can also be interpreted as a way to share ideas and clarify understanding, through communication of ideas reflected, refined, discussed and changed [2]. While the communication success criteria are that the recipient of the message can capture and interpret the message delivered in accordance with the purpose of the message source. The meaning of a communication is an

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activity to achieve the purpose of communication itself. Thus the communication process does not happen by accident but is designed and directed towards the achievement of objectives [3].

Communication skills in mathematics are one of the important competencies that must be developed in every mathematical topic. Mathematical communication is an aid in the transmission of mathematical knowledge or as a foundation in building mathematical knowledge [4]. Besides mathematical communication can also be interpreted as the ability to express mathematical ideas coherently to friends, teachers and others [5]. So it can be said that the mathematical communication skills are the ability of students to explain an algorithm, a unique way to solve problems, construct and explain the presentation of the real world phenomena graphically, words / sentences, equations, tables and offerings. NCTM states that the ability standards that should be mastered by students are as follows; (1) organizing and consolidating mathematical thinking and communicating to other students; (2) express mathematical ideas coherently and clearly to other students, teachers, and others; (3) increase or expand students' mathematical knowledge by thinking about the thoughts and strategies of other students; (4) using mathematical language appropriately in expressing mathematical connections. Mathematical communication indicators as follows, (1) drawing ability, which includes the ability of students to express the mathematical ideas in the form of drawings, diagrams or graphs; (2) the ability to write (written text), which is in the form of the ability to provide explanations and reasons in mathematics with correct and easily understood language; (3) the ability of mathematical expression (mathematical expression), namely the ability to make the mathematical models [6].

Indicators of mathematical communication skills used in this study are as shown in Table 1.

Table 1. Indicators of the mathematical communication skills

Indicator	Definition
Drawing	Express mathematical ideas in the form of drawings, diagrams, or graphs.
Written text	Provide mathematical explanations and reasons in correct and easy to understand the language
Mathematical expression	The ability to express mathematics.

Septiani's research results state that students' mathematical communication skills for indicators expressing mathematical ideas, mathematical situations using graphics, images and algebraic forms obtain a percentage of 24.5% in the low category [7]. Based on the explanation above, the researcher intends to conduct a research on students' mathematical communication skills. This study aims to analyze the mathematical communication skills of junior high school students. Through this research, it is expected to get detailed information about students 'mathematical communication skills as a reference for learning innovation, so that the students can master the concepts of science correctly and motivate students' thinking to obtain the best strategies for achieving learning objectives.

2. Experimental method

This research is a descriptive study with a qualitative approach. The population of this research is all of 8th grade students of SMP Muhammadiyah 3 Bandar Lampung. The data is obtained by analyzing and describing students' mathematical communication skills in the Two Variable Linear Equation System material. The subjects were selected by purposive sampling based on high, medium and low ability categories involving 30 students. In this study the data obtained from the results of tests of mathematical communication skills test consisting of 2 items essay, and the results of observations in class. The data obtained from observations were analyzed qualitatively, whereas for test results data

were analyzed quantitatively using descriptive statistics with the average calculation of research results in the form of percentages presented in tables and graphs to draw the conclusions.

3. Result and discussion

The indicators of the mathematical communication skills used in this study are drawing, written text and mathematical expressions. The results of students' mathematical communication skills tests based on the indicators include the following

Table 2. The test results of the students' mathematical communication skills

Indicator	The Percentage of average indicator fulfillment	Category
Drawing	22%	Low
Written text	55%	Low
Expresion mathematics	12%	Very Low

Table 2 shows that the level of mathematical communication skills of students on each indicator is not the same. Mathematical communication skills are still relatively low in solving real problems, this can be seen in the results of work done by the students. The following will present the answers of two different subjects, namely subject 1 named Cintya Dinata, who got a score of 6 from an ideal score of 20. And subject 2 was named Dafa Nabila who received a score of 13 from an ideal score of 20, this score is the maximum score obtained from 30 students.

Research subject 1 named Cintya Dinata in question number 1. The subject fulfills the written text indicator that she can writes what is known and asked about the problem given even though the information provided is written thoroughly. At the mathematical expression stage, she only writes the information obtained from the questions, but do not write it into the symbols or mathematical symbols. Thus, the student cannot determine the point to draw lines correctly and has an impact on the drawing stage, she cannot draw graphs to determine the solution to a given problem, and she is only able to model the problems into the form of mathematical models. She cannot solve the mathematical problems due to lack of understanding of the concept of how to solve SPLDV problems.

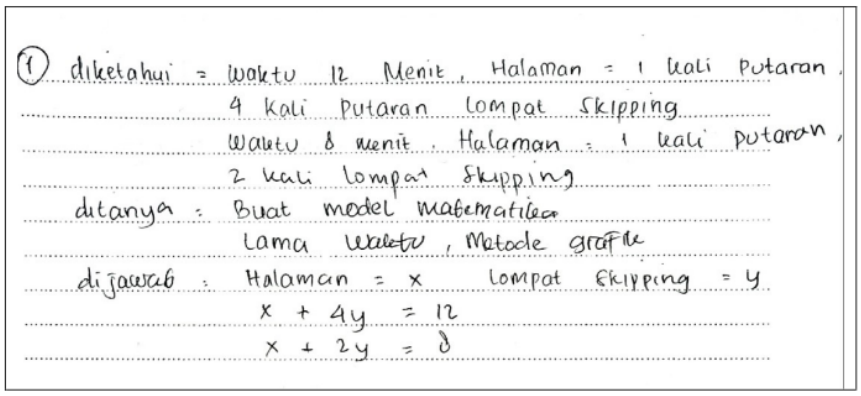

Figure 1. The first students' answer in question number 1

Research subject 2 named Dafa Nabila in question number 1. The subject fulfills the written text indicator. She can writes what is known and asked about the given problem. She is able to model the problems in the form of mathematical models. At the mathematical expression stage she cannot determine the point correctly so that the impact on the drawing stage is that she cannot draw the

graph correctly. The error made is when determining the points of the two equations presented, she cannot determine the x and y points of the equation. So she cannot determine the graph that is formed to interpret the given system of linear equations. In line with Sari, Kusnandi, and Suhendra's opinion which states that the mathematical communication skills as a person's ability to write the mathematical statements, write reasons or provide explanations of each mathematical argument used in solving mathematical problems using terms, tables, diagrams, notations or formulas mathematics correctly and examine mathematical thinking [8].

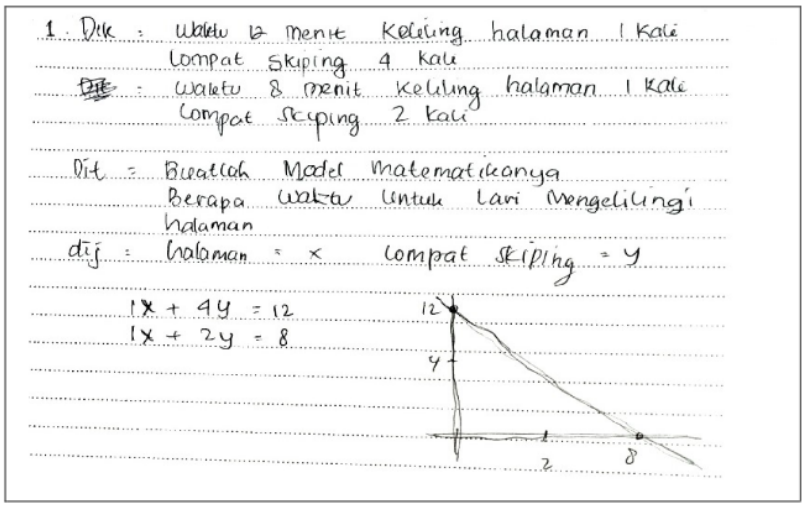

Figure 2. The second students' answer in question number 1

In question number 2, the 1st subject full fills the written text indicator. The students can write what is known and asked about the problem given. She is able to model the problem into a mathematical model, but she cannot solve the given problem. She is confused about how to substitute the results obtained into the equation to get the solution to the problem. Mistakes made by her in solving a given problem that is when she has done calculations using elimination, the results of the calculations are used as a solution of the problem given. That happens because she does not understand the information presented on the problem given.

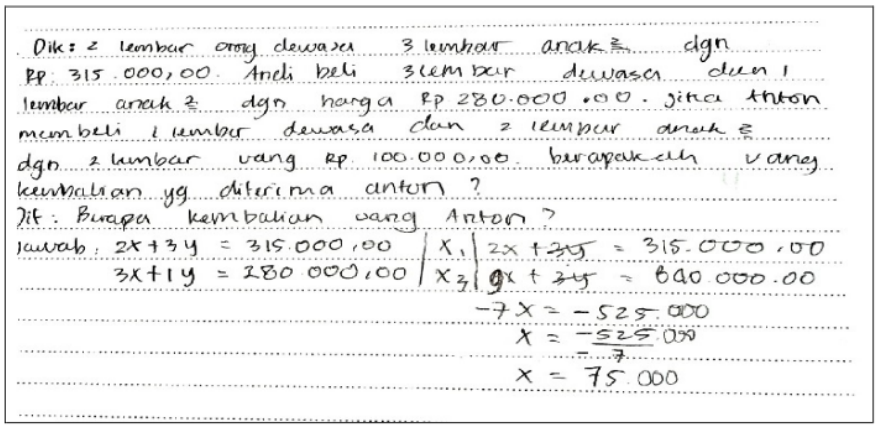

Figure 3. The first students' answer in question number 2

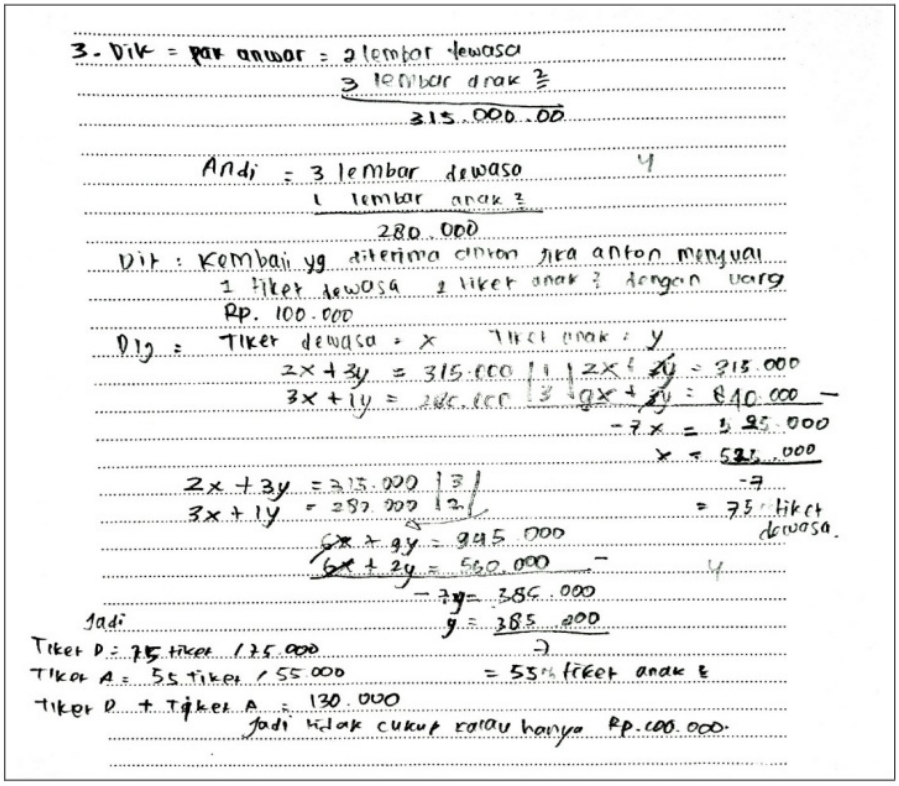

Figure 4. The second students' answer in question number 2

In question number 2, the 2nd subject fullfills the mathematical expression indicator, she is able to understand the problem so that she can write what is known and asked of the problem, besides that the student can also model the problem into a mathematical model. At the written text stage she is able to do the calculations using elimination and substitution correctly, but she lacks understanding of the information from the problem provided so the solution to solving the problem is not right. In line with Ansari's opinion in Wahyuningrum that the ability of mathematical communication skills as the ability of students in speaking, explaining, describing, listening, asking, clarifying, cooperating, sharing writing, and finally reporting what has been learned [9].

Based on the description of the subject above, the two questions presented do not fullfill all the indicators of the students' mathematical communication skills. The difficulty of the students in solving problems of linear equations is when determining the points and lines to interpret into the graph, and difficulties factually, conceptually, operationally, and principle errors in solving problems of linear equations. Factual difficulties are related to the students' mistakes in determining the Cartesian coordinate point and conceptual difficulties related to the concept of determining the intersection point on the line as well as the concept of the intersection points of x and y.

4. Conclusion

Based on the data obtained, it is known that the students' mathematical communication skills are still low. This can be seen from the achievement of each indicator of mathematical communication skills. In the written text indicator reaches 55%, the written text stage is the ability of students to write what is known and asked, and some students are also only able to make the mathematical models of the problems presented. While the drawing indicator reaches 22%. Drawing is the ability of students to express mathematical ideas in the form of drawings, diagrams and graphs. And for mathematical expression indicators it reaches 12%. The cause of the low mathematical communication skills of the students is because they have the difficulty in determining solutions, and drawing conclusions. This happens because the students do not understand the procedures or ways to solve real problems from system of two-variable linear equations material.

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