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Analysis of students mathematical communication skills using Bruner's theory

AF Rachman[1*], H Bharata[2], and A Asmiati[3]

[1]Magister Pendidikan Matematika, Universitas Lampung, Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung 35141, Indonesia
[2]Departemen Pendidikan Matematika, FKIP, Universitas Lampung, Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung 35141, Indonesia
[3]Departemen Matematika, FMIPA, Universitas Lampung, Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung 35141, Indonesia

[*]auliaf97@gmail.com

Abstract. Mathematical communication skills have an important role in mathematics because it can help students to express their understanding. This study aims to analyze the students mathematical communication skills using Bruner's theory in the system of three-variable linear equations material. The type of research is a qualitative descriptive research. The research was conducted at SMAN 4 Kotabumi with the subjects in this study are 129 students of X grade. The data collection technique used was a written test of mathematical communication skills. The results of this study indicate that students' mathematical communication skills are still relatively low. Constraints found by researchers that led to students' low mathematical communication skills are: (1) students have not been able to understand the problem and explanation correctly; (2) students have not been able to do the calculations correctly when associating with system variables equations; (3) students cannot conclude the results correctly.

1. Introduction

Mathematics education is one of the important education to be mastered because with increasing mathematical understanding, students will have excellent mathematical thinking skills. According to NCTM, there are five standards of mathematical thinking skills that must be possessed by students, namely problem solving ability, communication ability, connection ability, reasoning ability, and representation ability[1]. One of the most important mathematical abilities and must be developed by students in mathematics is mathematical communication skills.

Mathematical communication skills can be interpreted as the ability of students to be able to understand and comprehend the knowledge which received from others or vice versa, either directly or indirectly [2]. In other words, mathematical communication skills are a student's ability to convey a mathematical idea and can accept mathematical ideas from others to improve students' understanding. Mathematical communication skills has an important role in mathematics learning, including as a tool for exploiting mathematical ideas, helping students to see the various interrelationships of mathematical material, and as a tool to measure the growth and reflect the mathematical understanding in students [3].

With the existence of mathematical communication skills, the teacher will more easily understand about the ability of students of expressing their understanding in mathematics. But in reality there are still many mathematical communication skills of students in schools that are still relatively low. Eka *et*

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al. states that in general mathematics learning still uses conventional learning which tends to be teacher-centered so that it results in low mathematical communication skills of students [4]. One of the schools with low students mathematical communication skills is SMAN 4 Kotabumi. Based on the results of interviews with mathematics teachers in that school, it is known that the students are generally still confused when working on story questions about systems of linear equations with three variables which it can actually be illustrated in a model, they do not understand the language of the problem, and do not have the courage to express their ideas between the students and the teacher.

Based on the description above, it is necessary to analyze the mathematical communication skills of students in the material systems of linear equations with three variables. Analysis of mathematical communication skills of students in this study using Bruner's theory can be seen when students solve the problem of mathematical communication skills.

2. Method

This research was conducted at SMAN 4 Kotabumi located in North Lampung Regency, Lampung. This research is a descriptive study with a qualitative approach [5]. The research subjects are 129 students from four classes of X IPA. The purpose of this study was to analyze students' mathematical communication skills using Bruner's theory. The research instrument used was a written test in the form of a description consisting of three questions about the systems of linear equations with three variables. The students' written test results were assessed from three indicators of mathematical communication skills using Bruner's theory, namely enactive, iconic, and symbolic [6]. Then the results of the student's written test are assessed [5] and then classified into the category of students' mathematical communication skills, namely:

Table 1. Categories of Students Mathematical Communication Skills

Score	Assessment Category
81 – 100	Very Good
61 – 80	Good
41 – 60	Enough
21 – 40	Less
0 – 20	Very Less

Table 2. Guidelines for Scoring Students' Mathematical Communication Skills Tests

Indikator	**Kriteria Penilaian**	**Skor**
Enactive	No answer	0
	Make mathematical drawings/models but only a few are true	1
	Making mathematical drawings/models but not complete and correct	2
	Making mathematical drawings/models and it's correct	3
Iconic	No answer	0
	Only few mathematical ideas presented are true	1
	Presenting mathematical ideas but not complete and correct	2
	Presenting complete and correct mathematical ideas	3
Symbolic	No answer	0
	Only a few of the mathematical expressions made are true	1
	Make mathematical expressions correctly, but miscalculate	2
	Make mathematical expressions correctly, calculations are done correctly, and get solutions completely and correctly.	3

Volume 4, 2019 | P-ISSN 2655-2361, E-ISSN 2655-3252

3. Result and Discussion

The following are answers written by students, after analyzing the types of errors and then adjusted to the assessment indicators that have been set.

3.1. Identification of Student Answers

Question number 1 : A goldfish has a tail that is the same length as its head plus a fifth of its body length. Its body length is four fifths of the total length of the fish. If the length of the fish head is 5 cm, write it into the form of a three-variables linear equation!

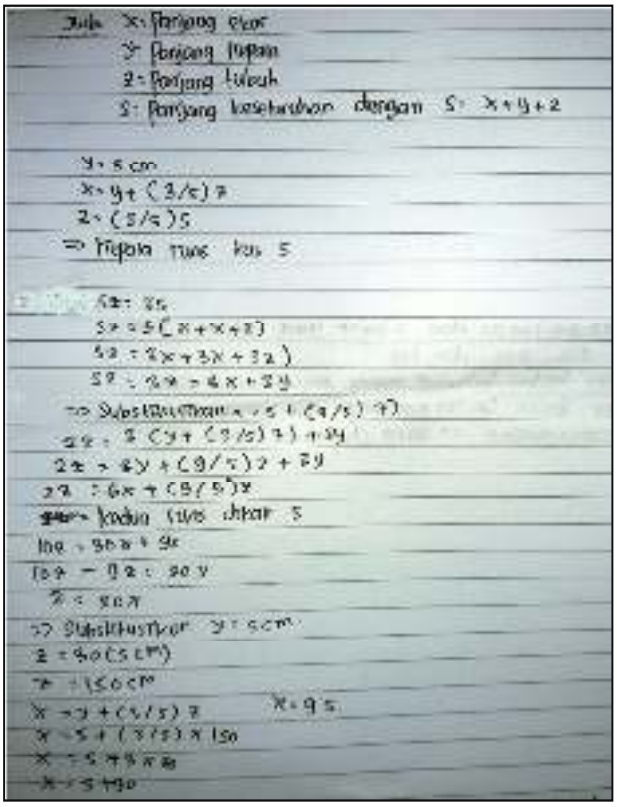

Figure 1. Photograph of student answer of question 1

From the 129 students, each of them had 56 students correct answers for enactive indicators and 14 students answered correctly for iconic indicators. Figure 1 shows that they are able to use the term naming for the question variable. But they make mistakes when explaining the form of a systems of linear equations with three variables and misinterpret the questions. The question only asks students to write the systems form of three variable linear equations not to find the value of each variable.

Question number 2 : A number consists of three numbers and its amount is 9. The unit number is three more than the number tens. If the number hundreds and the number tens are exchanged for location, the same number is obtained. Determine the number!

From the 129 students, each of them had 55 students correct answers for enactive indicators, 95 students answered correctly for iconic indicators, and 42 students answered correctly for symbolic indicators. Based on this, students have been able to describe the initial steps when going to solve a problem. Figure 2 shows that the students make mistakes when concluding the results of solving the problem. They do not understand the questions intended. Although they have shown a good way to solve problems.

Volume 4, 2019 | P-ISSN 2655-2361, E-ISSN 2655-3252

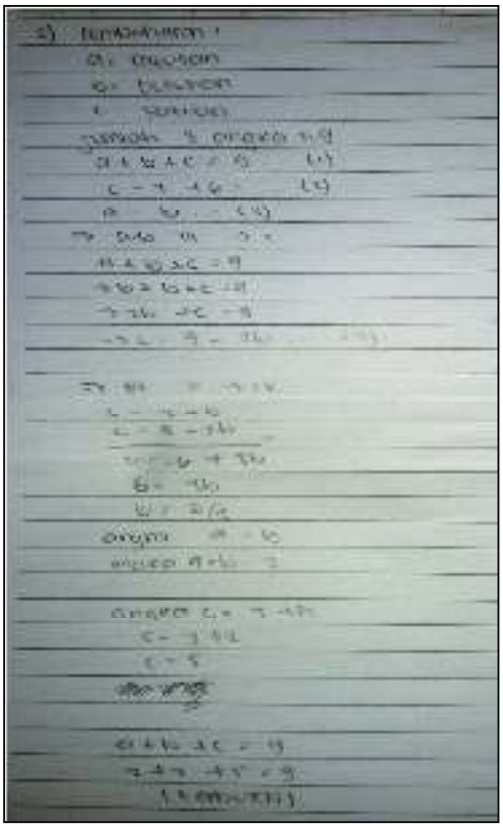

Figure 2. Photograph of student answer of question 2

Question number 3 : A housing company borrows IDR 2.250.000.000 from three different banks to expand its business reach. The interest rates of the three banks are 5%, 6%, and 7%. Determine how much the company loans to each bank if the annual interest to be paid by the company is IDR 130.000.000 and the amount of money borrowed at 5% interest is twice the borrowed money at 7% interest?

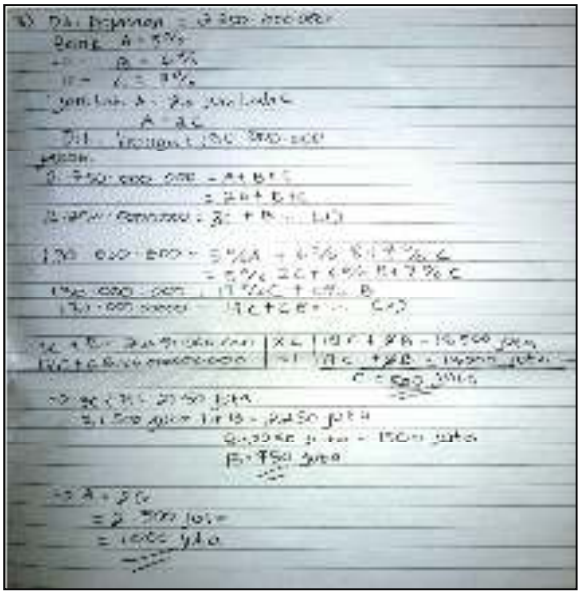

Figure 3. Photograph of student answer of question 3

Volume 4, 2019 | P-ISSN 2655-2361, E-ISSN 2655-3252

From the 129 students, each of them had 60 students correct answers for enactive indicators, 4 students answered correctly for iconic indicators, and 12 students answered correctly for symbolic indicators. Based on these results, students have not been able to describe the initial steps to solve the problem and have not understood the solution that should be done. Figure 3 shows that the students make mistakes when making symbols or variables that will be used for systems of linear equations in solving problems. They also make mistakes in writing the translation of problem solving related to the nominal numbers used instead using ordinary language.

3.2. Students Mathematical Communication Skills Test Results

Based on the results of written tests that have been carried out by students, the following data are obtained.

Table 3. Students Mathematical Communication Skills Test Results

Score	Assessment Category	Frequency	Percentage %
81 – 100	Very Good	14	10,85
61 – 80	Good	32	24,81
41 – 60	Enough	23	17,83
21 – 40	Less	35	27,13
0 – 20	Very Less	25	19,38
Total		129	100
Students Value Average		46,83	

4. Conclusion

Based on the results of the study showed that the mathematical communication skills of X IPA grade of SMAN 4 Kotabumi are still relatively low. This can be seen from the percentage of the results of students' mathematical communication skills tests which show that as many as 27 students with a percentage of 20,93% have high abilities, 41 students with a percentage of 31,78% have medium abilities, and 61 students with a percentage of 47,29% have low abilities. While based on indicator criteria using Bruner's theory, it was found that for question number 1, the enactive indicator of 43,41% and the iconic indicator of 10,85%. Question number 2 obtained the enactive indicator of 42,64%, iconic indicator of 73,64%, and symbolic indicator of 32,56%. Question number 2 obtained the enactive indicator of 46,51%, iconic indicator of 3,10%, and symbolic indicator of 9,30%.

Based on the results of the analysis and discussion that has been obtained, it can be concluded that the constraints of students in working on mathematical communication questions are as follows: 1) students have not been able to understand the problem and explanation correctly, 2) students have not been able to do the exact calculation when relating to the system variable equation, and 3) students cannot conclude the results correctly. It is hoped that teachers can provide motivation to the students to further improve their understanding and find fun learning alternatives for them in the schools to be able to improve students mathematical communication skills.

5. Acknowledgments

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Volume 4, 2019 | P-ISSN 2655-2361, E-ISSN 2655-3252

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