Analysis of students Initial mathematical communication skills in mathematics learning

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Abstract. This research is motivated by the low ability of students to communicate mathematical ideas, compile mathematical evidence using complete sentences, symbols, tables, and diagrams, to clarify the existing problems. This study aims to find out how the initial mathematical communication skills of students in learning mathematics, namely by giving mathematical problems related to the daily lives of students of grade VIII SMP. Problems are constructed based on indicators of communication ability and then assessed using the scoring rubric mathematical communication skills. The instrument used in the form of a preliminary test with 2 item and a sample of as many as 21 students. The results of the scoring rubric of students' mathematical communication skills obtained in indicator 1 were 23.81%, indicator 2 was 28.57%, indicator 3 was 38.11% and indicator 4 was 14.28%. If seen from the overall results of the initial test students only get 14.28% who is able to explain with the idea of dramatic communication. The results of this initial test study was 42.85%. It indicate the need for follow-up to improve students' communication skills.

1. Introduction
Mathematics is a science that is very closely related to everyday life. Every human activity can never be separated from mathematics. Mathematics subjects need to be provided to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, innovative and creative as well as the ability to work together. Mathematics is very useful in the lives of students, one of the benefits shared [1] who said that mathematics has two main functions, namely as pure science and applied science. Pure science means that mathematics is used to improve science, whereas applied science is used in everyday life.

[2] there are eight objectives of learning mathematics, one of which is: "Communicating the idea of reasoning, and being able to compile mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify the situation or problem".

Based on one of the objectives of mathematics above, the ability that must be mastered by students is mathematical communication skills. Mathematical communication is very important in learning mathematics and one of the abilities that must be possessed and developed by students. Mathematical communication is also one of the standard processes in learning mathematics. Communication in mathematics helps teachers understand the ability of students to interpret and express their understanding of mathematical concepts and processes they learn.

But in reality the mathematical communication skills of students are still low. Based on the observations of researchers at several schools in the city of Padang in October 2018 it was found that
mathematics learning activities Teacher Center. When the learning process takes place it is seen that students have difficulty in using complete sentences in proving mathematical problems given, they have difficulty clarifying the situation or mathematical problems using symbols, tables or diagrams. As a result of the lack of students' ability to communicate mathematics, so many of them decide to cheat because they are unable to answer the questions given by the teacher. This, if left unchecked, will certainly have a bad impact, in addition to the level of mathematical communication skills of students, it will also have a negative impact on learning outcomes later.

Teachers should be able to become facilitators to improve students' mathematical communication skills,[3] when students think, respond, discuss, explain, write, read, hear and study about mathematical concepts, they get a double benefit i.e. they communicate to learn mathematics and learn to communicate mathematically. [4] suggested that there are several indicators to measure students' mathematical communication abilities, including: (a) Connecting real objects, pictures, and diagrams into mathematical ideas. (b) Explain ideas, situations, and mathematical relations verbally or in writing with real objects, images, graphics, and algebra. (c) Stating everyday events in mathematical language / symbols. (d) Listening, discussing, and writing about mathematics. (e) Read a written mathematical presentation and arrange relevant questions. (f) Constructing conjectures, arguments, formulating definitions, and generalizations. (g) Explain and make mathematical questions that have been learned.

Based on the opinion above, the mathematical communication indicators that will be used are as follows: (1) Illustrate mathematical ideas in the relevant form of a problem (pictures, tables, diagrams, graphs, algebraic expressions) given. (2) Using mathematical language / symbols and mathematical operations in accordance with the given problem. (3) Select and write mathematical strategies relevant to the given problem and solve the problem coherently. (4) Give a rational reason for a statement (provide conclusions at the end of the answer).

The four indicators above represent the indicators proposed by Sumarmo. For indicators (a) Connecting real objects, pictures, and diagrams into mathematical ideas and indicators (b) Explaining mathematical or verbal ideas, situations, and relationships with real objects, pictures, graphics, and algebra already combined in indicators (1) that illustrates mathematical ideas in the relevant form of a problem (pictures, tables, diagrams, algebraic expressions) given. Then in indicator (c) Stating everyday events in mathematical language / symbols is clarified in indicator (2), namely using mathematical symbols / notations and mathematical operations in accordance with the given problem. Then in indicators (d) Listening, discussing, and writing about mathematics and indicators and indicators (e) Listening, discussing, and writing about mathematics need not be seen because it only occurs in group discussion activities. Then in indicator (f) Arranging conjectures, arguments, formulating definitions, and generalizations made clear in indicator (3), namely selecting and writing mathematical strategies relevant to the given problem and solving problems coherently. Then in the indicator (g) Explain and make the mathematical questions that have been studied clarified in indicator (4) that is giving a rational reason for a statement (giving a conclusion at the end of the answer).

Achievement of the indicators of mathematical communication skills above, calculated using the scoring rubric of mathematical communication skills of students. To get the maximum score required activities that refer to mathematical communication. In learning mathematics, communicating using mathematics learned at school really needs to be developed, because one of the functions of learning mathematics is as a way to convey ideas in a practical, systematic, and efficient manner.

Based on the initial proficiency tests conducted in class VIII SMPN 12 Padang in October 2018 obtained unsatisfactory results. The initial ability test consists of two questions related to indicators of mathematical communication skills. This test was taken by 21 participants. Table 1 shows the results of the initial ability test about mathematical communication skills.
Table 1. Percentage of achievement indicators of mathematical communication skills of students in class VIII SMPN 12 Padang

| Question Number | Mathematical Communication Indicators | Percentage of students % |
|-----------------|--------------------------------------|---------------------------|
|                 |                                      | 0  | 1  | 2  | 3  | 4  |
| 1               | 1                                    | 4,76 | 9,53 | 33,33 | 28,57 | 23,81 |
|                 | 2                                    | 9,53 | 14,28 | 23,81 | 28,57 | 23,81 |
|                 | 4                                    | 76,19 | 9,53 | 0,00 | 0,00 | 14,28 |
| 2               | 3                                    | 4,76 | 14,28 | 28,57 | 14,28 | 38,11 |
|                 | 4                                    | 85,71 | 9,53 | 4,76 | 0,00 | 0,00 |

Table 1 shows that mathematical communication skills of students are still relatively low. In both of these problems can be seen if no student gets a maximum scale of 4 with a percentage exceeding 75%. Based on the 4 mathematical communication indicators tested above, the indicator that gets the maximum scale at least is indicator 4. The 4th indicator of mathematical communication that is tested is to give a rational reason for a statement (give a conclusion at the end of the answer). Students are not accustomed to giving rational reasons for the answers they make, so most students do not make conclusions from these answers. This shows that the mathematical communication ability is not maximal. To find out the difficulties faced by students in communicating mathematics, there must be follow up in the future. Therefore, it is necessary to analyze the initial mathematical communication skills of students so that we can find out what difficulties are faced by students and how the best solution to improve mathematical communication skills.

2. Method
This research is part of the development research with the Plomp development model. The Plomp development model consists of three stages, including a preliminary research, prototype stage and Assessment Phase [5], [6]. The initial capability analysis conducted is included in the preliminary analysis stage. This research belongs to descriptive qualitative research. Data collection techniques are triangulated (combined), data analysis is inductive / qualitative, and qualitative research results emphasize more on meaning than generalization. Descriptive aims to describe systematically and accurately the facts and characteristics regarding the problems obtained in the field. Sources of data obtained from interviews and observations. Data collection methods in the form of a combination of interviews and observations. Interviews were conducted with teachers and students. Data analysis in this study uses an interactive analysis model that consists of data collection, data reduction, data presentation and data conclusion. Several stages are carried out for the initial ability analysis, namely by preparing the lattice questions and initial ability test questions.

3. Result and Discussion
This research has been carried out in class VIII of 12 SMPN Padang with 21 students. The initial test of mathematical communication skills of students is only done on one sub material, namely the number patterns in basic competencies 3.1 "make generalizations of patterns in rows of numbers and configurations of objects". The questions were only tested for one class with a total of 2 items. The form of the questions given is as follows:

| Question Number | Mathematical Communication Indicators | Percentage of students % |
|-----------------|--------------------------------------|---------------------------|
|                 |                                      | 0  | 1  | 2  | 3  | 4  |
| 1               | 1                                    | 4,76 | 9,53 | 33,33 | 28,57 | 23,81 |
|                 | 2                                    | 9,53 | 14,28 | 23,81 | 28,57 | 23,81 |
|                 | 4                                    | 76,19 | 9,53 | 0,00 | 0,00 | 14,28 |
| 2               | 3                                    | 4,76 | 14,28 | 28,57 | 14,28 | 38,11 |
|                 | 4                                    | 85,71 | 9,53 | 4,76 | 0,00 | 0,00 |
The first question consists of 3 indicators of mathematical communication ability to be assessed namely indicator 1, indicator 2 and indicator 4. Each of these indicators has 5 scores namely a score of 0, 1, 2, 3 and 4, giving a score based on the answers of students. Indicator 1 for a score of 0 (minimum score) is given if the student does not write down the answer to the problem given, score 1 is given if the student writes an answer but the answer is wrong and does not match the criteria, score 2 is given if the student writes an answer and is able to illustrate mathematical ideas in the relevant form of a given problem but the answer is wrong, a score of 3 is given if students are able to illustrate mathematical ideas in the relevant form of a given problem but there are a few wrong answers and a score of 4 (maximum score) is given if the student has been able to illustrate mathematical ideas in the relevant form of a given problem and the correct answer. The scoring rubric for indicator 1 obtained a score of 4 of 23.81%, a score of 3 of 28.57%, a score of 2 of 23.81%, a score of 1 of 14.28% and a score of 0 of 9.53%. This proves that out of the 21 students only 5 (23.81%) are able to illustrate mathematical ideas in the relevant form of the problem given correctly and most of the other students have not been able to achieve the indicators objectives.

Indicator 2 for a score of 0 (minimum score) is given if the student does not write down the answer to the problem given, score 1 is given if the student writes an answer but the answer is wrong and does not match the criteria, score 2 is given if the student writes the answer and is able to use mathematical symbols/notations and mathematical operations according to the problem given but incorrect answers, a score of 3 is given if students are able to use mathematical symbols/notations and mathematical operations in accordance with the problems given correctly and correct answers, and a score of 4 (maximum score) is given if students have been able to use mathematical symbols/notations and mathematical operations in accordance with the problems given correctly and the correct answers. The scoring rubric for indicator 2 obtained a score of 4 of 28.57%, a score of 3 of 23.81%, a score of 2 of 23.81%, a score of 1 of 14.28% and a score of 0 of 9.53%. This proves that of the 21 students only 6 (28.57%) are able to use mathematical symbols/notations and mathematical operations in accordance with the problems given correctly and correct answers and most of the others have not been able to achieve the goals of the indicator even there are 2 students who did not write down the answer to the problem.

Indicator 4 for a score of 0 (minimum score) is given if the student does not write down the answer to the problem given, score 1 is given if the student writes an answer but the answer is wrong and does not match the criteria, score 2 is given if the student writes the answer and is able to provide rational reasons for a statement but wrong answers, a score of 3 is given if students are able to provide rational reasons for a statement and correct answers and a score of 4 (maximum score) is given if students have been able to provide rational reasons for a statement, correct answers and the correct answers to the problem.
reasons for a statement but there are a few wrong answers, and a score of 4 (maximum score) is given if the student has been able to give a rational reason for a statement by right and correct answer. The scoring rubric for indicator 4 obtained a score of 4 was 14.28%, a score of 3 was 0.00%, a score of 2 was 0.00%, a score of 1 was 9.53% and a score of 0 was 76.19%. This proves that of the 21 students only 3 people (14.28%) are able to provide rational reasons for a statement correctly and the answers are correct. And most of the others have not been able to achieve the objectives of the indicator even there are 16 students who are not writing down the answer to the problem.

The second question consists of 2 indicators of mathematical communication ability to be assessed namely indicator 3 and indicator 4. Similarly, the first problem each indicator has 5 scores and the scoring is done based on students' answers. Indicator 3 for a score of 0 (minimum score) is given if the student does not write down the answer to the problem given, score 1 is given if the student writes an answer but the answer is wrong and does not match the criteria, score 2 is given if the student writes an answer and is able to choose and write mathematical strategies relevant to the given problem and solve problems coherently but wrong answers. Score 3 is given if students are able to choose and write mathematical strategies relevant to the given problem and solve problems coherently but wrong answers. Score 3 is given if students are able to choose and write mathematical strategies relevant to the given problem and solve problems coherently but wrong answers. Score 4 is given if the students have been able to choose and write mathematical strategies relevant to the given problem and solve problems coherently with correct and correct answers. The scoring rubric for indicator 3 obtained a score of 4 was 38.11%, a score of 3 was 14.28%, a score of 2 was 28.57%, a score of 1 was 14.28% and a score of 0 was 4.76%. This proves that from 21 students only 8 people (38.11%) are able to choose and write mathematical strategies relevant to the given problem and solve problems coherently with the right and correct answers, and most others have not been able to achieve the objectives of these indicators. Indicator 4 on question 2 is the same as the first question. The results of the second question scoring rubric for indicator 4 obtained a score of 4 by 0.00%, a score of 3 by 0.00%, a score of 2 by 4.76%, a score of 1 by 9.53% and a score of 0 by 85.71%. This proves that of the 21 students none wrote down the rational reasons for a statement with a correct and correct answer, even most students did not write the answer to the problem.

Based on the results of the scoring rubric indicators of the mathematical communication skills above it can be concluded that students of class VIII of SMPN 12 Padang have difficulty communicating mathematical ideas in accordance with existing indicators. Of the 4 indicators of mathematical communication ability that are tested the lowest score is seen in the 4th indicator that is making conclusions at the end of the answer. In the first problem, only 14.28% gave a correct conclusion and in the second question none of the students gave a correct conclusion, for more details, see Table 2:

| Indicator of mathematical communication skills | Question Number | Percentage of students% |
|-----------------------------------------------|------------------|-------------------------|
| 4                                             | 1                | 76.19  9.53  0.00  0.00  14.28 |
|                                               | 2                | 85.71  9.53  4.76  0.00  0.00 |

4. Conclusion
Research analysis of students' initial mathematical communication abilities is only carried out until the preliminary research stage. The Plomp model which consists of three stages namely preliminary research, prototyping phase, and assessment phase is very helpful in the analysis of mathematical communication skills. Based on the results of the initial mathematical communication skills that have been carried out it can be concluded that the communication skills of students are still low, therefore it must be followed up so as not to affect the learning outcomes of students.
To improve mathematical communication skills teachers can use several strategies, approaches and learning models that are in accordance with existing problems, such as teachers can apply the Realistic Mathematics Education (RME) approach, the Contextual Teaching and Learning (CTL) approach, and other approaches that can improve the ability mathematical communication of students.

5. References

[1] Raphael (Tanpa tahun) Mathematics http://www.wikimediafoundation.org
[2] Permendiknas 2016 Lampiran Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 22 Tahun 2016 tentang Standar Proses Pendidikan Dasar Dan Menengah. Jakarta: BSNP.
[3] NCTM 2000 Principles and Standars for School Mathematics. USA: VA.Panhuizen, M, Vanden Heuvel,(2000). The Didactical Use of Modelsin Realistic Mathematics Education: An Example from A Longitudinal Trajectoryon Percentage. Educational Studies in Mathematics, 54 (1): 9-35.
[4] U Sumarmo 2013 Berpikir dan Disposisi Matematika Serta Pembelajarannya. Kumpulan Makalah. FMIPA UPI. Bandung. Diterbitkan.
[5] T Plomp 2013 Educational Design Research: an Introduction. Dalam Tjeerd Plomp dan Nienke Nieveen (Ed.). An Introduction to Educational Design Research. Enschede: SLO•Netherlands Institute for Curriculum Development.
[6] IM Arnawa, Y Yerizon, S. Nita and RT Putra Development Of Students’ Worksheet Based On APOS Theory Approach To improve Student Achievement In Learning System Of Linear Equations,” Int.J.Sci. Technol. Res., vol 8, no. 04, pp. 287-292, 2019.