Profile of mathematical communication skills junior high school students in problem solving

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Abstract. Mathematical communication skills of students is the ability of students to understand, express and interpret mathematical ideas using language and mathematical representations either in writing or orally. The ability to communicate ideas, thoughts, or opinions is very important in learning mathematics. Each student is likely to have different mathematical communication skills in solving problems. This research aims to determine the communication ability of junior high school students in solving problems. This research is qualitative type that is a research process that is done naturally and natural in accordance with objective condition in the field without any manipulation, where in this case data retrieval is done through student written test, oral test delivery, and in-depth interview. In this research, using triangulation of time in which the written tests, oral tests, and interviews were carried out twice in different times. The result of mathematics communication ability on junior high school students in solving problems shows that there are some differences in each student where there are students who more detail in doing and also can remember things that are taught while the other students are more likely to do briefly and precisely. So it can be said that each student has different mathematical communication skills in solving problems.

1. Introduction
Schools as formal educational institutions that are born and developed effectively and efficiently from and by and for the community, are the tools that are obliged to provide educational services to the community. One of the subjects in school that students get in education is math. Of the various fields of study taught in schools, mathematics is a field of study that is considered the most difficult by the students. Nevertheless Cockrofit in Abdurrahman suggests that mathematics should be taught to students because it is always used in all aspects of life; all fields of study require appropriate mathematical skills; is a powerful, concise, and clear communication medium; can be used to present information in various ways; improve the ability of logical thinking, precision, and spatial awareness; and give satisfaction to the effort to solve challenging problems [1].

Communication occurs in every process of activity, both within the school environment and outside the school environment. In the school environment communication is widely used in teaching and learning process, is no exception to solve various problems related to the field of mathematics. To be able to solve various problems related to mathematics, then every student needs a good communication to solve the problem.

Based on the 2013 curriculum, one of the goals of mathematics learning is to communicate mathematical ideas. Communicating ideas is a way to share mathematical ideas with others so that there
are similar meanings of mathematical ideas. Weak communication skills will result in other mathematical abilities. In communication activities, basically there are 4 main activities namely: talking, listening, reading, and writing. The four activities are usually categorized into two forms of communication namely oral communication and written communication [2]. Mathematical communication required teachers and students to solve math problems. Meanwhile, according to Qohar mathematical communication is the ability to express and illustrate mathematical ideas into the mathematical model of form of equations, notations, images, and graphics (or vice versa) [3]. "Symbolizing and communicating in mathematics classrooms related to how students attribute meaning to mathematical symbols and how students become mathematical symbol users" [4]. According to Draper the importance of communication in mathematics is closely related to symbols. The importance of mathematical communication ability is also expressed by the National Council of Teachers of Mathematics communication is an important process in learning mathematics, through communication students can reflect and clarify mathematical ideas and connect between mathematical concepts so that students become clear, in using the math language [5]. According Segedhin revealed that "communication in education have mentioned factors which could be include two categories internal and external" [6].

According to Greene and Schulman in Aufin, mathematical communication is the ability to express mathematical ideas through speech, writing, demonstration, and depicting them visually in different types [7]. The ability to communicate ideas, thoughts, or opinions is very important in learning mathematics. A person will never get a master's or doctoral degree, as well as a professor before he is able to communicate his ideas and opinions coherently and systematically in the form of a thesis or dissertation.

In this research, researchers conducted a research related with mathematical communication skills possessed students with the aim to determine the ability of students' mathematical communication Junior High School in solving problem.

2. Experimental method
This research presents results in the form of explorations that explain the cause of the occurrence of the event. Therefore, this research uses descriptive-explorative research type with qualitative approach. According to Arifin qualitative research is a process of research conducted in a natural and natural in accordance with objective conditions in the field without any manipulation, as well as the type of data collected, especially qualitative data [8].

In this study subjects were randomly drawn as many as two students for tests and interviews. The selection of this subject is based on honest, credible, qualified and willing to do this research. This test intends to determine students' mathematical communication skills. The students used are as follows.

Table 1. Student taking research.

| No | Student         | Information |
|----|----------------|-------------|
| 1. | Surya Eka Prayoga | Student 1   |
| 2. | Ardella Bayu   | Student 2   |

In this research, researchers chose to collect data through the stages of tests and interviews and assisted with supporting instruments in the form of task sheets to solve problems and interview guides.

The instrument in this stage of the test is a task sheet instrument that aims to determine the ability of students’ mathematical communication in solving problems based on Polya step. To analyze the students' mathematical communication skills is not enough just to give a written test to the students. To obtain more accurate data the researcher can conduct interviews regarding the written test provided. This is done to avoid students who do not write tests based on their own ability. In this stage the researcher also needs an interview guidance instrument, the preparation of the instrument begins by studying the information obtained from the mathematics teacher class VII junior high school associated with the students’ communication skills. Furthermore, the information is used as a guide in preparing
questions. The questions are based on the purpose of knowing communication skills students with Polya step [9]. The indicators used in this study are as follows.

Table 2. Mathematical communication indicators.

| Descriptor                  | Indicator                                                                 |
|-----------------------------|---------------------------------------------------------------------------|
| A. Oral math communication  | 1. Expressing the math language (symbol and notation)                      |
|                             | 2. Interpret and evaluate mathematical ideas (symbols, terms, and mathematical information) |
|                             | 3. Present the settlement of a problem                                    |
|                             | 4. Explain the conclusions obtained                                       |
| B. Math communication written| 1. Use mathematical language (symbols and notation) appropriately         |
|                             | 2. Illustrates the problem situation visually                             |
|                             | 3. Use a thorough representation to express the mathematical concepts and solutions |
|                             | 4. Declare the result in written form                                     |

Table 3. Indicators steps solving problem according to Polya.

| No.         | Troubleshooting Steps | Indicator                                                                 |
|-------------|-----------------------|---------------------------------------------------------------------------|
| 1.          | Understand the problem| 1) The student repeats the question.                                       |
|             |                       | 2) Explain the most important part of the question includes what is asked, what is known, and how the conditions. |
| 2.          | Planning Problem Solving | 1) Create a troubleshooting plan.                                         |
|             |                       | 2) Connecting data or information with some related facts and has been studied before. |
| 3.          | Implementing the Plan | 1) Troubleshoot problems as planned.                                       |
| 4.          | Check again           | 1) Re-check the results obtained.                                          |

In order for the data obtained is valid or does not occur bias on observations, the researchers used the technique of triangulation time. Triangulation is done by comparing data obtained from test results and interviews at different times against the same subjects. The use of this method aims to get the findings are close to true. In this study researchers conducted tests and interviews at different times and subjects samahingga saturated data.

Analysis of data selected by the authors in this study based on the analysis during the field Miles & Huberman Model in Sugiyono [10]. The steps of data analysis include: data reduction, data presentation, and data verification. Data reduction is done by coding on interview transcripts. The coding is used to facilitate the tracking of important data on the exposure of existing data. After the data is reduced, then the next step is to present the data. In qualitative research the presentation of data can be done in the form of tables, graphs, phie chard and the like. Through the presentation of the data, then the data organized, arranged in a relationship pattern so it will be more easily understood. With the presentation of data, it will be easy to understand what happened. Plan for future work based on what has been understood. The third step in data analysis is the conclusion and verification. The preliminary conclusions raised are temporary and will change when strong evidence is found to be supportive at the next data collection stage. But if the conclusions raised in the initial stages are supported by valid and consistent evidence when the research returns to the field to collect the data, then the conclusion put forward is a credible conclusion. The conclusions in qualitative research are expected to be new findings that have not previously existed. The findings can be descriptions or images of an object that was
previously still dim or dark so that once researched becomes clear, it can be a causal or interactive relationship, hypothesis or theory.

3. Results and discussion

3.1. Student 1

From the research that has been done, obtained the answer from student 1 as follows.

![Figure 1. The answer of student 1.](image)

Based on Figure 1 answers student 1 in completing the test description it appears that students 1 can be identified its written communication skills that is in understanding the problem students 1 understand the problem by writing the things that are known and asked from the problem as seen in the code K1S1. In the planning phase of student problem solving 1 plan the problem solving by writing the formula to be used from the problem as shown by the K2S1 code. Then, in carrying out the plans of students first solve the problems in accordance with the formula that has been written, but the students first experienced an error in determining the answers, jawaban supposed to joint but the students first answered that question with an answer wedge as shown in the code K3S1 are due to students 1 is less understanding how to write symbols. Furthermore, the ability to re-examine the students 1 did not check back the answers that have been obtained as seen in the code K4S1 yan still there is a mistake writing symbols and answers.

Then, student 1 has the ability of oral communication based on interview to student 1 that is: student 1 can comprehend the problem orally, by mentioning things that known completely. Then, student 1 plans to solve the problem by mentioning the formula that will be used in solving the problem. Student 1 executes the plan by solving the problem according to the stated formula but, student 1 experiences a mismatch between the pronunciation and the writing of the symbol in question. Next the student 1 re-examines the answer by repeating the read result of the answers already obtained.

From result of analysis and interview can be concluded that student 1 do not understand the material set for a current pad 1 lessons students do not pay attention. In addition, student 1 also experienced a mistake in writing that is known from the problem. This is evidenced by the incorrect symbolic writing of the answer sheet and the mismatch between the pronunciation and the symbol in question. The error occurred because writing such a dis not blamed or not be corrected by the teacher concerned. This is in line with the research conducted by Tangül Kabael published in the International Conference on New Horizons in Education in 2012 with the title "Graduate Student Middle School Mathematics Teacher's Communication Abilities in the Language of Mathematics ", this study aims to determine the ability mathematical communication of teachers in junior high school. In this study it is concluded that the
junior high school mathematics teacher has the ability to read with understanding and writing in a weak language of mathematics [9]. Moreover, their reasoning abilities and knowledge of logical structure are not sufficient to support the mathematical symbolization of students in schools. For example, the mathematics teacher responsible for developing the math skills of high school students does not evaluate the meaning of the mathematical sentences they write. As a result, these findings suggest the need for some progress in mathematics teacher training programs in the context of mathematical literacy.

3.2. Student 2

From the research that has been done, obtained answer from student 2 as follows.

![Figure 2. The answer of student 2.](image)

Based on Figure 2 student answer 2 in completing the test description it appears that student 2 can be identified his written communication skills ie in understanding the problem students 2 understand the problem by writing down the things that are known and asked from the problem as seen on the symbol K1S2. In the planning phase of problem solving students 2 do not plan problem solving as shown by symbol K2S2 where student 2 does not write the formula to be used. Then, in implementing a plan to solve the problems of students 2 with direct way to answer these problems by calculating from the known, as seen in K3S2 code, but students 2 are appropriate in the writing of the symbol in question. Furthermore, the ability to re-examine the students 2 did not re-examine the answers that have been obtained as seen in the code K4S1 yang still there error answer.

Then based on the results of interviews with students 2, students 2 have the ability to communicate orally, namely: understanding the problem by way of mentions with coherence starting from the known and asked completely and correctly, plan the problem solving by mentioning the known, solve the problem in accordance with the plan i.e calculate in accordance with the formula mentioned in the settlement plan, correctly mentions the symbol or notation set, but student 2 does not re-examine the answer already described, so there is still an error in expressing the result a.

From the results of the analysis and interviews can be concluded that the students 2 less understand the way of writing based on mathematical concepts and how to write that knowns from the diagram. In addition, students 2 do not know how to do the problem number 2 and in a hurry to do it. This is in accordance with the research has been done by Hirschfeld in this reasearch aims to see how students understand the understanding of mathematical concepts and student attitudes when students are asked to communicate their ideas orally and in writing [2]. The results of this study indicate that when students are asked to generate their ideas orally and in writing, then their understanding of the mathematical concept is higher. The study also concluded that by listening to other students' thoughts, students can construct their minds and deepen their understanding of a learning concept.
4. Conclusion

Each student has different mathematics communication skills shown by the two students who became subjek research. In the first students the ability of mathematical communication is weak when dealing with questions that use the symbol but able to answer the problem both orally and in writing. While the second student is less able to read the diagram that has been presented and not systematic in answering the given problem. From both students it can be concluded that faithful students have advantages and weaknesses each means that each student has different communication skills.

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