Junior High School Students’ Mathematical Communication Ability in terms of High-Level Interpersonal Intelligence

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Abstract. Interpersonal intelligence is a person's ability to communicate and interact with others consciously in different environments. The difference in the level of interpersonal intelligence affects communicating with other students. Mathematical communication skills are the ability to convey mathematical ideas either orally, in writing, or in motion. The purpose of this study was to see the mathematical communication skills of students with high interpersonal intelligence. The type of research used is descriptive qualitative with instruments in the form of tests of mathematical communication skills, interpersonal intelligence questionnaires, and interviews. The subjects of this study were 2 students from class VIII SMPN 2 Baki who have high interpersonal intelligence selected by purposive sampling. The triangulation used is method and source. The results of this study indicate that students with high interpersonal intelligence can meet all indicators of mathematical communication skills. However, some students have not fulfilled one of the indicators of mathematical communication skills, namely expressing real objects, situations, and everyday events into the form of mathematical models. One of the contributing factors is that students do not understand the information on the story questions presented, so students must be asked story questions related to everyday life.

1. Introduction
Mathematics is a universal science that forms the basis for the development of modern technology. Mathematics has very important uses in various disciplines to develop human thinking [1]. Mathematics is a part of science that contributes significantly to the development of science and human resource development. Mathematics is a deductive science - active and abstract [2]. Mathematics also has an important role in fulfilling practical needs and solving problems in everyday life, besides mathematics can also play a role as a language or communication tool. The importance of the role of mathematics in life causes its importance to be given to schools, especially the primary and secondary education levels. One of the goals of mathematics in school is for students to have mathematical communication skills [3].

This ability has an important role and must be improved in schools [4]. Communication is the essence of teaching, assessment, and learning mathematics [5], [6] declare that communication is a very important part of learning mathematics. In line with NCTM, the objectives of learning mathematics are to discuss the five main standards of mathematics learning which include problem solving, reasoning and proof, communication, connection, and representation [7]. According to [7] mathematics communication skill is the ability to share mathematical ideas through written, spoken language, pictures, graphics, and other visual realizations. Lomibao explained that the ability of students to express a mathematical idea, discuss and describe a mathematical concept neatly and clearly [8]. Mathematical communication is the ability to communicate by involving the skills to manage ideas, symbols, terms, and observed information through listening, presenting, and discussing [9]. Nartani stated that students'
mathematical communication skills are the main process that students must have to improve their thinking skills in mathematics [10]. So mathematical communication ability haven active role in learning mathematics in schools, because in addition to being needed to socialize with others, it is also needed to support other mathematical abilities.

Since the COVID-19 outbreak, educational institutions have implemented a requirement of no learning and no direct teaching during the COVID-19 period [11], this has resulted in less effective lessons learned by students. One of them that was affected was mathematical communication ability. Online learning causes no interaction between teachers and students, as well as students and other students. But apart from the COVID outbreak, students' mathematical communication skills are low. Based on the results of research Handayani and Kaselin it can be said that students' mathematical communication skills are still below standard [12, 13]. The level of mathematical communication skills is influenced by several factors, such as differences in the intelligence of students [14].

In general, intelligence in humans includes verbal intelligence, visual, logical-mathematical, kinesthetics, intrapersonal, musical and interpersonal [15]. Interpersonal intelligence is a person's ability to relate well to others in managing relationships. So, a student who has high self-awareness will always try to develop his abilities. One of the characteristics of someone who has high interpersonal intelligence is having communication skills consisting of effective speaking skills and effective listening skills [16]. Therefore, interpersonal intelligence affects the high or low of students' oral and written mathematics communication skills. Interpersonal intelligence also affects mathematical communication skills [17]. Mathematical communication skills with students’ intrapersonal intelligence have a relationship in familiarizing students to build and communicate their ideas in oral and written form so that students can communicate their thoughts to teachers and their peers. This is supported by research [18] which concluded that written mathematics communication skills of students who have high interpersonal and intrapersonal intelligence occupy level 5, namely complete and correct. This means that research subjects who have a high level of intelligence will look superior in their writing ability because they prefer to interpret understanding by understanding, managing, and controlling themselves. Based on the above background, the purpose of this study is to describe the mathematical communication skills of students with high levels of interpersonal intelligence in writing and oral in solving math problems.

2. Method

This research was conducted using a qualitative descriptive method. This research was conducted on class VIII F SMP N 2 Baki. The purpose of this research is to describe students' mathematical communication skills with high interpersonal intelligence. Subjects in this study were 2 students taken from 5 students who have high interpersonal intelligence. Subject selection is seen from students who meet the most indicators of mathematical communication skills and other subjects are taken from students who are less able to meet indicators of mathematical communication skills. The instrument used was an interpersonal intelligence questionnaire consisting of 30 statements, test questions to describe the mathematical communication skills of two variable linear equation system material consisting of 3 questions, and interviews. Before this research took place, the test instruments for the description of mathematical communication skills and interviews were validated by the lecturer, while the interpersonal intelligence questionnaire instrument was validated by a psychologist.

The data collection technique in this research is a written test which is used to determine students' mathematical communication skills. Then proceed with interviews with the aim of being able to explore in depth how students' mathematical communication skills. The questionnaire is used by researchers to select students who have a high level of interpersonal intelligence. To determine the validity of the data, researchers used triangulation methods by comparing test results and interviews with the same data source, and triangulation of sources with respondent teachers of mathematics subjects and their classmates. Data analysis techniques in this study include: (1) data reduction, (2) data presentation, and (3) conclusions. Indicators of mathematical communication skills used in this study were adapted from Sumarmo [19].
Table 1. Indicators of mathematical communication ability

| No | Indicator                                                                 |
|----|---------------------------------------------------------------------------|
| 1  | Analyze and express real objects, everyday situations and events into mathematical models |
| 2  | Explain mathematical ideas and models in plain language                   |
| 3  | Explain and make questions from the questions studied.                    |

3. Result and Discussion

The researcher gave a written test in the form of description questions adjusted to the indicators of mathematical communication ability. The following will show the description questions used in this study and the results of the analysis of 2 subjects who have been selected by purposive sampling.

Today, Pak Eko and Pak Rivai are going to paint the fence of their house, so they plan to go to a material shop together. Pak Eko bought 2 kg of wood paint and 6 kg of wall paint for a total price of IDR 243,000. Meanwhile, Pak Rivai bought 3 kg of wood paint and 5 kg of wall paint at a price of IDR 248,500. Make an equation model of the problem above!

Figure 1. Problems for indicator 1

For example, it is known that SPLDV:

\[
6a + 2b = 46,500 \\
4b = 47,500 - 5a
\]

Create a daily problem story according to the SPLDV!

Figure 2. Problems for indicator 2

One day Anton sells his cake at Bu Endah's shop at the following price.

\[
\text{Rp 44.000} \quad \text{Rp 43.000}
\]

Make an SPLDV question related to the image that has been presented above and solve the problem you created!

Figure 3. Problems for indicator 3

3.1 Analysis of Subject I (S1)

S1 is one of the students in class VIII-F who has high interpersonal intelligence. Subjects chosen because the results of their work meet the most indicators of mathematical communication. The following will be the answers of students' answers and their analysis on each indicator.
3.1.1. Analysis Indicator 1. The following Figure 4 shows the results of the S1 answer for indicator 1.

| for example: 1 wood paint = x and 1 wall paint = y |
|--------------------------------------------------|
| 1x + 6y = IDR 243000                            |
| 3x + 5y = IDR 248500                            |

Figure 4. Results of S1 answers for indicator 1

Based on the results of student work in Figure 4, S1 has met indicator 1, namely stating real objects, situations, and everyday events in the form of a mathematical model. Students understand the information given about the questions then students can make an example or symbolize the story question that is delivered. So that S1 can make a mathematical model. From this work, it can be seen that the students first made an example with \( x \) as 1 wood paint and \( y \) as 1 wall paint. Then the mathematical model that is made, namely 2 kg wood paint and 6 kg wall paint for IDR 243,000 is modeled with \( 2x + 6y = 243000 \). Then 3 kg of wood paint and 5 kg of wall paint for IDR 248,500 are modeled with \( 3x + 5y = 248500 \). So, it can be concluded that S1 already understands and is able to express real objects, situations, and everyday events in the form of mathematical models. The result is in accordance with the student's statement who said: "I made an example pack for each type of paint, with wood paint as \( x \) and wall paint as \( y \). After that I made a mathematical model."

3.1.2. Analysis Indicator 2. The following Figure 5 shows the results of the S1 answer for indicator 2.

| Pak Tono sells household items. He sells 6 plates and 2 cups at a price of 46500 and the price of 2 cups is equal to 47500 - 5 plates |

Figure 5. Results of S1 answers for indicator 2

Based on the results of student work in Figure 5, S1 fulfills the indicators of explaining mathematical ideas and models into ordinary language. Students understand the information given from the questions asked then S1 students can make a story from the model, he makes the subject of the story with Mr. Tono then changes the variable \( a \) with a plate and variable \( b \) with a glass. Even though the story he makes is not interesting and still looks very simple and untidy, this is included in being able to explain mathematical ideas or models into a story. So, it can be said that S1 already understands and is able to explain mathematical ideas and models into ordinary language. The results are in accordance with the student's statement who said: "... there are 2 mathematical models, then I assume \( a \) is a plate and \( b \) is a glass, then I make the story."

3.1.3. Analysis Indicator 3. The following Figure 6 shows the results of the S1 answer for indicator 3.

| how much for a donut / 1y? |
|----------------------------|
| \( 7x + 2y = 44,000 \) \( \times 5 \) | \( 35x + 10y = 220,000 \) |
| \( 5x + 4y = 43000 \) \( \times 7 \) | \( 35x + 28y = 301,000 \) |
| \( -18y = -81000 \) | \( 81000 \) |
| \( y = 4500 \) | \( y = 18 \) |

Figure 6. Results of S1 answers for indicator 3

Based on the results of student work in Figure 6, S1 fulfills the indicators of explaining and making questions from the questions being studied. Students understand the information provided from the questions, it can be seen that students can make a question from the picture that has been described in the questions, and students have also been able to provide answers to the questions presented. Students make questions, namely, how much is the price of one donut, it can also be seen how the completion of S1 students write down 2 known mathematical models in advance i.e. \( 7x + 2y = 44,000 \) and \( 5x + 4y = 43,000 \). After that, S1 students multiply each of these mathematical models by numbers 5 and 7. Then S1 solve them with the elimination methods, so that they get the result of \( y = 4500 \), then the
price of 1 donut is IDR 4,500. It can be seen that S1 already understands and is able to explain and make questions from the questions being studied. The result is in accordance with the student's statement who said: "I am looking for the price of 1 for a donut or 1y. I use the elimination method, sir, so I get the price of one donut, which is 4500"

Based on all the results of the analysis, it is concluded that S1 is able to meet all indicators of mathematical communication skills, namely, analyzing and expressing real objects of everyday situations and events in the form of mathematical models; explain mathematical ideas and models in plain language; and can explain and make questions from the questions being studied.

3.2 Analysis of subject 2 (S2)
S2 is one of the students in class VIII-F who has high interpersonal intelligence. Subjects were chosen because the results of their work were less in meeting the indicators of mathematical communication abilities. The following will display the results of students' answers and their analysis for each indicator.

3.2.1 Analysis Indicator 1. The following Figure 7 shows the results of the S2 answer for indicator 1.

| Mathematical models |
|---------------------|
| For example: \( \begin{align*} x &= \text{wood paint} \\
| y &= \text{wall paint} \end{align*} \) |
| \( 2 \text{ kg of wood paint} + 6 \text{ kg of wall paint} = IDR 248,500 \) |
| \( \rightarrow 3x + 6y = 248,500 \) |

Figure 7. S2 answer results for indicator 1

Based on the results of student work in Figure 7, S2 has not met the indicators of stating real objects, situations, and everyday events in the form of a mathematical model. Students do not understand the information given from the questions, it can be seen that students can only make an example and students are still wrong in making their mathematical models. S2 students are also still confused about classifying the prices for each of their mathematical models. From S2's work it can be seen that he made an example with \( x \) as wood paint and \( y \) as wall paint, so that from this example it should be able to make it easier for S2 in making its mathematical model. However, in making the mathematical model S2 is still wrong. The subject wrote \( 2 \text{ kg of wood paint} + 6 \text{ kg of wall paint} = IDR 248,500 \), then the model was made to be \( 3x + 6y = 248,500 \) which should be \( 2x + 6y = 248,500 \). This shows that students are wrong in making the mathematical model. In addition, from the questions given, \( 2 \text{ kg of wood paint} + 6 \text{ kg of wall paint} \) should be priced at IDR 243,000, but the students gave a price of IDR 248,500. This shows that students are not precise in writing the price, which if it is continued will cause errors in the calculation. It can be seen that S2 does not understand and is not able to express real objects, situations, and everyday events in the form of mathematical models. The results are in accordance with the student's statement who said: "... I'm confused, sir, to make modeling of a story"

3.2.2 Analysis Indicator 2. The following Figure 8 shows the results of the S2 answer for indicator 2.

| Story. |
|--------|
| For example: \( \begin{align*} a &= \text{brown} \rightarrow 6a + 2b = 46,000 \\
| b &= \text{jelly} \end{align*} \) |
| Then the price of 6 chocolates plus 2 jelly is \( IDR 46,000 \) |
| \( 4b = 47,500 - 5a \) |
| The price for 4 jelly is \( IDR 47,500 \) minus the price of 5 chocolates |

Figure 8. S2 answer results for indicator 2

Based on the results of student work in Figure 8, S2 fulfills the indicators of explaining mathematical ideas and models into ordinary language. S2 students are able to understand the information from the questions given. It can be seen that postgraduate students can sort out the variables in the questions,
making it easier for them to make a story. S2 students think of $a$ as chocolate and $b$ as jelly. However, the students’ story-making is still not interesting. S2 students only write "then the price of 6 chocolates plus 2 jelly is IDR 46,000" which is the first mathematical model and writes "the price of 4 jelly is Rp. 47,500 minus the price of 5 chocolates" in which the variables $a$ and $b$ are replaced with chocolate and jelly, so that ST-2 students are able to make good stories, although not interesting. This is in line with the student's statement who said: "I made an example $a$ for chocolate and $b$ for jelly, but I was confused about making the story so I could only make it like that."

3.2.3 Analysis Indicator 2. The following Figure 9 shows the results of the S2 answer for indicator 3.

| Question          | Figure 9. S2 answer results for indicator 3 |
|-------------------|---------------------------------------------|
| How much is the price of 2 cake plus 2 donuts |                                            |

Based on the results of student work in Figure 9, S2 meets the indicators of explaining and making questions from the questions being studied. S2 students understand the information given to the questions. It can be seen that S2 students can make questions from the picture presented, namely how much is the price of 2 loaves of bread plus 2 donuts, but S2 students do not provide answers to the questions they make. Students are able to make questions from the problems presented, the questions made are also interesting and unusual. The teacher usually gives an example by asking the price of 1 donut or 1 bread, and sometimes also asking how much $x$ or $y$ costs. but here students are able to make questions by asking how much 2 loaves and 2 donuts cost. Unfortunately, the student did not provide the solution, but the student gave a statement that he could answer / complete it, just forgot to do it. The statement given by S2 students: "... I forgot to finish, but I usually finish with the combined method (elimination and substitution)". So, it can be concluded that S2 understands and is able to explain and make questions from the questions being studied.

Based on all the results of the analysis, it is concluded that S2 is able to meet 2 indicators of mathematical communication skills, namely explaining mathematical ideas and models into ordinary language; and can explain and make questions from the questions studied. And S2 has not been able to meet the first indicator in mathematical communication skills, namely analyzing and expressing real objects, situations, and everyday events in the form of mathematical models.

In this study, students who have high interpersonal intelligence have the following characteristics: 1) able to communicate verbally and in writing, 2) able to tell daily events into a mathematical model, and 3) be able to make mathematical modeling into a story about everyday life. day. These characteristics are in accordance with research conducted by Dien which states that the characteristics of students who have high interpersonal intelligence include (1) being able to create and maintain social relationships, (2) being able to empathize with others and understand others, (3) able to solve problems in social relations, (4) able to realize verbal and non verbal communication, (5) have communication skills [20].

Based on the overall results of the analysis, students with high interpersonal intelligence have good mathematical communication skills as well, because they have achieved all three indicators in communication skills. Dewi and Heni also argue that research subjects who have high intrapersonal intelligence will look superior in their mathematical communication skills. This is because they prefer to interpret understanding by understanding, managing, and controlling themselves [21].
4. Conclusion
Based on the results of tests and interviews, it is concluded that not all students with high interpersonal intelligence have good mathematical communication skills in solving math problems. There are students who are still unable to express real objects, situations, and everyday events into mathematical models. Some students still have difficulty making mathematical models of story problems. Students also have not been able to understand the mathematical model so that it can make it difficult for students to solve math problems. One of the contributing factors is that students still do not understand the information on the story questions presented. For this reason, teachers are expected to further hone students' communication skills by providing mathematical problems in the form of story problems related to everyday life. So that students get used to making a mathematical model of the problems presented so that it makes it easier for students to solve them.

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