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Abstract: In the past two years, scientific advancements have developed since the Coronavirus Disease of 2019. The Indonesian government has been forced to implement online learning activities led to several difficulties and hindered optimal learning experiences. This study aimed to analyze and describe the students' low, moderate, and high mathematical communication skills on Number Patterns for Eighth graders of SMP Negeri 48 Surabaya, Academic Year 2022-2023. This study used descriptive qualitative research design. The data were collected using testing, interviews, and documentation. The results showed that students with high mathematical communication skills were able to demonstrate all indicators effectively. Students with moderate mathematical communication skills have achieved indicators related to expressing their understanding through mathematical concepts and graphical representations, but struggled to meet the indicator for creating mathematical models based on given problems. Students with low mathematical communication skills were able achieve indicators related to expressing their understanding through mathematical concepts, but failed to meet the indicators for expressing their understanding through graphical representations and creating mathematical models based on given problems. Based on the research findings, the authors suggest using an interactive learning model to improve students' mathematical communication skills, both written and oral. This model should actively involve students and address any knowledge gaps resulting from online learning.

Keyword: Analysis, Mathematical Communication Skills, Number Patterns

INTRODUCTION

Humans continue to develop various fields of knowledge to solve life's problems progressively. In the past two years, the advancement of science has been accompanied by the emergence of a pandemic, namely Coronavirus Disease of 2019. This has affected the progress of science, particularly in the field of education. The Indonesian government has been forced to implement online learning activities, leading to several challenges faced by both teachers and students. These challenges include limited access to technological facilities for some students, teachers' inadequate mastery of current technology, and unstable internet connections, resulting in suboptimal learning experiences (Nuryana, 2022).

In the learning process, students are expected to have a good understanding of the subject matter. One of the essential skills students need to acquire is mathematical comprehension, also known as mathematical communication skills. According to a study by Prayitno (2013), this skill encompasses the ability to use mathematical language to understand mathematical symbols, express and interpret mathematical ideas both verbally and in writing, whether in the form of diagrams, tables, graphs, formulas, or

their application (Nurhasanah, Waluya, & Kharisudin, 2019). Teachers continuously strive to enhance students' mathematical communication skills, which can be applied to various mathematical topics, including the concept of Number Patterns. This particular topic involves problem-solving related to the arrangement of numbers, requiring mathematical communication skills to solve effectively.

Mathematical communication requires accurate, critical, analytical, and evaluative processes, both verbally and in writing, according to Lestari and Yudhanegara (2017). This means that solving mathematical problems takes broad/critical thinking, including analytical and evaluative thinking, not just replacing numbers into formulas. Understanding the material is essential to learning. In mathematics, if a teacher discusses a concept and presents a problem as a diagram and written text, students may struggle to understand the problem's intended meaning if the teacher doesn't clarify the unclear parts. Math symbols, graphs, and tables must be comprehended.

According to the findings of a study conducted by Hafidhoh and Marlina (2021) titled "Mathematical Communication Skills of Junior High School Students on Systems of Linear Equations with Two Variables ," students with high mathematical communication skills met all of the indicators, whereas students in the moderate and low categories were unable to meet the indicators of transforming mathematical ideas into written form, explaining ideas in written form, and communicating ideas in written form. This study is related to the upcoming study since it addresses the same theme, albeit with a different subject matter, of mathematical interpersonal skills.

This study aimed to analyze and describe the students with low, moderate, and high mathematical communication skills on Number Patterns for eighth graders in SMP Negeri 48 Surabaya in the academic year 2022-2023.

METHOD

The descriptive qualitative methodology was used in this study. This study investigated the conditions and circumstances, and the results are presented in the form of a descriptive research report. The subjects for this study were selected based on the results of a prerequisite test on the Number Patterns topic, specifically the material on Arithmetic Series and Progressions. One student with low mathematical ability, one with moderate mathematical ability, and one with high mathematical ability were chosen. These three students are from eighth graders in SMP Negeri 48 Surabaya.

The research used several testing methods. It began with a prerequisite test to determine the subjects, consisting of six essay questions that covered the Arithmetic Series and Progressions topic. This was followed by a mathematical communication ability test, which included three different types of questions with equivalent difficulty levels. Additionally, interviews were conducted with the students and teachers. The student interviews focused on their understanding of the given questions and their approach to solving them to ensure that the students approached the questions properly. The interviews with the teachers involved gathering their opinions regarding the selected students for the mathematical communication ability test. Documentation was used to collect data and information throughout the research process. This included capturing images of the students' test answer sheets.

The data analysis in this research involved the following steps: 1) Data reduction, where the researcher analyzed the students' responses, starting from those with low mathematical ability, progressing to moderate and high ability. 2) Data presentation involved aligning the test results with the indicators of both the subject matter and mathematical communication ability.

This research used triangulation, time, and sources based on different methods, including the mathematical communication ability test on the Number Patterns topic,

direct interviews to assess students' understanding of the questions, and documentation of data collected during the research activities.

RESULT AND DISCUSSION

Data of students' mathematical communication skills were obtained from their answer sheets during the mathematical communication ability test and from the interview results. The subjects were students from SMP Negeri 48 Surabaya, specifically one student with low mathematical skills, one student with moderate mathematical skills, and one student with high mathematical skill. These subjects were selected through testing and interviews with mathematics teachers, and the results are as follows.

Table 1. Results of Mathematical Communication skills Test

No.	name	category	question items	score
1	SBJ (Subject S)	high mathematical skills	1	92
			2	92
			3	92
2	BC (Subject B)	moderate mathematical skills	1	32
			2	28
			3	48
3	KB (Subject K)	low mathematical skills	1	0
			2	0
			3	3,5

Table 2. Data Results of Interviews with Teachers

NO.	NAME	QUESTIONS	RESULT
1	SBJ (students with **high** math**ematics skills**) (Subject S)	1. Are students active when learning takes place?	Yes, students are very active when learning takes place.
		2. Do students often get good grades?	Yes, Students often get good grades. Even these students are able to answer questions quickly
		3. Do students communicate well with the people around them?	Yes, students are able to communicate well with the people around them. Students often communicate with friends

				in their class and often communicate with the teacher when students have something to ask.
2	TAM (students with **high** math**ematics skills**)	1.	Are students active when learning takes place?	Students are less active when learning takes place.
		2.	Do students often get good grades?	Students often get good grades. The increase in value achieved recently has increased quite a lot.
		3.	Do students communicate well with the people around them?	Students are able to communicate well with their friends. But students are not quite able to communicate well with the teacher.
3	HAS (students with moderate math**ematics skills**)	1.	Are students active when learning takes place?	Students are not active enough when learning takes place
		2.	Do students often get good grades?	Students sometimes get good grades.
		3.	Do students communicate well with the people around them?	Students communicate well with their friends. But not able to communicate well with the teacher
4	BC (students with moderate math**ematics skills**) (Subject B)	1.	Are students active when learning takes place?	Students are active when learning takes place. As often ask something that is not understood.
		2.	Do students often get good grades?	Students quite often get good grades because students' curiosity is quite high.
		3.	Do students communicate well with the people around them?	Students are able to communicate well with the people around them.
5	NAP (students with **low** math**ematics skills**)	1.	Are students active when learning takes place?	Students are rarely active when learning takes place.
		2.	Do students often get good grades?	Students rarely get good grades.
		3.	Do students communicate well with the people around them?	Students are less able to communicate well with the people around them.
6	KB (students with	1.	Are students active when learning takes place?	Students are rarely active when learning takes place, but sometimes students are brave

low math**ematics** **skills**) (Subject K)			enough to ask something they don't know.
	2.	Do students often get good grades?	Students rarely get good grades.
	3.	Do students communicate well with the people around them?	Students are quite able to communicate well with the people around them.

After obtaining one subject in each category of high, moderate, and low mathematical communication skill, based on the assessment results and interviews, the following are the findings and discussions:

a) Subject S (student with high mathematical communication skills)
Subject S was able to answer all the given questions provided by the researcher. Below are the answers provided by subject S for question number 1.

Figure 1. Answers S no 1

It is known that the subject raises indications of skills to express their comprehension through writing mathematical thoughts and ideas in accordance with their own language after completing problem number 1. Researchers can say that subject S raises these indicators because the subject is able to get information properly and correctly as in the problem. During the interview session, Subject S was also able to mention information, what is asked for, and the skills to explain the procedures to solve the problem in detail. However, in the subject S completion section, he did not write a conclusion because he was not used to doing so, therefore he forgot to put the conclusion on the answer sheet.

The subject may be observed on the answer sheet above mentioning information from the offered picture questions such as the pattern of the number sequence, difference, first term, and tribe being asked. During the interview session the subject was also able to explain what information was obtained, what was asked, and was able to explain the sequence of completion that the subject had written. However, the subject has not written a conclusion from the results of the answers.

Then the completion of question number 2 on the subject was able to show indicators of students' skills to express their understanding through pictures, graphs and mathematical tables. The following is the result of the subject's answer to question number 2

Figure 2. Answers S no 2

The researcher can say that subject S show these indicators because the subject was able to understand the pieces of stick referred to in the problem, namely the lines in the square shape image.

Figure 3. Answers S no 3

Furthermore, in question 3, the subject could accurately recall the facts from the story problem. The subject created a number sequence pattern that corresponded to the question and correctly answered the question, which was the number of seats in the building/the number of the nth term. Researchers can state that the subject can show indications of students' skill in creating mathematical models through a problem since the subject understands the problem appropriately and correctly as presented by the subject during the interview.

b) Subject B (Students with moderate mathematical communication skills)
Subject B could only work on a few questions. The image below shows the result of subject B's response to question number one.

Figure 4. Answer B no 1

The subject can mention the information in the problem by writing down a series of numbers, writing down what is asked in the problem, and calculating the solution coherently. Researchers can state that the subject is able to bring up indicators of his skill to express his understanding through writing mathematical ideas and ideas in accordance with his own language because the subject is also able to mention the information contained in the problem and explain the sequence when working on the problem during the interview session. Furthermore, in question 2, subject B accurately identified the information, such as counting each line to count the pieces of stick in the picture. However, the subject is still careless when calculating the completion.

Figure 5. Response B no. 2

Based on the image above, the researcher can conclude that subject B indicates students' skills to articulate their understanding through drawings, graphs, and mathematical tables because the subject accurately mentioned the material in the problem during the interview session. However, when the subject answered the problem, he was not careful in documenting the formula utilized, preventing the researcher from correctly solving the problem.

Subject B was then able to obtain the information in question number 3. However, the subject was unable to compute the problem's completion correctly.

Figure 6. Answer B no 3

Based on the image above, the researcher can conclude that the subject can express his comprehension by writing mathematical thoughts and ideas per his own language. And the subject can produce indicators. Students could make a mathematical model through a problem because the subject wrote down the number sequence pattern of the problem. However, in calculating the completion of subject B, it is less precise so the results obtained by the subject are not quite correct.

c) Subject K (Students with low mathematical communication skills)
In question number 1 subject K could not conclude the information contained in the problem, the subject could not choose the concept correctly so that the subject could not solve the problem properly. The following is a picture of the results of the subject's answers to question number 1.

Figure 7. Answer K no 1

However, during the interview, subject could mention the information obtained by mentioning the first term and the difference between each number. The subject can mention the concept given but the subject cannot apply the concept properly. Then in question number 2 the subject did not write down any information, the subject only wrote down the formula and the stages of completion as shown in the following figure.
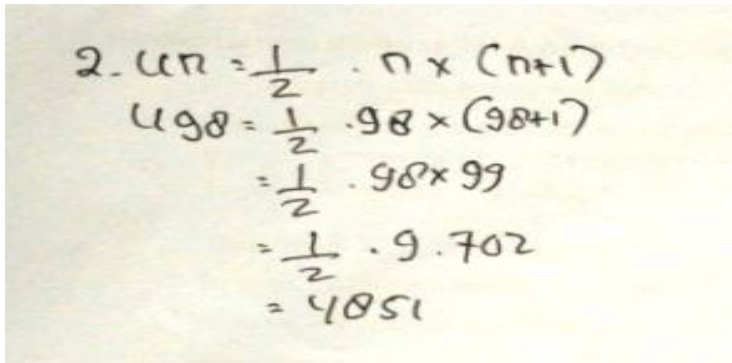
Figure 8. Answer K no 2

During the interview session the subject was unable to name the sequence of numbers that matched the picture and mentioned the concept used but the subject was unable to apply the concept mentioned. Furthermore, in question number 3, the subject only gets information about the number sequence, namely 33, 37, 41, ... and so on up to the 10th term as shown in the picture below.
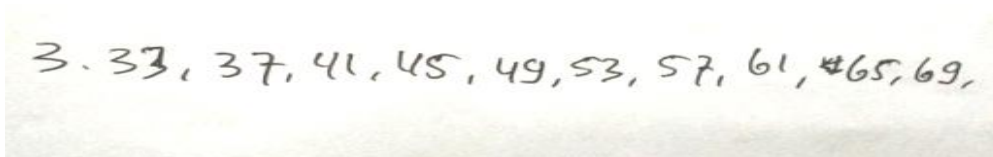

Figure 9. Answer K no 3

During the interview, the subject also only provided information about the first, second, third, and subsequent terms of the number sequence until the tenth term. When the researcher asked about the question and the concept used to solve the problem, the subject responded that they were asked about the 10th term and did not use any specific concept. The subject solved the problem simply by adding 4 to the previous number in the sequence. This indicates that the subject with low mathematical skills struggles in effectively communicating mathematically, both in written and verbal and one contributing factor is the lack of understanding of the given information, aligning with the opinion of (Purwanto, E. (2022); anggraini, L. etc.(2022); Lutviana etc. (2022)).

According to the researcher, the findings of this study support the results of a study conducted by Hafidhoh and Marlina (2021) titled "Mathematical Communication skills of Junior High School Students in the Topic of Systems of Linear Equations with Two Variables." The previous study showed that students with high mathematical communication ability fulfilled all the indicators. In contrast, students in the moderate and low categories could not achieve the indicators of transforming mathematical ideas into written form, explaining ideas in written form, and understanding contextual problems in symbolic or mathematical form. However, the results differ in the category of students with moderate mathematical ability. In this study, students in the moderate category could understand and express their understanding through visual representations.

CONCLUSION

Based on the research findings and discussions, it was found that the mathematical communication skills test results conducted on three eighth graders at SMP Negeri 48 Surabaya, the following conclusions can be drawn.

1. Students with low mathematical communication skills could only demonstrate some indicators, such as accurately infer information from the given questions. However, they struggled to achieve the indicator of creating mathematical models as they did not write down number sequence patterns in some questions. These students also failed to fulfill the indicator of understanding visual representations, leading to difficulties in solving the problems effectively and accurately.

2. Students with moderate mathematical communication skills demonstrated some indicators, including expressing their understanding of the given questions and adequately representing their understanding through visual representations. However, they could not correctly fulfill the indicator of creating number sequence patterns and had difficulty applying the chosen concepts effectively, resulting in less accurate problem-solving outcomes.

3. Students with high mathematical communication skills could demonstrate all the indicators effectively. They were able to convey the information obtained from the given questions accurately. They expressed their understanding through visual representations and successfully created number sequence patterns for each question. However, these students did not provide conclusions for their completed solutions.

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