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Analysis of Climber Students' Mathematics Communication Skills in Solving Algebraic Problems

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Articles Information

Abstrak

Keywords:

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Penelitian ini bertujuan untuk mendeskripsikan kemampuan komunikasi matematis siswa dengan kategori climber. Subjek dalam penelitian ini dipilih berdasarkan hasil tes ARP. Teknik yang digunakan dalam penelitian ini adalah tes dan wawancara kepada siswa climber yang dipilih dari siswa kelas VII SMP. Untuk analisis data digunakan metode Miles and Huberman. Adapun hasil dari penelitian ini adalah siswa climber mampu memenuhi semua indikator komunikasi matematis yang ditetapkan. Siswa Climber mampu mengungkapkan benda nyata, situasi dan kejadian sehari-hari dalam bentuk model matematika (berupa gambar, tabel, diagram, grafik, ungkapan aljabar), menjelaskan ide dan model matematika (berupa gambar, tabel, diagram, grafik, ungkapan aljabar) ke dalam bahasa lisan atau tulisan, Menjelaskan dan membuat soal-soal matematika yang dipelajari, Mendengarkan, mendiskusikan, dan menulis tentang matematika, dan membuat konjektur, menyusun argumentasi, merumuskan definisi dan generalisasi.

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This study aims to describe students' mathematical communication skills in the climber category. Subjects in this study were selected based on the results of the ARP test. The techniques used in this study were tests and interviews with climber students who were selected from class VII junior high school students. For data analysis, the Miles and Huberman method was used. The results of this study are climber students are able to fulfill all the established mathematical communication indicators. Climber students are able to express real objects, situations and everyday events in the form of mathematical models (in the form of pictures, tables, diagrams, graphs, algebraic expressions), explain ideas and mathematical models (in the form of pictures, tables, diagrams, graphs, expressions algebra) into spoken or written language, Explain and create mathematical questions being studied, Listen, discuss, and write about mathematics, and Make conjectures, construct arguments, formulate definitions and generalizations.

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INTRODUCTION

Communication implies giving information, messages or ideas to other people with the intention that these other people have the same information, messages, or ideas as the sender of the message. Mathematical communication is an important ability for students to master (Prayitno et al., 2017). Students are able to express their mathematical ideas orally, in writing, pictures, diagrams, using real objects, or using mathematical symbols (Mandasari et al., 2018). Mathematical communication is part of the mathematical power that must be possessed by students. (Suhaedi, 2012). Through communication, students can express ideas by expressing their mathematical knowledge (Faizah & Sugandi, 2022).

Communication plays an important role in helping students, not only develop concepts but also make connections between abstract ideas and mathematical language and symbols (Ismayanti & Sofyan, 2021). Students should also be given the opportunity to present their thoughts through speaking, writing, painting pictures, or graphics (Astuti & Leonard, 2018). Communication gives freedom to students to talk and discuss mathematics. Therefore, if students have good communication skills, it is likely that student learning outcomes in learning mathematics will also be good.

However, in reality, students' mathematical communication skills at school are no longer a serious concern for mathematics teachers, especially when the learning process is carried out online (Faizah & Sugandi, 2022). This was then carried over after the learning process was carried out normally again, resulting in obstacles in the mathematics learning process (Safaria & Lestari, 2022). For this reason, teachers must have the creativity to produce interesting learning, so that they can arouse students' enthusiasm for learning (Waluya, 2022). To get quality students, it takes teachers who also have good quality. In addition, the resilience of students also supports the quality of learning outcomes. A person's toughness and resilience in solving problems can be categorized in the adversity quotient (Francis, 2000). Adversity quotient divides a person's characteristic into 3 categories, namely Climber, Camper, and Quitter. In this study, only Climber was chosen to describe. Students who has climber category are the type of person who generally does not know the term surrender in the face of difficulties, they always seek solutions and are very capable of surviving in the face of severe difficulties, and it will affect students' communication skills.

Research that describes mathematical communication skills has been carried out by previous researchers. Sekaryanti et al., (2022) described communication skill of the students who have high, middle and low ability students. Students with high mathematical abilities are able to provide correct answers, but have not yet reached an extended level of abstraction, students with moderate mathematical abilities can demonstrate correct procedures but still have difficulty using and processing information, and the students with low mathematical abilities cannot solve the problems, they can only solve some of the problems presented. Kamid et al., (2020) analyzed students' mathematical communication skills in terms of cognitive style and gender. It showed that there was a significant difference of Field Independent (FI) and Field Dependent (FD) students in mathematical communication skills. FI can explain the information contained in the problem well, use mathematical models well, and can explain problem solving strategies well. Whereas

FD is able to explain the information contained in the questions quite briefly but incompletely, is able to use mathematical models well, but is incomplete in explaining problem solving strategies, and is lacking in re-evaluating answers. Neswary & Prahani, (2022) analyzed the mathematics communication skills of the students on the junior high school. They stated that the **Mathematical communication skills of students in classes IX-1 SMP Negeri 3 Bilah Hulu Labuhan Batu is still low so it needs to be made in consideration for further research.** None of the research have been done, there is still no research that describes students' mathematical communication in terms of adversity quotient. even though the characteristics of the adversity quotient greatly affect students' learning abilities, including students' mathematical communication abilities (Hidayat & Sari, 2019). Therefore, this study aims to describe students' mathematical communication skills in terms of the adversity quotient in the climber category.

METHOD

The aim of this study was to describe the mathematical communication skills of students with the adversity quotient type Climber in solving algebraic problems. Data were obtained by using data collection techniques through tests and interviews. At the beginning of the implementation, to get research subjects, an Adversity Response Profile (ARP) test was carried out on grade 7 students to find out the type of student's Adversity Quotient. After the ARP results were obtained, an explanation was given regarding the material in algebraic forms orally and in writing. Students were asked to discuss and ask questions about the material that had been explained. Then, the selected students were given a written test for Algebra material. After obtaining the test results, the researcher conducted in-depth interviews with the selected research subjects. Researchers conducted interviews with the aim of obtaining in-depth information related to students' mathematical communication which was not obtained through analysis of the results of written answers.

Furthermore, data analysis used the Miles and Huberman method, namely data reduction, data presentation/analysis, and drawing conclusions. Reducing data is done by reducing data obtained from tests and interviews, focusing on the main things that are in accordance with students' mathematical communication indicators, and removing data that is not needed. The reduced data was then analyzed using students' mathematical communication indicators according to the theory of Hendriana and E. E. Sumarmo (2017). The last step in data analysis is drawing conclusions and verification based on the results of data analysis.

To test the validity of the data in this study, time triangulation was carried out, namely, the data obtained was triangulated by comparing the data on the results of written tests and interviews in stage I with the data on the results of written tests and interviews in stage II. The tests and interviews in stages I and II were given a seven-day interval with the same subject and similar Algebra questions.

Data analysis in this study was carried out using indicators of written mathematical communication abilities expressed by Hendriana and E. E. Sumarmo (2017) as explained in the following table.

Table 1. Indicators and Sub-Indicators of Mathematical Communication Ability

No.	Indicators	Sub- Indicators
1.	Stating real objects, situations and everyday events in the form of mathematical models (in the form of pictures, tables, diagrams, graphs, algebraic expressions)	<ul style="list-style-type: none"> - Can represent the problem to an equivalent form - Changing the word problem sentences into mathematical symbols - Represent everyday problems into mathematical models
2.	Explain mathematical ideas and models (in the form of pictures, tables, diagrams, graphs, algebraic expressions) in spoken or written language	<ul style="list-style-type: none"> - Can explain what is known from a given mathematical problem - Can describe data in the form of tables, charts or graphs, or algebraic forms - Can state the data given in the form of tables, charts or graphs, or algebraic forms
3.	Explain and create math questions being studied	<ul style="list-style-type: none"> - Can explain what is asked of a given mathematical problem - Can ask questions related to the math material being studied
4.	Listen, discuss, and write about mathematics	<ul style="list-style-type: none"> - Can listen to the material delivered by the teacher - Can understand the material explained by the teacher - Can express opinions regarding the solution to the problem given - Can write down a problem-solving plan given
5.	Making conjectures, constructing arguments, formulating definitions and generalizations.	<ul style="list-style-type: none"> - Arrange a solution to the problem in a structured and detailed manner - Explain the results of problem solving that has been done clearly and in detail - Can draw conclusions from the answers to solving the problems given

RESULT AND DISCUSSION

This research was started by giving the ARP test to grade 7 students at SMP Hasanuddin Surabaya. The 7th grade at the school is a heterogeneous class with various abilities and types of students. There are 43 students in grade 7 at SMP Hasanuddin Surabaya. Based on the results of the ARP test at school, it was obtained that the results of students with the criteria of 2 students were Climbers, 38 students as Campers, and 3 Quitters.

From the results of the ARP test, selected climber students who have been determined, then given the Algebraic Form Material test. In detail the results of the study as follows.

1. Student Cl 1

The answers of Student CL 1 can be presented in Figure 1 below.

③ Misal = Panjang = p
 lebar = l
 Ditanya = panjang dan lebar
 luas
 Jawab : a. $k = 2 \times (p + l)$ b. $L = p \times l$
 $20 = 2 \times (3l + l)$ $7,5 \text{ m} \times 2,5 \text{ m}$
 $20 = 2 \times (4l)$ $\Rightarrow 18,75 \text{ m}^2$
 $20 = 8l$ jadi, panjangnya = 7,5 m
 $20 = 8l$ lebarnya = 2,5 m
 $20 = 8l$ Luasnya = 18,75 m²
 $8 = 8l$
 $2,5 = l$
 $l = 2,5 \text{ m}$ ✓
 $p = 3 \times l = 3 \times 2,5$
 $7,5 \text{ m}$

Figure 1. Student Cl 1's Answer

Based on the answers to question number 1 from Cl 1 students, it is known that Cl 1 students are able to represent problems from word problems into mathematical symbols that are known from known writing, namely for example the length and width which are known by p and l. Cl 1 students can also arrange solutions to problems in a coherent and detailed manner according to mathematical rules. To solve problem a, S1 substitutes into the formula for the perimeter of a rectangle, namely $k = 2 \times (p + l)$. Then it can be known the length and width, which is 7.5 m long and 2.5 m wide. If the length and width have been found, then question b can be done. Problem b is a question to find the area of a rectangle. The formula used is $L = p \times l$, then it is known that the area is 18.75 m².

Based on the results of the interviews, CL 1 students were able to mention the steps in working on problem number two along with the reasons in order. When asked about what initial steps were used, S1 mentioned by way of example. Then substitute it into the circumference formula. The reason S1 uses the perimeter formula is because what is known is the perimeter of the rectangle. Since the length is three times the width, the length is replaced by 3l, after which the width is found. Next is to determine the length, because the length is 3 times the width, then 3 is multiplied by the width and find the length. After that determine the area with the formula $L = p \times l$.

In this case, CL 1 students can explain what is known, describe data, and explain the steps to do well. Cl 1 students can also discuss answers with researchers in interview sessions.

In the implementation of learning, as long as the observation activities are carried out, Student CL is an active student in the class. CL students always answer every question given by the teacher. In addition, Cl students are also very brave to explain the results of discussions in class. CL students are also always active in asking the teacher using polite language. Cl students are students who have very high motivation in solving problems. In addition, S1 also really understands every problem given by the teacher, so he can translate ideas from story problems into mathematical sentences very well.

In the implementation process the observer also observed the activities of Cl students during the discussion. CL students are very active in discussing in their groups. Student CL listens carefully to every explanation conveyed by the teacher and is careful in reading the questions given. CL students can accept

all the opinions conveyed by their group mates. In discussions, if something is unclear, CL students ask the teacher politely. CL students are also able to present the results of discussions in front of the class.

Based on the results of observations, it can be concluded that CI students are active, careful, and have high motivation in learning in class.

2. Student CI 2

The answers of Student CL 2 can be presented in Figure 1 below.

Handwritten solution for a word problem:

2b) Misal = panjang = p
Lebar = l

Ditanya = panjang, lebar, dan luas

Jawab = $k = 2 \times (p + l)$
 $20 = 2 \times (3l + l)$
 $20 = 2 \times 4l$
 $20 = 8l$
 $2,5 = l$

$l = 2,5 \text{ m}$
 $p = 3 \times l = 3 \times 2,5 \text{ m}$
 $7,5 \text{ m}$

$l = p \times l$
 $2,5 \text{ m} \times 7,5 \text{ m}$
 $= 18,75 \text{ m}^2$

Jadi, panjangnya = 7,5 m, lebarnya = 2,5 m, dan luasnya = 18,75 m²

Figure 2. Student CI 2's Answer

Based on the answers to question number 1 from CI 2 students, it is known that CI 2 students are able to represent problems from word problems into mathematical symbols that are known from known writing, namely the length is for example p and the width is l. After that, CI 2 wrote down the questions, namely the length and width. To solve problem a, CI 2 substitutes into the formula for the perimeter of a square, namely $k = 2 \times (p + l)$. Then it can be known the length and width, which is 7.5 m long and 2.5 m wide. If the length and width have been found, then question b can be done. Problem b is a question to find the area of a rectangle. The formula used is $L = p \times l$, then it is known that the area is 18.75m²

Based on the interview, CI 2 explained that the step used was to make an example so that the length and width can be found. Then use the formula for the perimeter of a rectangle, because all that is known is the area and width. Width is replaced with l, while length is replaced with 3l, then find the width and length. To answer question number 2b, the formula used is $L = p \times l$. The formula is used because it corresponds to question number 2b, which is finding the area. Then found the extent.

Based on the results of interviews with CI 2 students, it can be concluded that CI 2 students are able to explain what is known, describe data, and explain the steps to do well. CI 2 students can also discuss answers with researchers in interview sessions.

In the implementation of learning, as long as the observation activities are carried out, CI 2 is a student who is active in class. CI 2 rarely asks the teacher, but when talking to the teacher, CI 2 uses polite and

courteous language. When they feel there are difficulties in understanding the questions, S3 prefers to ask their classmates.

In carrying out the observation the observer also observed the activities of Cl 2 during the discussion. Cl 2 is an active student in the discussion. Cl 2 is able to accept opinions from his friends. S3 has high motivation in solving problems from questions, so he is able to convey ideas from word problems into mathematical sentences in discussion activities. Cl 2 listens to the previous teacher's statement and reads the questions carefully, so they understand the meaning of the questions. When the teacher approached and asked Cl 2 to explain a few steps in working on the problem, Cl 2 was quite able to explain it in polite language. Because Cl 2 and their groups were not the first two groups to collect assignments, they did not present them. Based on the results of observations, it can be concluded that Cl 2 is a student who is quite active in learning activities and is able to respect the opinions of others

13 Discussion

Based on the results of the research described above, it is known that Cl 1 and Cl 2 students, who are students with the Climber criteria, show that they have fairly good communication skills. This is indicated by the results of the answers of the two research subjects that meet all indicators of mathematical communication. This is in line with the results of research conducted by Lestariningsih (2021) that climber students can understand the problem well, can write down things that are known with mathematical symbols, are able to make a mathematical model of the given problem, carry out a re-examination of what has been done, and solve problems with precise and complete steps. Likewise, Widyarti (2020) who stated that students in the climber category have good verbal and written mathematical communication skills.

In accordance with the theory of Francis (2000) which states that students in the climber category have a strong positive thinking character, have high self-motivation and always try to get maximum results. From the character possessed by students in the climber category, they will always try to understand, solve the problems given, and always try to understand what they learn. This causes climber students to try to get the best results. Climber students tend to persist in facing difficult situations (Waluya, 2022). This is what causes climber students to fulfill all mathematical communication indicators.

2 CONCLUSION

Based on the results of the research and discussion described above, it can be concluded that students in the climber category have good communication skills. It can be seen that climber students are able to fulfill all the established mathematical communication indicators. Climber students are able to express real objects, situations and everyday events in the form of mathematical models (in the form of pictures, tables, diagrams, graphs, algebraic expressions), explain ideas and mathematical models (in the form of pictures, tables, diagrams, graphs, expressions algebra) into spoken or written language, Explain and create mathematical questions being studied, Listen, discuss, and write about mathematics, and Make conjectures, construct arguments, formulate definitions and generalizations. This research is only limited to students in

the climber category, further research can be carried out for students in the camper or quitter category, so as to obtain an overall picture of students' mathematical communication abilities in terms of the Adversity Quotient.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9
