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Students' Relational Thinking and Mathematical Communication in Contextual Problem-Solving in Muhammadiyah Junior High School 8 Batu

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Abstract: Students' Relational Thinking and Mathematical Communication in Contextual Problem-Solving in Muhammadiyah Junior High School 8 Batu. Objective: This research aims to describe students' relational thinking and mathematical communication processes in solving mathematical problems using contextual problems in curved geometric shapes. **Method:** This research uses qualitative research methods by collecting data using relational thinking tests, written mathematical communication, and interviews to determine oral mathematical communication. The research instruments used in this research were relational thinking tests, written mathematical communication, and interview guidelines. The subjects of this research were junior high school students in the IX class. The data analysis is a test and interview results, then conclusions are drawn. **Findings:** The research results show that the dominant students were in the medium category after carrying out tests on relational thinking and written mathematical communication. **Conclusion:** In the analysis of oral communication thinking, the results showed that students who were in the low category in relational thinking processes were still unable to fulfill several indicators; apart from that, students were still not able to communicate mathematically, but in mathematical oral communication they were in the medium category. Meanwhile, students in the moderate category of relational thinking processes can only fulfill several indicators and must be able to communicate mathematically. Still, according to the analysis of mathematical oral communication, they are classified as good. Students in the high category of relational thinking processes are just unable to build complete relationships and can communicate mathematically well.

Keywords: relational thinking, mathematical communication, contextual problems.

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INTRODUCTION

Solving mathematical problems is always linked to how students think and reason in the learning process. Hence, the development of mathematics learning prioritizes analytical, critical, logical, systematic, and creative thinking skills (Ekayana, Hermanto, & Affaf, 2020; Hashim, Houssein, Hussain, Mabrouk, & Al-Atabany, 2022; Yulianah, Supratman, & Rahayu, 2022). Mathematics subjects given at school aim to provide provisions for students to understand mathematics learning material in the process of solving mathematical problems, relate mathematical material in the form of facts to

everyday life, and have an attitude of respect for the use of mathematics in everyday life, this is explained in the decision of the head of the Educational Standards, Curriculum and Assessment Agency No. 8 of 2022(BSKAP, 2022). One way to provide students with provisions for using mathematics in everyday life is to think about mathematics.

The National Council of Teachers of Mathematics (NCTM) discusses the importance of problem-solving and states that the goal of learning mathematics is not just solving the problems given but how students think; perseverance, curiosity, and self-confidence must be built by learning to solve mathematical problems. (NCTM 2000). PISA in global competition has a vital role in problem-solving, and according to the results of the PISA survey test, mathematics learning in Indonesia is still not optimal because these students need to understand or master the problem-solving process.(Nurrahmah, Susanto, & Permadi, 2019; Sudrajat, 2022). Three cognitions are involved in the problem-solving process: problem presentation, problem-solving identification, and solution implementation (Anam et al., 2018; Flavell, 2024).

The problem-solving process is essential and cannot be separated from the mathematics learning process (Chuderski & Jastrzêbski, 2018). Increasing the ability to think relationally has a vital role in the problem-solving process, and knowledge and high-level thinking processes are needed in the problem-solving process (Rahayu, 2019; Wardani, D. L., 2020; Weinan & Yu, 2018). One of the high-level thinking processes is that students can link concepts from previous learning and use them in the process of solving a given problem; this is referred to as relational thinking, and students can be said to have relational thinking if students can connect between objects and between concepts, and use The equal sign is a form of relationship in the problem-solving process (Cavalcante et al., 2024; Kose & Kiziltoprak 2020; Molina & Castro, 2021; Polotskaia et al., 2022; Zhao et al., 2021). According to Polya, (1973), there are four steps in the problem-solving process: understanding the problem, making a plan, implementing the plan, and checking again. This can be interpreted as understanding the problem, which is a crucial first step in solving a problem.

Mathematics helps people learn to think logically, systematically, critically, and rationally and to work together. One focus of mathematics learning is improving students' abilities in mathematics, especially their ability to communicate mathematically (Putri & Musdi, 2020; Rohid et al., 2019; Setiyani et al. 2020). So, at every level of education, mathematics subjects must be taught. This aims to help students learn to use mathematical ideas or notions to explain situations or problem (Pongsakdi et al., 2020; Saptana et al., 2022). In the decision of the head of the Educational Standards, Curriculum and Assessment Agency No. 8 of 2022, it is stated that regarding the standard content of mathematics learning objectives, communication skills so that students can communicate something in the form of symbols, diagrams, tables, or other forms that aim to clarify the problem given (BSKAP, 2022). Mathematical communication is a student's ability which aims to express mathematical ideas orally and in writing. This is also expressed by the National Council of Teachers of Mathematics, that mathematical communication is a way for students to share mathematical ideas that they already understand (Luque-Sánchez & Montejo-Gámez, 2023; Nasution & Suyanto, 2023; Paroqi et al., 2020; Sumaji et al., 2020).

During the mathematics learning process, students are given problems related to daily life, which is one way to improve problem-solving abilities (Darma et al., 2018; Prismana, Kusmayadi, and Pramudya 2018; Sutama et al.

2022). All problems in the form of facts, concepts, principles, and both natural and abstract objects that are related to the mathematical context and problems related to everyday life are called contextual mathematical problems (Chen et al., 2022; Ilhan & Akin, 2022; Kolar & Hodnik, 2021; Yulianah et al., 2022; Yuwandra & Arnawa, 2020). NCTM (2000) states that students can connect concepts that are known and applied in areas of everyday life if the student is given a contextual problem. Through solving mathematical problems, it is hoped that students can implement their skills and knowledge in solving everyday problems.

The difference between this research and previous research is that it links relational thinking, mathematical communication, and contextual problems together. This will be a renewal of previous research. The contextual problems that will be used are the problems in the material for Building Curved Side Spaces at the Junior High School (SMP) class IX level. Contextual problems will be packaged into questions containing indicators of relational thinking and mathematical communication. From the results of the problem work that students have carried out, an analysis of students' relational thinking processes and mathematical communication in solving contextual problems will be carried out. Related research Analysis of students' relational thinking processes and mathematical communication in solving contextual problems will be a renewal of previous research.

Based on the description above, it is known that in the process of learning mathematics, giving students problems related to daily life is very important to master. This is one way to improve students' abilities in the problem-solving process. Apart from that, one of the focuses of mathematics learning is students' ability to communicate mathematically and to link concepts from previous learning and use them in solving a given problem. Therefore, this research aims to describe students' relational thinking and mathematical communication processes in solving mathematical problems using contextual problems with curved-sided geometric material.

METHOD

Participants in this research were 28 students in class IX of SMP Muhammadiyah 8 Batu, and the sample used in the written test was 28 students, while three students conducted interviews. Sampling was done by looking at the analysis of relational thinking processes and written mathematical communication from each category of low, medium, and high; 1 student was taken who was used as a subject for interviews.

This research uses a descriptive qualitative approach to interpret, describe, and analyze data obtained in the field and described narratively(Amin et al., 2021; Nurhanifah et al., 2021). Data sourced from selected research subjects is then described descriptively. The data collection techniques used in this research are relational thinking tests, written mathematical communication, and interviews to determine oral mathematical communication. The period of this research is one week.

The instruments used are relational thinking tests, written mathematical communication tests, and oral mathematical communication tests. The research instrument used refers to indicators of relational thinking and mathematical communication. The number of questions tested was 1 question, while the interview items were six, each indicator containing 1 question. The relational thinking research instrument was adapted from research Nurrahmah, (2020) as many as four indicators, namely 1) Students build overall relationships and determine known elements. 2) Students build relationships through symbols, properties, or rules to find unknown numbers. 3) Students use relationships as

symbols, properties, or rules to find unknown numbers. 4) Students rationalize relationships in the form of symbols, properties, or rules used. Meanwhile, mathematical communication indicators are adapted from research (Fitriyani & Khasanah, 2017), consisting of written and oral mathematical communication. The indicators for written mathematical communication are: 1) Create mathematical situations by conveying concepts and information in writing. 2) Describe the problem situation. 3) Expressing a mathematical concept and its solution using a comprehensive representation. 4) Use mathematical language and symbols appropriately. 5) Expressing the solution to the problem algebraically using pictures, tables, or charts. 6) State the results in written form. Meanwhile, the indicators of oral communication are 1) Providing solutions to specific problems. 2) Convey the answer to a problem using tables, pictures, models, etc. 3) choose the most appropriate solution for solving the problem. 4) Provide opinions or suggestions to answer questions more easily. 5) Convey convincing arguments to answer questions or statements raised by the audience. 6) Can interpret and evaluate concepts, symbols, terms, and mathematical information. Geometry material experts and interview guides, namely Drs, carried out instrument validation. Marhan Taufik, M.Si lecturer at Bachelor of Mathematics Education UMM and teacher at Muhammadiyah 8 Batu Middle School, namely Laili Nur Hanifah, M.Pd.

Research to obtain high credibility, among others, through the involvement of researchers in the participants' lives. For a long time, they tried to confirm and clarify the data they obtained with the participant or member examination (back to the participants after data analysis) or have a panel discussion with experts or experts to review the data they had obtained.

Data analysis in this study used a qualitative approach. Researchers analyzed the results of relational thinking and written mathematical communication tests that students had carried out. Meanwhile, researchers analyzed oral mathematical communication by conducting interviews with students designated as subjects. The interview guide was prepared based on verbal and mathematical communication indicators and analyzed using a scoring rubric. Then, it is classified by looking at the criteria for relational thinking and written mathematical communication. Mathematical communication data analysis techniques and relational thinking use the formula the percentage of mathematical communication or relational thinking (P) equal to the total number of values obtained ("Xi) divided by the maximum score ("X) multiplied by one hundred percent. Below are guidelines for classifying the value of students' mathematical communication or relational thinking (Rusmini, 2019).

Table 3. Presentation table of relational thinking and mathematical communication

Value scales	Mathematical Communication Criteria or relational thinking
$0\% < X \leq 60\%$	Low
$60\% < X \leq 75\%$	Currently
$75\% < X \leq 100\%$	Good

The research procedure begins with conducting observations at the school to identify problems, then at the planning stage, which consists of creating test questions on curved geometric shapes and answer keys, creating interview guidelines to analyze oral mathematical communication, and creating relational thinking scoring guidelines. Moreover, written

mathematical communication. Meanwhile, at the implementation stage, researchers distribute test questions and direct students to work on the test questions that have been distributed. After students complete the test, the test results are analyzed regarding how students write relational thinking and mathematical communication processes. Then, the researcher selected and determined three students with written mathematical communication scores in the low, medium, and sound categories to be used as subjects for oral mathematical communication and conducted interviews. The final stage of this research is analyzing the data. Based on credible data, data analysis is then carried out using proprietary data Miles et al., (2014), namely data condensation (which aims to simplify and focus the data obtained by researchers while in the field based on the results of relational thinking tests and written mathematical communication of students, presentation of data (data display) which aims to explain the results of tests on relational thinking and written mathematical communication students, as well as interviews that the subjects have described studied, as well as concluding (conclusion drawing) based on analysis of findings obtained from relational thinking and mathematical communication tests written by students as well as interviews given to the subjects studied based on predetermined groupings.

RESULT AND DISCUSSION

Based on the research results at SMP Muhammadiyah 8 Batu, conducted face to face and within seven days of mathematics learning. This research began by distributing relational thinking and mathematical communication tests with material on curved geometric figures with a processing time of 30 minutes. Furthermore, this research interviewed three students designated as subjects to analyze students' oral mathematical communication. Then, the researcher analyzed the results of the essay tests and interviews that had been carried out.

Relational Thinking

Relational thinking test given to 28 students. The relational thinking test questions in essay form consist of 1 question, which contains material on curved-sided shapes, and students are asked to find the surface area of a conical shape without a base. The time given to work on this question is one hour.

Based on the results of the relational thinking test, it was found that there were three students in the low category, 21 students in the medium category, and four students in the high category. Students predominantly do not write conclusions based on the results of their work. Students' relational thinking processes in solving contextual problems have various results, but the results are different and dominant in the medium category. This means that students' relational thinking processes, as seen from the test results, where the test questions are prepared based on indicators of relational thinking, still need to be improved.

This is in line with research conducted by Hermanto et al., (2020); Molina & Castro, (2021), which shows that students still have difficulty solving problems using relational thinking. This is because students are used to carrying out mathematical calculations procedurally. In this way, students follow procedures commonly used to complete math assignments, and it becomes standard for math assignments to be completed with specific calculations.

Written Mathematical Communication

Relational thinking test given to 28 students. The written mathematical communication test questions in essay form consist of 1 question containing material on curved-sided shapes, and students are asked to find the surface area of a conical shape without a base. The written

mathematical communication test questions are the same as those tested to determine the relational thinking process. The time given to work on this question is one hour.

Based on the results of the relational thinking test, it was found that there were three students in the low category, 21 students in the medium category, and four students in the high category. Students predominantly do not write conclusions based on the results of their work. Students' written mathematical communication in solving contextual problems has various results. However, the results are the same as those of written mathematical communication, which is dominant in the medium category. This means that mathematical written communication still needs to be improved.

This is in line with research conducted by Pane et al., (2018); Rahmi et al., (2017), which shows that students' mathematical communication still needs to improve. The factors that influence this are 1) Students do not understand the material given by the teacher and do not want to ask questions; 2) Students have not been able to write down the information obtained from the questions; 3) Students are still mistaken in using mathematical symbols.

Oral Mathematical Communication

From the tests carried out previously, one student was taken from the results of written mathematical communication, each categorized as low, medium, and reasonable, to be assigned as a subject in oral mathematical communication. The following are the interview results where the questions refer to verbal and mathematical communication indicators, and the results of the tests that have been carried out are as follows.

Students with Low Written Communication Category

The percentage of students' relational thinking is 44%, and written mathematical communication is 38%. The following are the results of the analysis of relational thinking, namely Relational Thinking Indicators adapted to research in Nurrahmah (2020): 1)Students build overall relationships and determine known elements; Students do not write down the known diameter or radius and height of the cone in the problem, and students do not write down the relationships of the known elements. 2) Students build relationships through symbols, properties, or rules to find unknown numbers. The student did not write down what was asked in the question, namely the surface area of the banana leaves needed by the mother to cover the tumpeng that the mother had made. 3) Students use relations in the form of symbols, properties, or rules to find unknown numbers. Students work on the questions wholly and correctly, using the formula for the surface area of a cone without a base to solve the problems in the questions. 4) Students rationalize relationships in the form of symbols, properties, or rules used; Students do not write conclusions from the results of the work they have done. Written Mathematical Communication Indicators adapt property (Fitriyani & Khasanah, 2017): 1) Create mathematical situations by conveying concepts and information in writing; Students do not write down the diameter, radius, and height of the cone in the problem. 2) Describe the problem situation; Students do not write down the problems or what is asked in the questions. 3) Expressing a mathematical concept and its solution using a comprehensive representation: Students work on the questions correctly and completely by using the formula for the surface area of a cone without a base to solve the problems in the questions. 4) Use mathematical language and symbols appropriately; Students work on questions using symbols and mathematical language correctly. 5) Expressing the solution to the problem algebraically using pictures, tables, or charts; Students do not use pictures to solve the problem. 6) State the results in written form; Students do not write conclusions from results of their work.

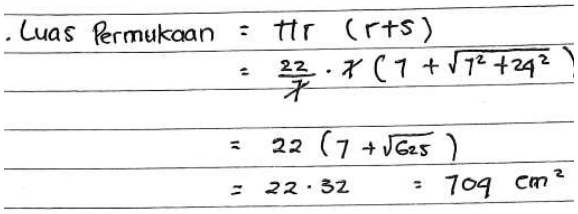

Figure 1. The results of students' work are in the low category

After conducting interviews, the results were obtained: students had a 75% percentage and were in the medium category for oral mathematical communication. The results of the interview are to determine students' oral mathematical communication abilities, namely indicators of oral mathematical communication that adapt property (Fitriyani & Khasanah, 2017): 1) Providing solutions to specific problems; Students state the known diameter, radius, and height of the cone in the problem. 2) Convey the answer to a problem using tables, pictures, models, etc.; students use the formula for the surface area of a cone without a base that has been studied previously but does not use pictures to convey answers or solve problems in the questions. 3) choose the most appropriate solution for solving the problem. At first, students find out what shape the geometric shapes are in the problem; then, students work using the formula for the surface area of a cone without a base studied previously. 4)Provide opinions or suggestions to answer questions more easily. The student said that there was no other way to solve the problem. 5) Convey convincing arguments to answer questions or statements raised by the audience; students said that the main points of the question were things that were known and asked about in the question. 6) Can interpret and evaluate concepts, symbols, terms, and mathematical information. The student conveys the area of banana leaves the mother needs to cover the tumpeng the mother has made or the conclusion of solving the problem in the question.

Students with Medium Written Communication Category

The percentage of students' relational thinking is 63%, and written mathematical communication is 63%. The following are the results of the analysis of relational thinking, namely Relational Thinking Indicators adapted to research: 1) Students determine known elements and build overall relationships; Students write the known length, diameter, and height of the tube in the problem, but students do not write down the relationship of the known elements. 2) Students build relationships through symbols, properties, or rules to find unknown numbers. The student wrote down what was asked in the question, namely the surface area of the banana leaf needed by the mother to cover the tumpeng that the mother had made, but the student wrote it incompletely. 3) Students use relations in the form of symbols, properties, or rules to find unknown numbers. Students work on the questions wholly and correctly using the formula for the surface area of a cone without a base to solve the problems in the questions. 4) Students rationalize relationships in the form of symbols, properties, or rules used; Students do not write conclusions from the results of the work they have done. Written Mathematical Communication Indicators that adapt property (Fitriyani & Khasanah, 2017): 1) Create mathematical situations by conveying concepts and information in writing; Students write down the diameter and height of the cone in the problem. 2) Describe the problem situation. Students write about the problems or things asked about in the question. 3) Expressing a mathematical concept and its solution using a comprehensive representation: Students work on the questions wholly and correctly, using the formula for the surface area of a cone without a base to solve the problems in the questions. 4) Use mathematical language and symbols appropriately; Students work on questions using symbols and mathematical language correctly. 5)

Expressing solutions to problems algebraically using pictures, tables, or charts; Students do not use pictures to solve the problem. 6) State the results in written form; Students do not write conclusions from the results of their work.

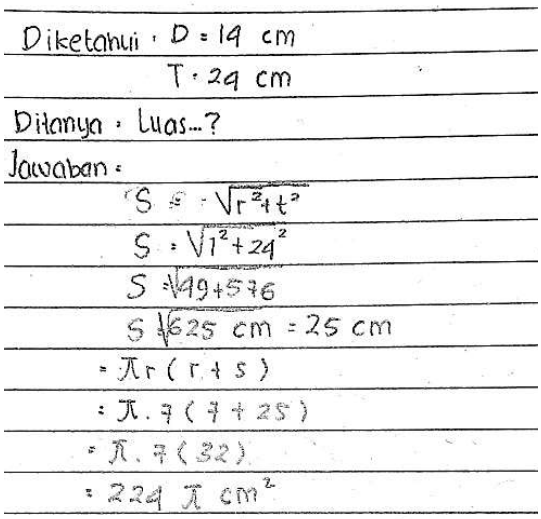

Figure 2. The results of students' work in the medium category

After conducting the interview, the results were obtained: students had a percentage of 92% and were categorized as good in oral communication. The results of the interview are to determine students' oral mathematical communication abilities, namely indicators of oral mathematical communication that adapt property (Fitriyani & Khasanah, 2017): 1) Providing solutions to specific problems; Students state the length, diameter, and height of the tumpeng that Mother has made or constructed a conical space as well as the formula for the surface area of a cone. 2) Convey the answer to a problem using tables, pictures, models, etc.; students use the formula for the surface area of a cone without a base that has been studied previously but does not use pictures to convey answers or solve problems in the questions. 3) choose the most appropriate solution for solving the problem. At first, students find out the geometric shapes in the problem, and then they understand what is being asked about in the problem. Then, students worked using the formula for the surface area of a cone without a base, which had been studied previously. 4) Provide opinions or suggestions to answer questions more easily. The students said there was another way to solve the problem: without looking for the slanted side of the cone first but working directly using the formula for the surface area of a cone without a lid. 5) Convey convincing arguments to answer questions or statements raised by the audience; students said that the main points of the question were things that were known and asked about in the question. 6) Can interpret and evaluate concepts, symbols, terms, and mathematical information. Students convey the surface area of banana leaves needed by the mother to cover the tumpeng that has been made.

Students with Good Written Communication Category

The percentage of students' relational thinking is 81%, and written mathematical communication is 94%. The following are the results of the analysis of students' relational thinking and mathematical communication, namely Relational Thinking Indicators adapted to research: 1) Students determine known elements and build overall relationships; Students write the known diameter, radius, and height of the cone in the problem, but students do not write down the relationship of the known elements. 2) Students build relationships through symbols, properties, or rules to find unknown numbers. Students write down what is asked in the question, namely the surface area of the banana leaves needed by the mother to cover the tumpeng that has been made. 3) Students use relations in the form of symbols, properties, or rules to find unknown numbers. Students work on the questions wholly and correctly, using the formula for the surface area of a cone without a base to

solve the problems in the questions. 4) Students rationalize relationships in the form of symbols, properties, or rules used; Students write conclusions from their work results. Written Mathematical Communication Indicators that adapt property (Fitriyani & Khasanah, 2017): 1) Create mathematical situations by conveying concepts and information in writing; Students write down the cone's diameter, radius, and height in the problem. 2) Describe the problem situation. Students write about the problems or things asked about in the question. 3) Expressing a mathematical concept and its solution using a comprehensive representation: Students work on the questions wholly and correctly, using the formula for the surface area of a cone without a base to solve the problems in the questions. 4) Use mathematical language and symbols appropriately; Students work on questions using symbols and mathematical language correctly. 5) Expressing solutions to problems algebraically using pictures, tables, or charts; Students use pictures to solve the problem. 6) State the results in written form; Students write conclusions from the results of their work.

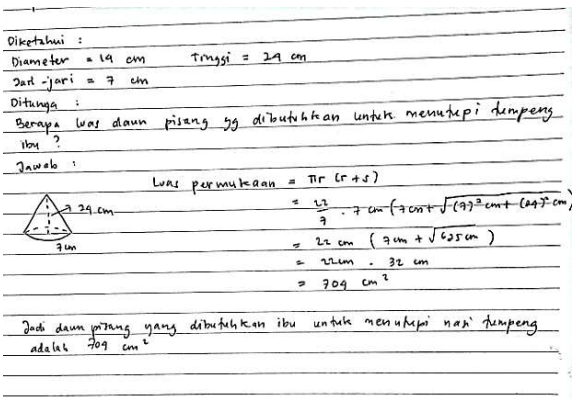

Figure 3. The results of the student's work are in the excellent category

After conducting interviews, the results were obtained: students had a percentage of 96% and were categorized as good in oral communication. The results of the interview are to determine students' oral mathematical communication abilities, namely indicators of oral mathematical communication that adapts property (Fitriyani & Khasanah, 2017): 1) Providing solutions to specific problems; Students state the length, diameter, radius, and height of the cone as well as the formula for the surface area of the cone. 2) Convey the answer to a problem using tables, pictures, models, etc.. Students use the formula for the surface area of a cone without a base studied previously and use pictures to convey answers or solve problems in the questions. 3) choose the most appropriate solution for solving the problem. At first, students find out what geometric shapes are in the problem, then understand what is being asked in the problem. Then, students worked using the formula for the surface area of a cone without a base, which had been studied previously. 4) Provide opinions or suggestions to answer questions more easily. The students said there was another way to solve this problem, namely by first calculating the slanted side of the cone. 5) Convey convincing arguments to answer questions or statements raised by the audience; students said that the main points of the questions were things that were known and asked about the questions, as well as the results of the work. 6) Can interpret and evaluate concepts, symbols, terms, and mathematical information. The students convey the surface area of the banana leaves needed by the mother to cover the tumpeng that was made previously.

Research results related to relational thinking align with the research Kurniawan & Rudhito, (2016), which states that students are used to working on mathematical problems procedurally, so they still have difficulty thinking relationally when solving contextual problems. When solving problems, students only focus on the procedures they have done before and use predetermined methods, namely solving problems

in a certain way. This is also in line with Pratiwi, Yulianti, and Fitrianna (2018) that many students still need to work on questions because they need help understanding the material previously taught. During the problem-solving process, the most critical steps are identification and understanding. Students will quickly solve mathematical problems when relational understanding is embedded in them. This is demonstrated by students being able to understand problems, plan solutions, and check the results of their answers. Students in this group only have instrumental understanding abilities because students need help explaining the reasons for each completion step.

Based on the research results, the number of students in the written mathematical communication category is low. This is in line with the research Pane et al., (2018), which states that mathematical terms, symbols, notation, and structures are used less in the problem-solving process by students with low abilities and are less able to communicate mathematical concepts in other forms such as pictures and everyday language. Research results Ahmad & Nasution, (2018) show that students who are less able to communicate mathematically are less able to understand mathematical concepts using pictures. Overall, students' written mathematical communication is in the medium category. This aligns with the research Maryati et al., (2022), which states that students can understand, interpret, and evaluate mathematical concepts visually, written, and verbally. Students whose mathematical abilities do not meet the indicators write mathematical modeling and use pictures, algebra, and mathematical symbols to write mathematical ideas (Hodiyanto, 2017). The students' mathematical communication category results in the excellent writing category align with the research Septian et al., (2020), which states that students can understand, interpret, and evaluate mathematical concepts visually, in writing, and orally. This aligns with the research Septikayanti et al., (2022), where students who can communicate mathematically well can master writing well and in categories and use mathematical symbols correctly and precisely to write mathematical situations or ideas. Apart from that, based on the results of this research it is in line with research conducted by Kurniawan and Rudhito (2016) and Nafiah et al. (2022), which shows that students still have difficulty solving contextual problems using relational thinking. This is because students are familiar with procedural mathematical calculations. As a result, when they solve problems, they focus on procedures they have used consistently, and it becomes second nature that math problems must be solved with specific calculations.

■ CONCLUSION

The results of the research show that students in the low category of relational thinking processes are still incapable of meeting indicators; apart from that, he is still unable to communicate mathematically, but the results of the analysis of oral mathematical communication as classified in the medium category. Meanwhile, students categorized as moderate in the relational thinking process can only fulfill several indicators and must be able to communicate mathematically. However, according to the analysis of oral mathematical communication results, they are in a suitable category. Students in the high category of relational thinking processes cannot build relationships as a whole and can communicate well mathematically, both in written and oral communication.

Students who have solved problems using indicators of relational thinking and mathematical communication can solve problems entirely and correctly, but some things could still be improved. Meanwhile, students who have not solved problems using indicators of relational thinking and mathematical communication skills are due to inadequate thinking and forgetting the steps to

solve them according to indicators of relational thinking and mathematical communication skills, while students who cannot solve problems using indicators of relational thinking and mathematical communication skills because there is no motivation and enthusiasm in learning mathematics.

Based on this preliminary research, more in-depth research is needed to optimize students' relational thinking and mathematical communication skills. Educators are expected to be able to implement innovative learning as an effort to improve students' mathematical communication and pay more attention to groups of students in the low category so that these students are included in achieving learning goals.

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