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Analysis of the Mathematical Reasoning Ability of Grade 8th Students on Triangular Materials

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Abstract: One of the basic skills in mathematics education is mathematical reasoning, which is essential to help students acquire the critical and logical thinking skills they will need in the future, especially in understanding and solving geometric difficulties such as the idea of triangles. This research is qualitative descriptive research that aims to describe the mathematical reasoning ability of grade VIII students of SMP Negeri 25 Pekanbaru. The data collection technique in this study is in the form of a description test instrument of 6 questions and interviews. Data analysis techniques are carried out by data reduction, data presentation and conclusions. Based on the results of the study, it was obtained that the average mathematical reasoning ability of students was 45.50% with a fairly good category. The highest indicator of reasoning ability is the ability to perform calculations based on certain rules or formulas of 94% with very good criteria. The lowest indicator of reasoning ability is in the indicator of checking the validity of an argument of 23% with a low criterion.

Keywords: Mathematical reasoning ability, Triangle, Learning

1. Introduction

In general, education is a process that can develop everyone's potential into the best version of themselves to live and survive. Therefore, being educated is very important because it can shape human beings into helpful people for both the State, Nusa and the Nation (Alpian et al., 2019). The purpose of education is to improve the quality of human resources. One way to develop people's ability to use their intellect to solve problems and build a bright future is through education. (Yusdiana & Hidayat, 2018). If educational goals are to be seen as an aspect, then these goals must be the primary foundation for all educational actions to produce the expected results. All educational efforts that are not in line with the goals must be avoided and considered inappropriate. (Noor, 2018).

Student interaction with teachers and learning materials in the classroom is called learning (Suardi, 2018). Mathematics learning is taught in schools as one of the compulsory subjects (Nababan, 2020). Mathematics is one of the sciences in the school curriculum that can foster the development of methodical, logical, and creative thinking skills in mastery of data and knowledge (Ramdan & Lessa Roesdiana, 2022). This shows that students' understanding of mathematics and mathematical concepts will increase if they experience the

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subject more often (Ariawan & Zetriuslita, 2021). Therefore, students must study mathematics well and acquire mathematical knowledge as early as possible. However, mathematics is also a subject that, in practice, is still considered challenging for students to understand and even feared by most students (Nurkhaeriyyah et al., 2018).

In mathematics learning, many things must be mastered by students, one of which is the ability to reason. Reasoning is an activity or process of thinking to draw conclusions or make new statements based on previous statements and the truth that has been stated. Improving students' mathematical reasoning skills needs to be supported by the right learning approach to achieve learning goals. (Sumartini, 2015). Therefore, for students to deepen the concepts and process of building their knowledge in mathematics, teachers must be able to support the development of students' reasoning skills. (Burais et al., 2016).

Mathematic reasoning skills have a significant impact on the way students learn mathematics. Because students with solid mathematical reasoning skills will quickly understand the mathematical content, and students with weak mathematical reasoning skills will have difficulty understanding it (Tukaryanto et al., 2018). A person with mathematical reasoning skills can reason logically when drawing general or specific conclusions about the activities of the learning process. (Oktaviana & Aini, 2021).

However, in reality, many classroom teaching still fail to develop students' mathematical thinking capacity, so their mathematical reasoning skills are limited. (Komala & Rismayanti, 2017). The low mathematical reasoning ability of students will have an impact on how well they learn. (Monariska, 2018). The lack of active participation of students in the learning process that teachers apply in the classroom is one of the causes of students' low mathematical reasoning skills. (Burais et al., 2016).

In Mathematics, all materials can be used to measure reasoning ability. However, geometry seems to be the most relevant choice because of its distinctive material properties. Geometry is a branch of mathematics taught to help students understand the properties and relationships between geometric elements and be good problem solvers. (Muslimin & Sunardi, 2019). On the other hand, good mathematical reasoning skills are needed in mathematics, especially triangular materials, so that students can solve mathematical problems correctly and precisely. One of them is when students are asked to determine whether the triangle is straight, compare the sides, determine the area, determine the congruence of the triangle, and solve triangular problems in daily life. These materials certainly require a good level of reasoning so that students can solve problems correctly and precisely.

Developing reasoning skills cannot be separated from thinking, which is observing mathematical phenomena, making guesses, testing generalizations, and providing logical reasons for conclusions. (Linola et al., 2017). Based on the material and characteristics of the students in this study, the indicators of mathematical reasoning ability used by the researcher are: (1) Performing calculations based on specific rules or formulas; (2) Ability to perform mathematical manipulation; (3) Finding patterns or properties of mathematical phenomena to make generalizations; (4) Ability to compile a book, provide reasons/blind to the truth of the solution; (5) Checking the validity of an argument; (6) Ability to conclude from statements.

Based on the description above, the objectives of this study include the following: determining the level of mathematical reasoning ability of grade VIII students of SMP Negeri 25 Pekanbaru on triangular material in solving mathematical reasoning ability test questions.

2. Research methods

This qualitative descriptive research aims to describe students' mathematical reasoning skills in solving triangular material problems. The research subjects were 25 students in grade VIII.1 of SMP Negeri 25 Pekanbaru. The determination of subjects was carried out using random sampling techniques. The research instruments used in this study are mathematical reasoning questions, as many as six questions and interviews.

The data analysis used in this study is qualitative. Qualitative data analysis consists of three flows, namely, (1) Data reduction, (2) Data presentation, and (3) Concluding. The researcher used a modified percentage formula to determine the value of the mathematical reasoning ability test sheet. (Akbar, 2017) That is:

$$P = \frac{TSe}{TSh} \times 100\%$$

The caption is the percentage of practicality, the total empirical score, and the expected maximum score. The assessment criteria for the mathematical reasoning ability test sheet are presented below:$PTSeTSh$

Table 1 - Criteria for Mathematical Reasoning Ability

Value	Criterion
$81\% - 100\%$	Excellent
$61\% - 80\%$	Good
$41\% - 60\%$	Pretty Good
$21\% - 40\%$	Low
$0\% - 20\%$	Very Low

(Riduwan, 2016)

Table 1 explains the range of scores and criteria obtained by students in terms of mathematical reasoning; for cases whose scores are not included in the Riduwan criterion score, they will follow the rounding conference to meet these criteria.

3. Results and discussion

3.1 Result

The research was conducted in class VIII.1, providing a test instrument for mathematical reasoning questions in triangular matter problems.

Table 2 - Students' Mathematical Reasoning Ability Scores

	Indicators/Questions						Total Average Percentage
	1	2	3	4	5	6	
Sum	94	51	38	36	31	23	45,50 %
Average Percentage	94%	51%	38%	36%	31%	23%	

Table 2's results showed that the average percentage of mathematical reasoning ability of grade VIII.1 students in triangular material was 45.50%, with relatively good criteria. The average percentage of students' mathematical reasoning ability is highest in question 1, with an indicator of calculating based on specific rules or formulas, 94% with perfect criteria. The lowest indicator is in question number 6, with the indicator checking the validity of an argument, which is 23% with a low criterion.

Based on Table 2, there are three criteria obtained by students, namely, indicator one obtained 94% with perfect criteria; for indicator two, 51% with pretty good criteria; and for indicators three, four, five and six, respectively, 38%, 36%, 31% and 23% with low criteria.

3.2 Discussion

Based on the analysis results from Table 2, reasoning question number 1 obtained a score of 94% with perfect criteria; on average, students correctly answered reasoning question number 1. The first question item with an indicator performs calculations based on a certain number or formula. It can be seen in Figure 1 that the student can solve reasoning problems well. The student was able to describe a right triangle, determine the length of the oblique side of the PQR triangle, determine the height of the XYZ triangle, compare the ratio of the sides of the PQR and XYZ triangles and the student was also able to deduce the right triangle of the PQR and the right triangle XYZ of the same building.

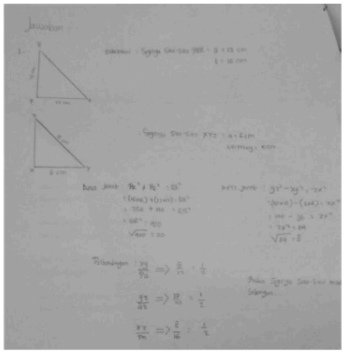

Figure 1 - Students' answers to question number 1

However, five students made several mistakes in answering the number one reasoning question. In determining the height or oblique side of the triangle, students make a mistake in determining the concept of the Pythagoras theorem. When looking for the slanted side of a PQR triangle that should use the concept of $PR^2 = PQ^2 + RP^2$, However, students are less careful about making the formula to be. Students also made a mistake when comparing the triangle side ratio formula. They were supposed to compare the height of the PQR triangle with the XYZ triangle, but the students compared the height of the PQR triangle to the beveled side of the XYZ triangle. $PR^2 \times RQ^2 = QR^2$Is is in line with the statement by Lestari, Aripin & Hendriana (2018) Lack of thoroughness in reading questions and calculations and not remembering formulas.

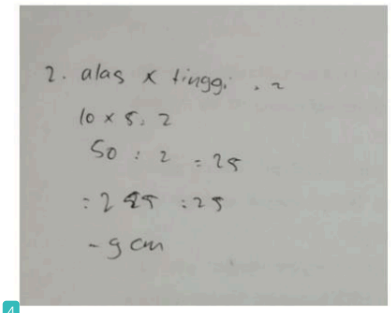

Figure 2 - Students' answers to question number 2

The second question item is an indicator of the ability to manipulate data. Based on Table 2 of 51% with quite good criteria, in answering the question, students have obtained calculation results, determining the area of the triangle and the number of triangles. However, out of 25 students, only five were able to write the concept of the area of the triangle correctly; the other 16 students were still not correct in writing the concept of the area of the triangle. This was also expressed by Darmawan et al., (2018) In his research, the use of wrong concepts, lack of background knowledge and reasoning, and mistakes in calculating basic operations still occur in students. Segitga has a formula. $l = \frac{a \times t}{2}$Many students experience mistakes in writing the formula for the area of a triangle by writing $l = a \times t : 2$. This is in line with the statement by Awwalin, (2021) The lack of students' ability to understand the problems that are being given is the cause of these mistakes. A total of 4 students could not answer how many triangles were needed to fill the area of the combined triangle, and there

were still many students with an error in giving the unit of area of a triangle. Students also do not understand what is considered and asked in the questions. This causes students to be unable to solve problems correctly.

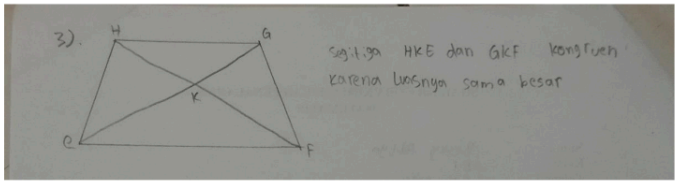

Figure 3 - Student's answer to number 3

The third question item with indicators finds patterns or properties of mathematical phenomena to make generalizations. Based on Table 2, 38% have a low category. In the third reasoning question, it can be said that not all students were able to answer the question correctly. On average, students only answered questions by describing isosceles trapezoids; some other students answered questions using the properties of isosceles trapezoids and triangular congruence properties that were not precise and correct, and some students did not answer question number three. This is due to a lack of understanding of mathematical concepts; students do not understand the basic mathematical concepts needed to answer reasoning problem number three. Anisa et al. (2021) It is stated that understanding concepts is very important in solving mathematical problems. Students will be hampered in mastering other mathematical materials if their understanding of concepts is not good.

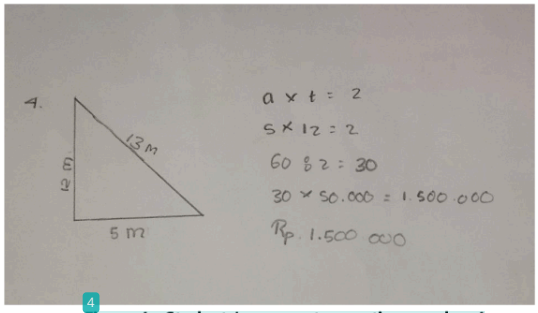

Figure 4 - Students' answers to question number 4

The fourth question item indicates the ability to compile evidence, providing reasons/evidence for the truth of the solution. Based on Table 2, 36% have low criteria. Only two students can state questions in the form of pictures and writing, determine the area of the garden, determine the costs needed to build the park, and provide the right reasons to compare the costs and existing funds. 2 students could answer reasoning questions quite accurately by doing the same steps. However, the student did not explain the comparison of the price obtained with the available funds. Students who think this way often behave hastily in action. In the context of reasoning, this kind of thinking model falls into the category of early impulsive thinking. (Shodiqin & Zuhri, 2018). However, in answering the number four reasoning question, students often make several mistakes, among others, making mistakes in calculating the area of a triangle, making mistakes in multiplication calculations, and not determining the unit of area. Impulsive students have the advantage of being quick to answer questions. However, the impulsive students' mathematical reasoning ability is due to limitations, including inadequate mastery of the content, lack of complete answers, answering questions

without providing all the necessary evidence, and lack of interaction during the learning process (Rohmah et al., 2020).

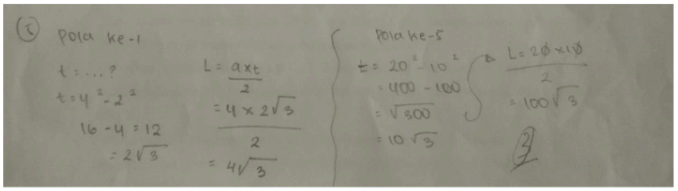

Figure 5 - Students' answers to question number 5

The fifth question item indicates the ability to conclude from statements. Based on Table 2, of 31% with low criteria answering the question, only eight out of 25 students can answer question number 5. The student can determine the height and area of the triangle in the first and fifth patterns. However, while answering question number 5, the students did not conclude from the results of the broad calculation in the fifth pattern; they only wrote the final answer results. Students with such characteristics usually have the potential to have numerical thinking skills superior to reasoning. (Indrawati, 2015). Initially, a math student will prefer to choose to count. This is because counting, a type of numerical intelligence, does not require a high-level thinking process. However, incentivized experiences and exercises will encourage students to reason. (Irawaan, 2015). A total of 5 students could only determine the height or area of the first triangle pattern. As many as 12 students did not answer reasoning question number 5 due to the lack of students' problem-solving strategies in answering patterned questions, making them confused about where to start.

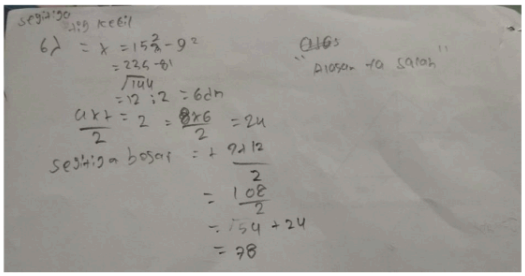

Figure 6 - Students' answers to question number 6

The sixth question item with an indicator checks the validity of an argument. Based on Table 2 of 23% with low criteria, only 9 out of 25 students could answer question number 6 with sound reasoning. The student can determine the height of the small and large triangles, the student can determine the area of the large and small triangles, and the student can also determine the combined area of the right triangle by adding the two triangle areas. However, in work on reasoning problem number 6, the students still made many mistakes in writing the concept of the area of the triangle, the formula of the Pythagorean theorem in determining the height of the large or small right triangles, and some students did not write down the units in answering the questions. As many as 16 other students did not answer reasoning question number 6 because students had difficulty answering questions with high categories. Students who struggle with basic concepts, cannot turn problems into mathematical models, and are used to doing calculations regularly are all the causes of their low reasoning skills (Isnaeni et al., 2018).

Based on the analysis of reasoning questions one to six, it was concluded that the average student could do questions one and two in the category of easy questions. However, students could not do reasoning

problems four to six in difficult questions. This may be an input in the future that students need to get used to working on reasoning problems with medium and complex categories.

4. Conclusion

Based on the analysis of the research data discussed, the average mathematical reasoning ability of grade VIII students on triangular material is 45.50%, with relatively good criteria. The highest indicator of reasoning ability is the ability to perform calculations based on specific rules or formulas, 94% with perfect criteria, and the lowest indicator of reasoning ability is the indicator of checking the validity of arguments, 23% with low criteria.

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