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Analysis of Students' Critical Thinking in Problems Solving on Curved-Sided Spherical Figures

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Abstract

Curved-side spatial structures are one of the geometry materials taught at the junior high school/Islamic junior high school level, especially in class IX. Completing questions up to the room side arch can help students finish problems contextual to others. Training students' critical thinking skills in solving a mathematical problem is one of the tasks of a mathematics teacher. From the data from the researcher's interview with the mathematics teacher of grade IX students of Palu Christian Middle School, information was obtained that the teacher had carried out learning activities with various strategies to train students' critical thinking skills in solving mathematical problems. However, students' critical thinking skills did not change, and there was no increase. This study aims to obtain a clear description of the critical thinking skills of grade IX students in solving mathematical problems. This research is a qualitative study. The data collection methods used in this study were test and interview methods. The critical thinking indicators used were focus, reason, inference, situation, clarity, and overview. This study involved 28 Palu Christian Middle School students in the odd semester of the 2022/2023 Academic Year. Three students were selected as research subjects, where one student represented each level of mathematical ability, namely high mathematical ability (ST), medium mathematical ability (SS), and low mathematical ability (SR). The results of this study indicate that students with high mathematical ability meet all critical thinking indicators. Students with moderate mathematical abilities fulfill several indicators of critical thinking, namely focus, clarity, and overview. Students with low mathematical abilities fulfill several indicators of critical thinking, namely clarity and overview.

INTRODUCTION

Mathematics is essential in developing patterns, thinking logically, and critical skills. Mathematics is a subject that can train students to develop critical, logical, and creative thinking (Amalia, et al. 2015). Therefore, mathematics is essential and needed by students to build competence in themselves, one of which is critical thinking skills, so that mathematics subjects can play a role in helping students train their critical thinking skills to solve contextual problems in everyday life.

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Minister of Education and Culture Regulation Number 16 of 2022 states that one of the goals needed in mathematics learning is to create individuals who have logical, critical, analytical, careful, thorough, responsible, responsive, and never give up attitudes. According to Agnafia (2019), critical thinking is the ability to analyze situations based on facts and evidence to obtain a conclusion. In other words, critical thinking is a rational and reflective process that allows students to analyze problems in making decisions and evaluating decisions according to what is believed and done. Students with critical thinking skills do not just believe in facts without proving it and try to prove that the information is valid and accountable. Students will explore what they learn to find the relationship between the information obtained in solving a problem. Mathematics is an abstract idea or concept arranged hierarchically, and reasoning is deductive. Therefore, not all students always succeed in achieving mathematics learning goals. Mathematics learning goals can be achieved when viewed in terms of knowledge and skills, one of which is assessed from students' success in solving mathematics problems.

Practicing critical thinking skills allows students to get used to facing challenges and solving problems by analyzing their thoughts to decide on a choice and correctly draw conclusions. Therefore, students with critical thinking skills can solve mathematical problems, analyze problems, and utilize the information they have to solve them.

Learning about mathematics is not enough by memorizing because mathematics is not a historical science that is enough by memorizing. As we know, learning mathematics requires thinking critically, logically, carefully, creatively, systematically, effectively, and efficiently. However, the reality is that many students, when solving problems, cannot process the information in the problem correctly, which causes students to have difficulty solving problems. Ennis (1996) "Critical Thinking is reasonable, reflective thinking that is focused on deciding what to believe or do," or critical thinking is reflective and reasonable thinking that focuses on deciding what to believe or do, meaning that critical thinking skills are the ability to link previous understanding, reason and have cognitive strategies to generalize and prove or evaluate a decision reflectively. Students must be able to think critically to avoid making mistakes when making decisions and solving contextual problems in everyday life. Activities in learning mathematics are expected to help students solve mathematical problems using critical thinking.

Critical thinking is an essential competency that is important for students, so every student is expected to have a logical, critical, analytical, consistent, and careful attitude, be responsible responsive, and not give up easily when solving problems. Solving a problem is a process of training and forming a person's critical thinking skills. Problem-solving is related to critical thinking skills. Through learning to solve a problem, students can form their way of thinking analytically, logically, and deductively, which are components of critical thinking skills. Geometry material is one of the compulsory subjects at every level of education, from simple to complex. Amelia, et al. (2021) stated that geometry fosters students' mathematical thinking processes and dramatically influences other subject matter in mathematics, so geometry plays a role in almost every subject in mathematics lessons. This material is used to understand arithmetic, algebra, calculus and others well, so that students' abilities in geometry are expected to be mastered in depth. Curved side space is one of the geometry materials taught at the junior high school/MTS level, especially in grade IX.

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Students often encounter application material in life, so by completing questions and getting up the room side, students can practice finishing problems contextual to others. Mathematics teachers at the Salvation Army Christian Middle School in Palu said that the material on curved-sided solids is often considered difficult by students because solving the problems requires several steps and a long time, so students need to think critically to solve the problems on curved-sided solids. The material on curved-sided solids is one of the mathematical materials that can be used to train critical thinking skills because this material requires the ability to analyze, evaluate, create, or design a way to solve the problem. Training students' critical thinking skills in solving a mathematical problem is one of the tasks of a mathematics teacher.

From the data from the researcher's interview with the mathematics teacher of grade IX students of the Salvation Army Christian Middle School in Palu, information was obtained that the teacher had carried out learning activities with various strategies to train students' critical thinking skills in solving mathematical problems. However, students' critical thinking skills did not change, and there was no increase. Seeing the problems that occur in schools, it is necessary to clearly describe the critical thinking skills of grade IX students in solving mathematical problems. This will be learning information and understanding for students and teachers in designing learning strategies according to students' critical thinking skills to train students in solving mathematical problems. Based on the description above, the researcher concludes that students' critical thinking skills in solving a problem or issue, especially in solving mathematical problems, are essential for every student, so teachers need to know how critical thinking skills students have.

Therefore, the researcher is motivated to conduct research related to students' critical thinking skills, so the title of this study is "Analysis of Students' Critical Thinking in Solving Curved Side Space Problems in Grade IX Students of Palu Christian Salvation Army Middle School." Based on the description of the background presented, the formulation of the problem in this study is, how do IX grade students of Palu Christian Salvation Army Middle School think critically in solving curved side space problems?

The purpose of this study is to obtain a description of the critical thinking of grade IX students of SMP Kristen Bala Keselamatan Palu in solving problems of curved side solids. The study benefits for students are that students can apply and improve critical thinking in solving mathematics problems, especially on the material of curved side solids, and can improve their learning achievement in class. Teachers use it as a reference by teachers in designing learning strategies that can train students' critical thinking, which is the level of mathematical ability possessed by students so that they can get used to thinking critically in solving a problem or mathematical problem. For researchers to increase the researcher's insight or knowledge regarding critical thinking possessed by students, and can be a reference for other researchers who research critical thinking skills in solving mathematics problems.

METHODS

The type of research conducted is qualitative descriptive research because this study aims to explore students' critical thinking skills in solving problems on curved side space material naturally and more deeply. This qualitative research approach aims to describe or analyze the

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critical thinking skills of the subjects studied through data or samples that have been collected as they are.

This research was conducted at the Salvation Army Christian Middle School Palu, Jalan Towua No.80, South Palu District, Palu City, Central Sulawesi Province. This research was conducted in the odd semester of the 2023/2024 academic year. The data collection instruments used were test sheets and interviews. The subjects in this study were three students from class IX A of the Salvation Army Christian Middle School Palu with high, medium, and low mathematics abilities. The subjects of this study were selected based on the scores obtained when working on the test questions and several considerations with subject teachers.

RESULTS AND DISCUSSION

Subjects with high mathematical abilities in solving curved side space problems, in the focus criteria, subjects with high mathematical abilities mention the main points/core of the problem correctly. This is in line with the opinion of Afandi (2016) that students with high mathematical abilities read problems clearly and can determine the main problem by referring to what is known and asked correctly.

In the reason criterion, the subject provides the right reasons to support the conclusions he made. Then, in the inference criterion, the subject determines the initial steps in solving the problem correctly, explains the steps in more detail, and writes them neatly on the answer sheet. From the solution steps, the subject concludes with the correct answer. Thus, it can be concluded that the subject concludes correctly based on the steps for solving the curved side space problem.

Next, in the situation criteria, the subject uses all the information in the question. The subject explains that in solving the question, it is necessary to process other information before using it. This shows that the subject has used the information in the question correctly. In line with Afandi's opinion (2016), students with high mathematical abilities mention all the information used to solve the question correctly. In the clarity criteria, the subject correctly explains the terms in the question. Sa'adah argues that students can easily explain problems clearly and precisely in their language. Finally, in the overview criteria, the subject in solving the question has checked or re-checked what has been found and done by re-reading the answer from the beginning.

Based on the discussion, critical thinking of subjects with high mathematics ability in solving curved-side spatial problems includes the criteria of focus, reason, inference, situation, clarity, and overview. This is in line with what was stated by Ulfa et al. (2018), which states that high-category students can meet the critical thinking indicators of focus, reason, inference, situation, clarity, and overview.

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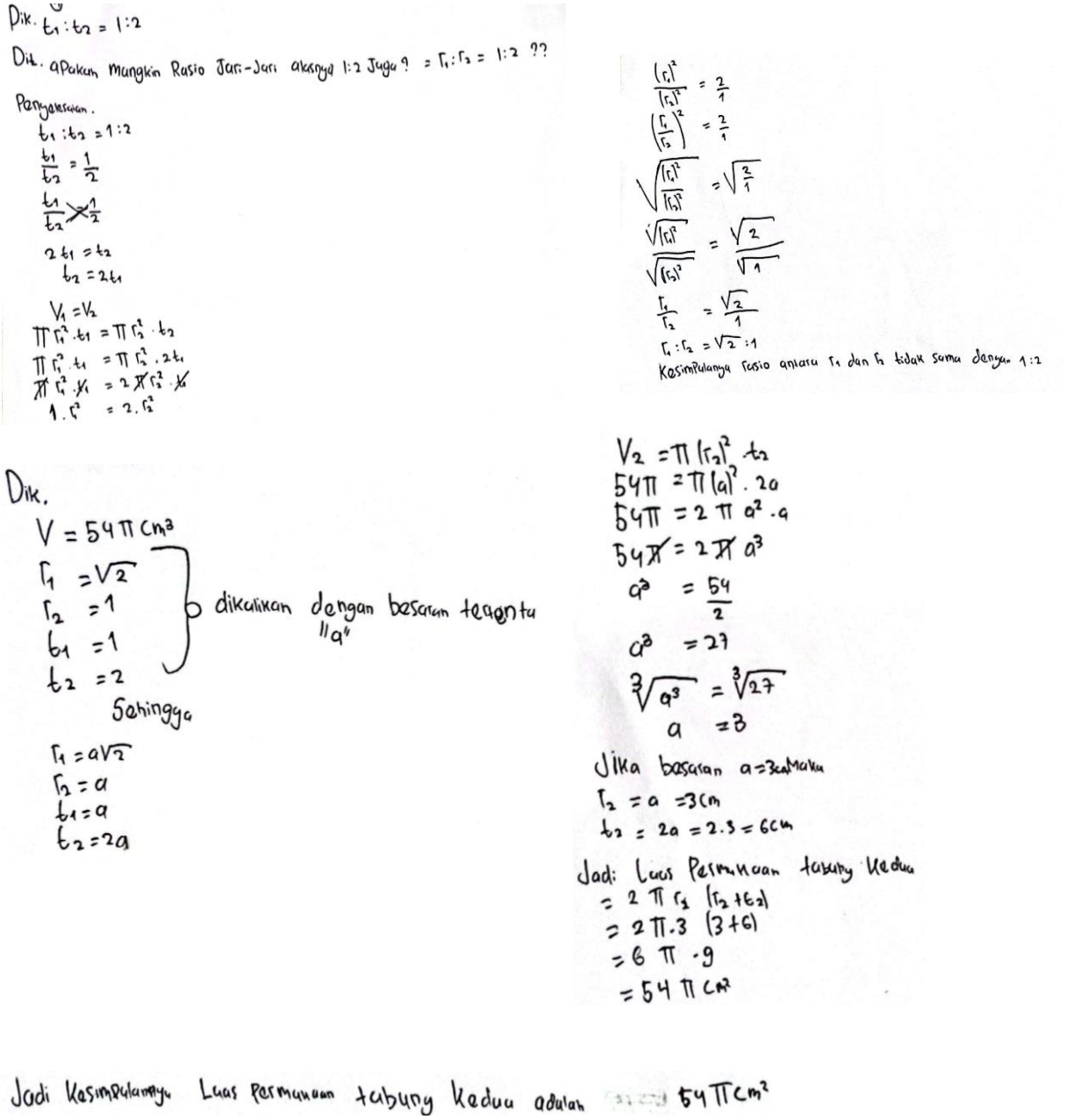

Figure 1. High Mathematics Ability Subject Answers

Such as subjects with high ability, subjects with moderate mathematical ability in solving problems with curved-sided space shapes, and subjects with moderate mathematical ability in correctly stating the central point/core of the problem. This is in line with the opinion of Afandi (2016) that students with mathematical abilities read questions clearly and can determine the main problem by referring to what is known and asked appropriately.

In the reason criterion, the subject provides the right reasons to support his conclusions, but the reasons cannot reach the truth. Then, in the inference criterion, the subject determines the initial steps in solving the problem correctly, explains the steps done, and writes them neatly on the answer sheet. From the solution steps, the subject cannot provide the correct conclusion

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based on what was asked. Thus, it can be concluded that the subject could not conclude correctly because it was wrong based on the steps of solving the curved side space problem that the subject worked on.

Next, in the situation criteria, the subject uses all the information in the question. The subject mentions all the information in the question, but while working on it, there is some information that the subject does not use and ignores its meaning. This shows that the subject has not used the information in the question correctly. In the clarity criteria, the subject correctly explains the terms in the question. In the overview criteria, the subject solving the question has checked or re-checked what has been found and worked on by re-reading the answer.

Based on the discussion, critical thinking of high-level mathematics ability subjects in solving curved-sided spatial problems includes the criteria of focus, clarity, and overview.

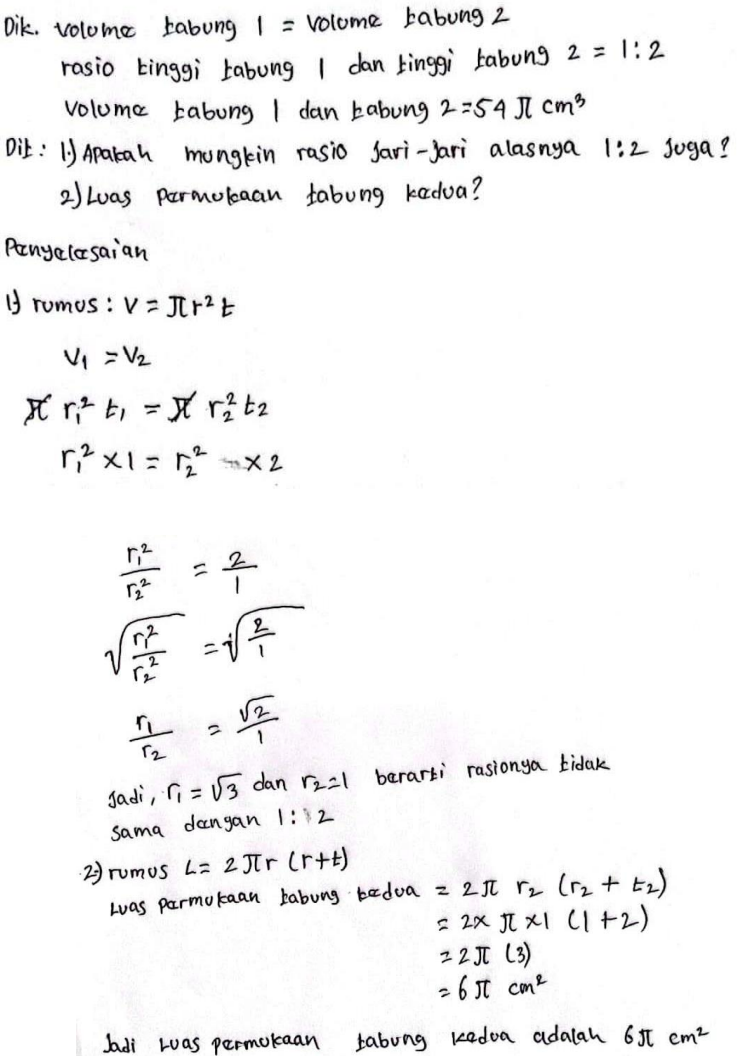

Figure 2. High Mathematics Ability Subject Answers

For subjects with low mathematical abilities in solving curved side space problems, in the focus criteria, the subject mentions the central point/core of the problem but is not precise. In the reason criteria, the subject can provide the right reasons to support his conclusions, but the

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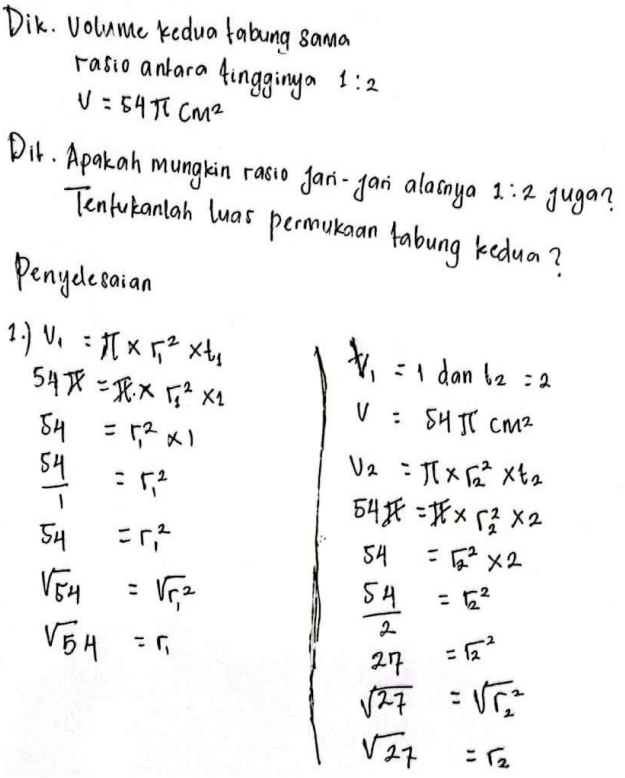
reasons cannot reach the truth. Then the inference criteria, the subject determines how to solve the problem correctly, explains the steps done, and writes them on the answer sheet. From the steps of the solution, the subject cannot provide the correct conclusion based on what was asked because the steps of the solution are not precise. This is in line with the opinion of Sa'adah (2018) that students with low abilities in solving problems are still wrong, so the conclusions produced are not yet correct. Thus, it can be concluded that the subject could not conclude correctly because the steps for solving the curved side space problem that the subject worked on were wrong.

The subject uses all the information from the question in the situation criteria. The subject mentions all the information in the question, but in working on it, there is some information that the subject ignores the meaning. Thus, the subject does not use information that is by the question. Regarding clarity criteria, the subject can correctly explain the terms in the question. In the overview criteria, the subject solving the question has checked or re-checked what has been found and worked on by re-reading the answer.

Based on the discussion, critical thinking of high-level mathematics ability subjects in solving curved-sided spatial problems includes the criteria of clarity and overview.



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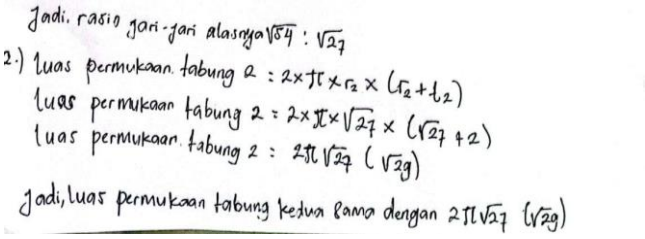

Figure 3. Low Mathematics Ability Subjects' Answers

Based on the research results that have been analyzed and discussed, it can be concluded that:

Students with high mathematical abilities fulfill all critical thinking indicators: focus, reason, inference, situation, clarity, and overview. Students with high mathematical abilities can mention (verbally or in writing) the main points/cores of the problem, namely regarding the possibility that the ratio of the base radius is the same as the ratio of its height (focus). Students also provide appropriate reasons to support the conclusions made, namely regarding the ratio of the base radius and the surface area of the cylinder (reason). Students can make accurate conclusions from the problem based on reason with steps to solve it (inference). Students also use all appropriate information to solve the problem (situation), explain the meaning of the terms contained in the problem (clarity), and check or re-check what has been found and done (overview).

Students with moderate mathematical abilities meet several indicators of critical thinking, namely focus, clarity, and overview. Students with moderate mathematical abilities can mention (verbally or in writing) the main points/cores of the problem, namely regarding the possibility that the ratio of the base radius is the same as the ratio of its height (focus). Students also provide reasons to support the conclusions made, namely regarding the ratio of the base radius and the surface area of the cylinder, but these reasons cannot reach a truth (reason). Students have been unable to make conclusions from the problem based on reason because the steps for solving it are not yet correct (inference). Students have also not used all the appropriate information to solve the problem (situation). Students can explain the meaning of terms in the problem, such as ratios and other symbols (clarity), and check or re-check what they have found and done (overview).

Students with low mathematical abilities only meet several indicators of critical thinking, namely clarity and overview. Students with low mathematical abilities have not been able to state (verbally or in writing) the main points/cores of the problem correctly, namely regarding the possibility of the ratio of the base radius being the same as the ratio of its height (focus), students provide reasons to support the conclusions made, namely regarding the ratio of the base radius and the surface area of the cylinder. However, these reasons cannot reach a truth (reason), students cannot make conclusions correctly from the problem based on reason because the steps for solving it are also not correct (inference), students have not used all the appropriate information to solve the problem (situation), students can explain the meaning of the terms contained in the problem correctly such as ratios and other symbols (clarity). Students check or re-check what has been found and done (overview).

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CONCLUSION

Students with high mathematical ability meet all critical thinking indicators (focus, reason, inference, situation, clarity, overview) in solving problems, demonstrating the ability to understand, analyze, and reflect on their work. Students with moderate ability meet some indicators, namely focus, clarity, and overview, but are not entirely correct in solving and using information. Students with low ability only meet clarity and overview but are less accurate in stating the core of the problem, providing reasons, and using relevant information to solve the problem.

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