

Mathematical Reasoning Ability of Junior High School Students during the Covid-19 Pandemic in Solving HOTS Questions for Circle Material

Haris Wahyu Pamungkas^{1, a)} and Sri Sutarni^{1, b)}

¹*Muhammadiyah University of Surakarta*

Author Emails

^{a)} *a410170037@student.ums.ac.id*

^{b)} *ss101@ums.ac.id*

Abstract. This study aims to determine the mathematical reasoning ability of junior high school students during the covid-19 pandemic in solving HOTS questions on circle material. This research uses descriptive qualitative method. The research subjects were six eight grade students at SMP Muhammadiyah 1 Kartasura. Data collection techniques using tests and interviews. Data analysis using data reduction techniques, data presentation, and drawing conclusions. The results showed that students with high mathematical reasoning abilities were able to fulfill all indicators of mathematical reasoning well and solve all questions correctly. Students with low mathematical reasoning abilities are only able to fulfill the indicators of presenting mathematical statements well and are not able to solve all questions correctly.

Keywords: Circle, Hots, Mathematical Reasoning

INTRODUCTION

Education is a conscious effort of everyone in seeking knowledge in order to develop the skills, personality and potential inherent in a person so that it will be a provision in life. According to (Karim, 2020) education is a planned awareness process in developing the ability of students to become individuals who are devoted, faithful, knowledgeable, and independent and creative. Education is part of each individual's efforts to develop and improve natural abilities in line with human social values, both physically and spiritually (Fajar et al., 2019). Education is very influential on the quality of human resources from an early age, elementary school, middle school to college. The quality of human resources can be improved through successful learning in every educational institution. The better the quality of education in a nation, the better the progress of the nation.

The National Council of Teachers Mathematics (NCTM) states that the process of learning mathematics cannot be separated from reasoning abilities. Reasoning ability is an ability to think based on logic to make new conclusions based on statements that have been proven to be true. Suherman (in Sumartini, 2015) suggests that reasoning is a process of thinking to produce conclusions. One way of logical thinking can be trained through mathematical reasoning abilities. Gardner (in Eka Lestari, 2015) reveals that mathematical reasoning is the ability to analyze, generalize, integrate, synthesize, give appropriate reasons and solve unusual problems.

Based on the survey results from the Trend International Mathematics and Science Study (TIMSS) in 2011 showed that the mathematical ability of Indonesian students was ranked 38 out of 42 participating countries with an average score of 386, still below the TIMSS average score of 500 (Mullis

et al., 2012). The average achievement of Indonesian students in TIMSS 2011 has decreased from the average achievement of TIMSS 2007 which obtained a score of 397. The cognitive domain in TIMSS 2011 which has the lowest average percentage achieved by Indonesian students is the cognitive domain of reasoning, namely by 17% (Rosnawati, 2013). This shows that the reasoning ability of students in Indonesia is still at a low level. The low reasoning ability of students needs serious attention from all elements of education

Various efforts to improve students' mathematical reasoning abilities can be done, one of which is by providing practice questions that are different from the usual examples. Questions with the Higher Order Thinking Skills (HOTS) type can be used to help improve reasoning abilities. HOTS type questions not only solve problems with standard formulas or algorithms, but encourage students to develop reasoning skills and use mathematics to solve problems of everyday life (Permana et al., 2020). According to (Nugroho, 2018) HOTS is an ability to investigate and process information in the form of facts or ideas by understanding, connecting, categorizing, and evaluating.

According to (Suryapuspitarini et al., 2018) questions with the HOTS category are questions that train high-level thinking skills and involve the reasoning process, thereby increasing logical, critical, reflective and creative thinking skills. With the HOTS type questions, the problems to be solved tend to be complex so it is possible to have more than one solution, the information on the questions uses dynamic, contextual and innovative problems so as to train students to use mathematical reasoning skills. In addition, HOTS type questions encourage students to not only memorize and seek textbook knowledge, but HOTS type questions are also expected to be used to measure the extent of students' mathematical reasoning abilities. From the statements that have been presented, it can be concluded that the HOTS questions train students to think at the higher level at the level of analysis, evaluation and creation.

This study aims to describe the mathematical reasoning abilities of eighth grade students of SMP Muhammadiyah 1 Kartasura during the covid-19 pandemic in solving HOTS type questions with circular material oriented to four indicators of mathematical reasoning, namely presenting mathematical statements, manipulating mathematics, compiling evidence or giving reasons for the correctness of the solution and draw conclusions.

RESEARCH METHOD

This research is a qualitative research with a qualitative descriptive approach. This research was conducted at SMP Muhammadiyah 1 Kartasura with the subject of class VIII students. The data was obtained from the results of tests and student interviews regarding the questions about the circle material. Sources of data in this study were students of class VIII D SMP Muhammadiyah 1 Kartasura.

Data collection techniques used in this study were tests and interviews. The test used in this study was in the form of a description of the type of circle material with a total of three questions given to the research subject. The results of students' answers are then assessed based on the assessment rubric and analyzed based on indicators of mathematical reasoning ability to determine the level of students' mathematical reasoning abilities. Interviews were conducted to seek additional information and strengthen the answers obtained by students in working on the HOTS questions on the circle material.

Data analysis techniques used in this study include data reduction, data presentation, and drawing conclusions. Data reduction is an activity to choose the main things needed in the research process. Researchers do data reduction by way of abstraction. Data abstraction is an attempt to summarize the core things, processes and statements must be maintained so that they are still in the research data (Sutama, 2019). Presentation of data is the process of a collection of information presented in a structured manner to draw conclusions. Drawing conclusions in this study is a follow-up to the analysis of the data reduction and data presentation stages that have been carried out previously.

RESEARCH RESULTS AND DISCUSSION

Based on research data that has been carried out, from the results of the written test of 25 students there are 12 student in the low category, 9 student in the medium category and 4 students in the high category. The classification of the mathematical reasoning ability criteria used is based on (Arikunto, 2013) in the table 1. below

TABLE 1. CATEGORY LEVEL OF STUDENT REASONING ABILITY

Value	Attainment of Reasoning Ability	F	Percentage
High	Score > 71%	4	16%
Medium	$42 \leq \text{score} \leq 71\%$	9	36%
Low	Score $\leq 42\%$	12	48%
	Total	25	100%

The following are the results of the discussion related to research on mathematical reasoning ability.

1. Mathematical Reasoning Ability of High-Skilled Students (S-T1)

The results of the work of S-T1 on question number 1 can be seen in Figure 1.

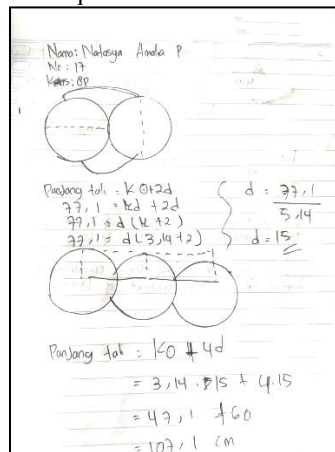


FIGURE 1. THE RESULTS OF ANSWER NUMBER 1 BY S-T1

In Figure 1. it can be seen that the subject S- T1 has completed question number 1 to completion. In the picture, the S-T1 subject immediately worked on the problem without writing down what was known and what was asked, but at the time of the interview, the S-T1 subject was able to explain the mathematical statement completely orally. The following is a snippet of the interview with the subject of S-T1.

- P : Apa yang diketahui dalam soal nomor 1 ?
- S-T1 : Diketahui Pak Jaya memiliki dua buah pipa sama besar yang diikat dengan panjang tali 77,1 cm, Pak Jaya ingin menambah satu pipa lagi di tengah-tengah dengan ukuran yang sama
- P : Kemudian apa yang ditanyakan ?
- S-T1 : Yang ditanyakan yaitu berapakah panjang tali minimum yang dibutuhkan Pak Jaya untuk mengikat tiga pipa
- P : Bagaimana penyelesaiannya ?
- S-T1 : Pertama saya mencari diameter pipanya dulu mas, habis itu kalau udah ketemu diameternya tinggal menghitung panjang tali untuk mengikat tiga pipa menggunakan rumus keliling lingkaran ditambah 2 kali diameter sama dengan 77,1 cm
- P : Apa alasan kamu menggunakan cara seperti itu ? coba jelaskan !
- S-T1 : Alasannya karena pada soal belum diketahui diameternya pipa, sehingga perlu mencari diameternya dulu kemudian busur kanan dan kiri pada pipa sama

dengan satu keliling lingkaran dan tali yang atas dan bawah itu panjangnya sama dengan diameter

P : Apakah kamu yakin bahwa jawabanmu sudah benar ?

S-T1 : Kalau menurut saya yakin sih mas

P : Terus bagaimana kesimpulannya ?

S-T1 : Jadi, panjang tali minimum yang dibutuhkan Pak Jaya untuk mengikat tiga pipa sama besar adalah 107,1 cm.

In the interview excerpt above, it can be seen that S-T1 was able to provide his argument clearly and fluently by describing what was known and what was asked. The interview excerpt shows that the subject of S-T1 is able to perform mathematical manipulation well according to mathematical concepts. In addition, the subject of S-T1 is able to explain a simple way to solve the problem in question number 1 correctly. It can be seen that the subject of S-T1 is able to explain the reasons related to the method used in providing problem solving solutions and is able to draw conclusions correctly. The results of this study are in line with research conducted (Pandu & Suwarsono, 2021) regarding the analysis of reasoning abilities student mathematics in solving math problems limit material. The results of the study stated that subjects with high ability is able to meet all reasoning indicators mathematically in solving a given problem

Based on the results of the exposure and interview excerpts, it can be concluded that the subject of S-T1 is able to fulfill all indicators of mathematical reasoning ability

2. Mathematical Reasoning Ability of Low-Skilled Students (S-R6)

The results of the work of S-R6 on question number 1 can be seen in Figure 2.

Handwritten solution for question 1 by S-R6:

$$\begin{aligned}
 D &= \pi \times k \\
 &= 3,14 \times 77,1 \text{ cm} \\
 &= 242,094 \\
 &= 77,1 + (2 \times 242,094) \\
 &= 77,1 + 484,188 \\
 &= 561,288
 \end{aligned}$$

FIGURE 2. THE RESULTS OF ANSWER NUMBER 1 BY S-R6

In Figure 2. it can be seen that the subject of S-R6 have completed question number 1 to completion. In the picture the subject S-R6 immediately worked on the problem without writing down what was known and what was asked, but at the time of the interview the subject S-R6 was able to explain mathematical statements orally. The following is a snippet of the interview with the subject of S-R6.

P : Apa yang diketahui dalam soal nomor 1 ?

S-R6 : Yang diketahui panjang tali Pak Jaya 77,1 cm untuk mengikat dua pipa

P : Kemudian apa yang ditanyakan ?

S-R6 : Berapa panjang tali minimum yang diperlukan Pak Jaya untuk mengikat tiga pipa tersebut ?

P : Bagaimana penyelesaiannya ?

S-R6 : Pakai rumus

P : Pakai rumus apa ? coba jelaskan!

S-R6 : Rumus keliling, karena ini bukan kelipatan tujuh pakainya $\phi = 3,14$ terus dikali 77,1 hasilnya 242,094

P : Sampai itu saja ?

S-R6 : Belum...terus 77,1 ditambah $(2 \times 242,094)$ ketemu hasilnya 561,288

P : Apa alasan kamu menggunakan cara seperti itu ?

S-R6 : Emm...karena saya tahunya seperti itu

- P *Apakah kamu yakin bahwa jawabanmu sudah benar ?*
 S-R6 *Kurang yakin*
 P *Terus bagaimana kesimpulannya ?*
 S-R6 *Jadi talinya harusnya panjangnya 561,288 cm.*

From the interview excerpt, it can be seen that the subject of S-R6 is able to explain a complete mathematical statement. It can be seen that the subject of S-R6 is able to describe what is known in the question and what is asked in the question. However, the subject had difficulty in finding the correct solution. S-R6 subjects are not able to manipulate mathematics correctly and completely. It can be seen that the subject of the S-R6 cannot give a clear reason for the method used. Subjects S-R6 were able to draw conclusions verbally but were incomplete and incorrect. The results of this study are in line with the research conducted (Suprihatin et al., 2018) about ability analysis mathematical reasoning of junior high school students on the material of triangles and quadrilaterals. The results showed that students in the poor category did not achieve good mathematical manipulation indicators. Many students who have difficulty understanding the questions and are confused when doing mathematical manipulation.

Based on the results of the exposure and interview excerpts, it can be concluded that the subject S-R6 is able to fulfill the indicators of presenting mathematical statements, unable to fulfill the indicators of manipulating mathematics and indicators of compiling evidence or providing reasons for the correctness of the solution, able to meet the indicators of drawing conclusions but still incomplete and incorrect.

CONCLUSION

Based on the research and discussion that has been described previously regarding the ability of mathematical reasoning in solving HOTS type questions on circle material, the following conclusions are obtained. Students with high mathematical reasoning abilities are able to fulfill all indicators of mathematical reasoning, namely presenting mathematical statements, mathematical manipulation, compiling evidence or providing reasons for the correctness of solutions, and drawing conclusions. Students with high abilities are able to understand the information referred to in the questions well and are able to solve questions correctly and completely. Students with low mathematical reasoning abilities are only able to meet the indicators of mathematical reasoning presenting mathematical statements well. Students with low abilities are not able to fulfill the indicators of mathematical manipulation correctly and completely, are unable to compile evidence or provide reasons for the correctness of the solution, and are unable to draw conclusions correctly. Students with low abilities are not able to understand the information referred to in the questions properly and are not able to solve correctly and completely on all questions.

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