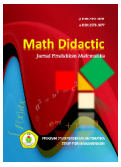

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ANALYSIS OF LOGICAL THINKING ABILITY OF STUDENTS 1G MADRASAH MU'ALLIMIN MUHAMMADIYAH YOGYAKARTA ACADEMIC YEAR 2022/2023

ANALISIS KEMAMPUAN BERPIKIR LOGIS SISWA 1G MADRASAH MU'ALLIMIN MUHAMMADIYAH YOGYAKARTA TAHUN AKADEMIK 2022/2023

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Abstract: Education is a systematic effort to develop individual abilities in the era of globalization. According to Law Number 20 Article 3 of 2003 education has a strategic function in preparing high intellectual, emotional and social abilities. Thinking ability affects success in learning. Thinking is the process of interpreting circumstances from existing premises. Logical thinking becomes a step in solving complex problems for every individual. Mathematics affects the formation of a mindset. The ability to think logically is based on indicators in making meaning, making logical connections between concepts and facts, grieving and testing concepts, solving problems rationally, and drawing conclusions. The research was conducted on seventh-grade G-class students of Madrasah Mu'allimin Muhammadiyah Yogyakarta using test and interview methods as confirmation. Student work results were analyzed descriptively and grouped into four categories in general and based on indicators. It was found that students' abilities were in the less high category with a percentage of 76.7% and based on indicators the majority were in the less high category. So, it can be concluded that student's ability to think logically is low.

Keywords: thinking, logical, mathematical, indicators

Abstrak: *Pendidikan merupakan usaha sistematis dalam mengembangkan kemampuan individu di era globalisasi. Menurut UU Nomor 20 Pasal 3 tahun 2003 pendidikan memiliki fungsi strategis dalam mempersiapkan kemampuan intelektual, emosional, dan sosial yang tinggi. Kemampuan berpikir mempengaruhi kesuksesan dalam belajar. Berpikir merupakan proses menafsirkan keadaan dari premis yang ada. Berpikir logis menjadi langkah dalam memecahkan masalah kompleks bagi setiap individu. Matematika mempengaruhi dalam pembentukan pola pikir. Kemampuan berpikir logis didasari oleh indikator dalam membuat makna, membuat hubungan logis antara konsep dan fakta, menduka dan menguji konsep, menyelesaikan masalah secara rasional, dan menarik kesimpulan. Penelitian yang dilakukan kepada siswa kelas tujuh G Madrasah Mu'allimin Muhammadiyah Yogyakarta menggunakan metode tes dan wawancara sebagai konfirmasi. Hasil pekerjaan siswa dianalisis secara deskriptif dan dikelompokkan menjadi empat kategori secara umum maupun berdasarkan indikator. Ditemukan kemampuan siswa berada pada kategori kurang tinggi dengan persentase 76,7% dan berdasarkan indikator mayoritas berada pada kategori kurang tinggi. Sehingga dapat disimpulkan bahwa kemampuan berpikir logis siswa tergolong rendah.*

Kata Kunci: *berpikir, logis, matematis, indikator*

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Education is defined as a conscious and planned systematic effort to develop individual abilities to face the future era of globalization as well as to shape skills in society. Advances in science, technology, and information have led to intense competition among humans globally, especially humans who can think, critically, and creatively, have a high desire to know, are elaborative, easily access, and analyze information (Zulfickar & Sobandi, 2020). As stated in Law Number 20 Article 3 of 2003 concerning the National Education System, education has a strategic role and function in preparing for various challenges in the future. The formation of high intellectual, emotional, and social abilities is inseparable from the role of the world of education. One of the important processes in the formation is learning activities. Learning activities are the process of changing behavior in learners by involving several components, namely students (learners), teachers, media, and other components (Mahmud & Idham, 2017). The learning process is carried out by using the basic abilities that will affect the success of learning, namely thinking.

Thinking is an ability naturally given by God Almighty (Faradina & Mukhlis, 2020). In thinking there is a process of interpreting the situation, analyzing, reasoning, or drawing conclusions from existing premises, weighing and deciding is done instinctively (Pamungkas et al., 2017). The ability to think logically or logically is one of the important abilities that can be a provision in determining goals and steps in achieving goals. Logical thinking is an activity related to making decisions and solving complex problems (Diana, 2018). Logical thinking is often found in various daily activities, such as using good communication and determining the way home. Logical thinking is usually done when you find a problem you are facing and need the best solution. Under these conditions, there is a process of transforming information from various judgments, abstractions, and imagination, so that the best problem-solving is found (Pamungkas et al., 2017). In general, the ability to think logically can be used when problems are found to be solved both small and big problems with various sequential steps and fulfilling the existing conditions so that a good pattern of thinking is formed.

Mathematics is one of the compulsory subjects for elementary, middle, and high school students. Mathematics is an important subject for students because it became one of the aspects that is developed in mathematics, namely the ability to solve problems. Based on Permendikbud No. 07 of 2022 the standard content for learning mathematics is related to analyzing problems and solving problems with existing procedures (Permendikbudristek No 20, 2022). The ability to solve problems according to Gardner is an indicator of intelligence possessed by individuals, in this case students(Ulum, 2020).

Each student has a variety of intelligence that becomes a uniqueness. According to Gardner (Cahyo, 2021) student intelligence is divided into several categories, namely: logical-mathematical, visual-spatial, kinesthetic, linguistic, interpersonal, and intra-personal intelligence. Mathematical logical intelligence is one of the intelligences possessed by students in making decisions. According to Adriawan (Faradina & Mukhlis, 2020) Indicators of students' logical thinking are as follows

Table 1. Logical Thinking Indicators

No	Logical Thinking Indicators	Indicators
1	Thinking Disorder	Students can mention all the information obtained in the questions (known and asked). Disclose in general the steps that will be used to solve the problem.
2	Arguing ability	Students can express logical reasons regarding all the completion steps that will be used from the beginning to get the conclusion correctly. Solve questions correctly at each step and can provide arguments for each step used in problem-solving. Express a logical reason for an incorrect final answer.
3	Conclusion Drawing	Students can give conclusions correctly on the final answer

Apart from that, the indicators for logical thinking according to Lestari (Wulandari & Fatmahanik, 2020) are not much different, these indicators are as follows.

1. Make meaning of the answers of reasonable arguments,
2. Making logical connections between different concepts and facts,
3. Guessing and testing based on reason,
4. Solve mathematical problems rationally,
5. Draw logical conclusions.

The indicators of logical thinking that are expressed when carried out can form a coherent mindset for students in solving problems in classroom learning (Fauzan, Agina, & Setiawan, 2020). Students are asked to explore existing information to support the completion steps, analyze needs, reveal how to solve problems through the information obtained, and conclude that it is the best problem-solving.

Research on the analysis of logical thinking skills has been done before. Based on the results of research on the ability to think logically in class VIII students of a junior high school in Cirebon (Widianti & Hidayati, 2021) is classified as lacking. Other research with indicators found that students' abilities varied (Rinawati & Ratu, 2021). Some objects are only able to get to the stage of compiling problems, while others are only able to carry out problem-solving plans. Research on other logical thinking skills has been conducted at SMP N 1 Cikampek Karawang with geometrical material. Of all the indicators used, all have not been fulfilled by students due to their lack of understanding of the spatial concept (Utami, 2021).

Research on logical thinking skills can be found with varying results. However, it is rare to find research that analyzes every indicator of the ability to think logically. Mapping the ability to think logically is necessary because it has an influence on students' learning outcomes in mathematics, as happened in class V students at SD Kugus Bajawa I (Milsan & Wewe, 2018). In addition, based on the results of bibliometric mapping by taking data on the keyword "logical thinking in mathematics" from Google Scholar on February 19, 2023, using PoP (Harzig) software at intervals of 2018 - 2023. Then the data was visualized with Biblioshiny, and it was found that logical thinking is related to problem-solving and decision-making, so it becomes very important to do a portrait of students' logical thinking abilities. So that this research can be used as a reference regarding the ability to think logically for each indicator and the basis for class action or further research.

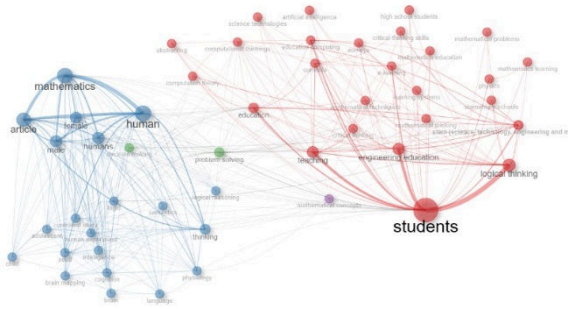

Figure 1. Thematic Mapping of Logical Thinking

Research Method

This research will use the descriptive analysis method. This study aims to get a general and detailed description of the students' condition in mathematical logical thinking. The subjects of this study were 31 seventh-grade G class students of Madrasah Mu'allimin Muhammadiyah Yogyakarta.

The logical thinking indicators used in this study use indicators according to Lestari (Wulandari & Fatmahanik, 2020) with adjustments to the explanation of the indicators. Data collection methods were used through tests and interviews. The test was carried out using 5 story questions containing mathematical problems, while the interview was used as confirmation of the work on the test results. The questions tested are listed in Table 2.

Table 2. Mathematical Logical Thinking Ability Test Instrument

Number	Question
1	The training schedule for three volleyball teams to play on the same court is as follows. Team A practices every 3 days, team B practices every 5 days, and team C practices every 6 days. If they March 1, 2022, they train together, then what date will they train together again?
2	It is known that a rectangle is expressed in x cm and its length is 3 cm longer than its width. If the perimeter is 24 cm, what is the width of the rectangle?
3	It is known that Hilmi's age is now 8 years younger than Haikal's age. If the sum of their ages is 32 years, how old will Haikal be 15 years from now?
4	Mrs. Sri went to the market to buy food needs at home. Mrs. Sri bought 2 bunches of Kale for IDR 3,000 per bunch, 2 kg of rice for IDR 11,000 per bunch, and 2.5 kg of eggs for IDR 24,000 per kg. After being totaled, Mrs. Sri gave Rp. 103,000 to the seller. How much change should Mrs. Sri receive?
5	If a number is multiplied by 6, the result will be equal to the sum of that number by 25. What is this number?

The results of the work of the instruments being tested will be analyzed on the level of students' abilities in interpreting answers with reasonable arguments, logical relationships between different concepts and facts, guessing and testing based on reason, solving problems systematically, and concluding logically.

Data analysis was performed using descriptive analysis method. The analysis is carried out with stages included in the indicators of logical thinking, namely the ability to think, argue, and draw conclusions. Researchers categorize the results of students' workability into 4 levels based on the grouping (Mardapi, 2008). The grouping is based on the following provisions.

Table 3. Conditions for Categorizing Mathematical Logical Thinking Ability

Category	Criteria	Interval Limit Scale 100/Conversion	Description
Very High	$x > (Mi + 1{,}5\ SDi)$	$x > 62{,}5$	X = arithmetic average
High	$Mi \leq x < (Mi + 1{,}5\ SDi)$	$50 \leq x < 62{,}5$	Mi = Ideal mean/average
High Enough	$(Mi - 1{,}5\ SDi) \leq x < Mi$	$37{,}5 \leq x < 50$	SD = Standard Deviation
Less high	$x < (Mi + 1{,}5\ SDi)$	$x < 37{,}5$	

Result and Discussion

General Logical Thinking Ability Analysis

Based on the results of the logical thinking ability test conducted in class 1G at the Mu'allimin Muhammadiyah Yogyakarta Madrasah, the researcher obtained a score for student work, and then data processing was carried out. The data is processed and percentages are sought to find out the categorization of logical thinking skills. The categorization of students' logical thinking abilities is presented in Table 4.

Table 4. Percentage Results of Mathematical Logical Thinking Ability

Category	Percentage
Very High	0,0%
High	0,0%
High Enough	10,0%
Less high	76,7%

Based on the test results, it was found that the largest percentage, namely 76.7%, was in the less high category. While the quite high category is at 10.0%. From the overall results of the existing percentages, it was found that students' logical thinking abilities from all the indicators specified were in the quite high and not high enough categories. These percentages can be depicted in the pie chart below. It can be seen that the majority of class 1G students at Madrasah Mu'allimin Muhammadiyah Yogyakarta have the ability to think logically in the less high category.

Students' logical thinking ability is also analyzed based on predetermined indicators. The researcher processed the data for each indicator by adding up all the students' scoring results according to the indicators, then categorizing the scoring results with predetermined categories. Categorization was carried out using Mardapi's categorization (2008) by looking at the percentage results of the instrument test as follows.

Table 3. Percentage of Logical Thinking Ability per Indicator

Category	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5
Very High	0,0%	0,0%	0,0%	3,3%	3,3%
High	6,7%	0,0%	0,0%	0,0%	3,3%
High Enough	16,7%	3,3%	3,3%	16,7%	10,0%
Less high	63,3%	83,3%	83,3%	66,7%	70,0%

Based on the percentages shown in the table, it can be seen that the results of the test data for logical thinking instruments vary per indicator. The percentage on the results of indicator 1 obtained the maximum result in the less high category of 63.3%. The percentage of indicator 2 obtained the maximum results obtained in the less high category of 83.3%. The percentage of indicator 3 obtained

the maximum results in the less high category. The percentage of indicator 4 found the maximum value in the less high category of 66.7%. The percentage of indicator 5 found the maximum value was found in the less high category of 70.0%. Of all the percentages for each indicator, it was found that of all the indicators tested the largest percentage was in the less high category and the lowest percentage was found in the very high category. These percentages are illustrated in the following bar chart.

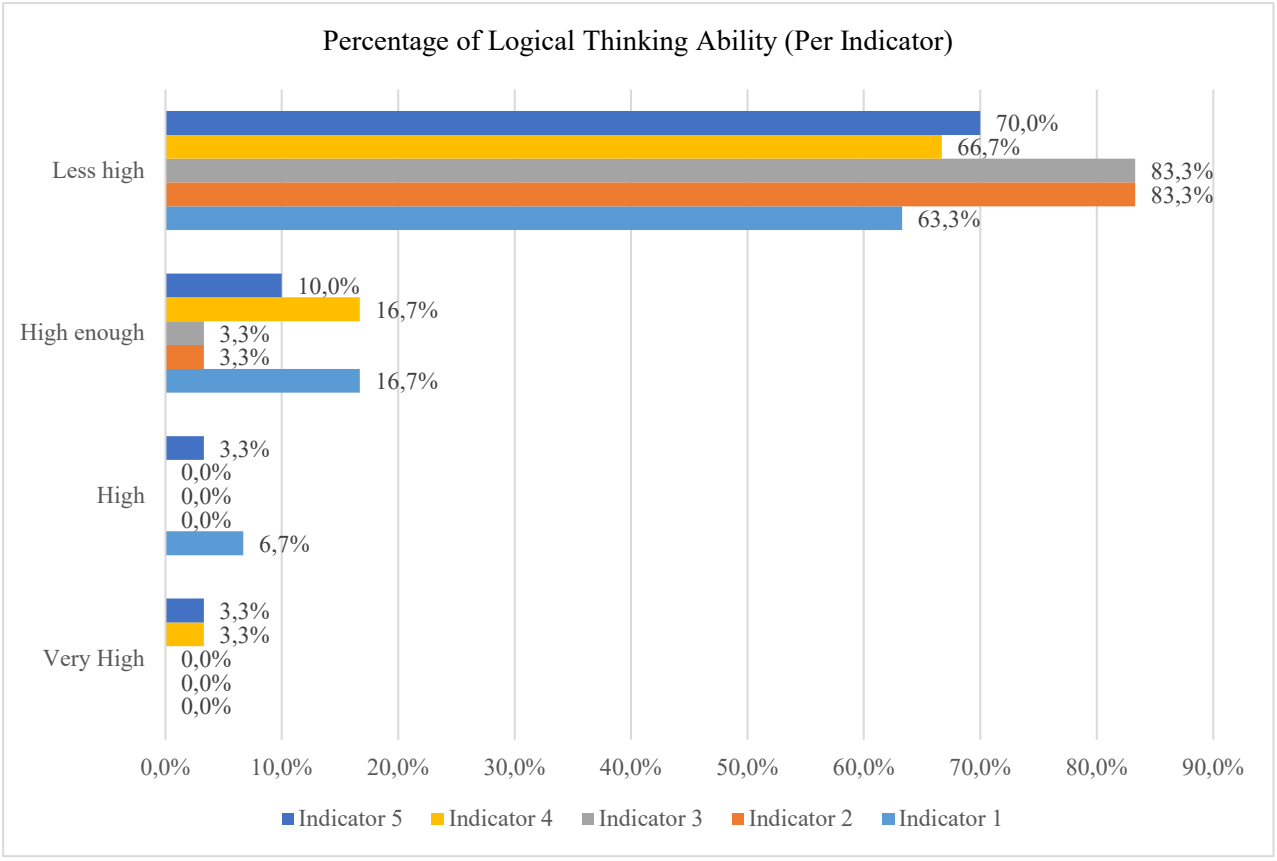

Figure 2. Percentage of Logical Thinking Ability (Per Indicator)

From the percentages that have been obtained through direct tests, an analysis of each indicator is carried out to find the problems found. The analysis is carried out by observing the results of student work from the test instruments that have been given based on achievement indicators and confirming student work using the interview method so that students' abilities can be analyzed accurately for each indicator tested. One of the students with a fairly high category was taken as a sample, namely student A.

Analysis of Ability to Think Logically Per Indicator

Indicator 1, namely the ability to make meaning about answers to reasonable arguments. Students are expected to be able to understand the purpose of the questions given and mention all the information from the questions. Seeing the results of student A's work in number 2, students are still not able to understand the questions and write them coherently. Students still think abstractly and have not been able to write down the results of their thoughts coherently. Shown by not being neat in writing and incomplete in writing down the information in the problem.

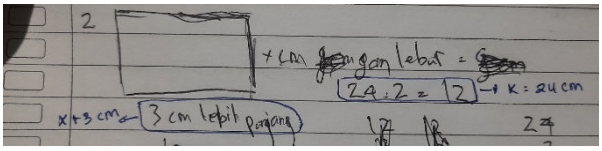

Figure 3. Student Answers to Question Number 2 Stage of Interpreting the Problem

Another condition was found in the results of student A's work on problem 4. Students were able to write down information on the problem better and it could be used in determining the next step, namely determining formulas, solutions, and conclusions. The results of student work can be seen in the following figure.

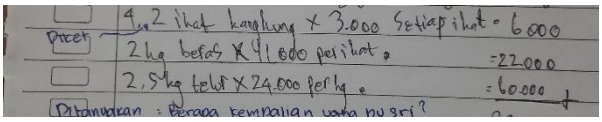

Figure 4. Student Answers Number 4 Stage of Interpreting the Problem

After seeing the results of student work, confirmation was carried out to find out the obstacles to students in indicator 1. Based on student A's answers, information was obtained that students were constrained when understanding some of the questions and experienced confusion when determining information that could be used to solve problems in the questions. Students can better understand if the problem is an everyday experience so that it can be imagined in the mind. The condition of these students is in line with the results of research in class IX E SMPIT Raudhatul Jannah (Zamani & Hendriana, 2022) that it is easier for students to understand questions related to everyday life.

Indicator 2, namely the ability to connect logically between different concepts and facts. Students can plan the process of solving problems and reveal the general process of solving problems. In this indicator, it was found that the majority of student test results were still in the less high category. The ability on this indicator can be seen in the results of work no. 2 of student A below.

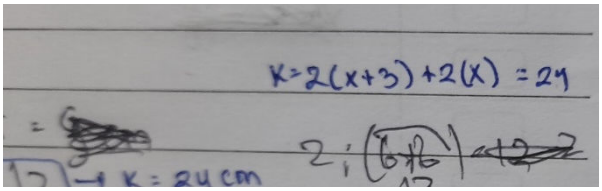

Figure 5. Student Answers Number 2 Stage Linking facts and concepts

Students have not been able to connect mathematical concepts with facts obtained from the information in the problem. This concept can be in the form of a formula or a mathematical sentence for the next step of completion. Similar abilities were also found in other questions.

After confirmation through interviews. Students experience difficulties in determining mathematical formulas or concepts because their knowledge of the material is still minimal and doubt the correctness of the concepts to be used. This condition makes students choose to use personal thinking without any basic mathematical concepts. The lack of ability to connect facts and concepts also occurs in SMPN Kersamanah in the experimental class which only gets a percentage of 47% (Fauzan, Agina, Setiawan, et al., 2020).

Indicator 3, namely the ability to guess and test based on reason by determining the strategy in solving the formula used. In this indicator, there was no formula testing by student A so the scoring was in the less high-level category. Based on the results of the interview as confirmation, student A did not test the formula due to students' doubts about the formula to be used and the impact of not knowing the formula.

Indicator 4, namely the ability to solve problems systematically and rationally with students being able to solve questions correctly and the truth can be proven. This ability can be seen in the work of student A as follows.

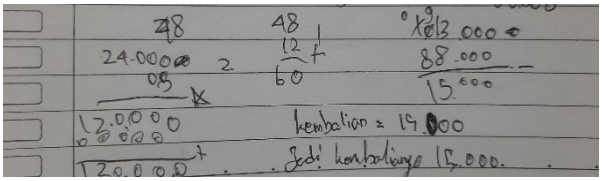

Figure 6. Student Answers Number 4 Problem Solving Stage

From the results of student work in number 4, it was found that students were able to solve problems that had been found previously. Completion can be done by students but the process is still not structured and systematic. In other conditions, students still cannot solve the problems formulated earlier. As happened in question number 1 below.

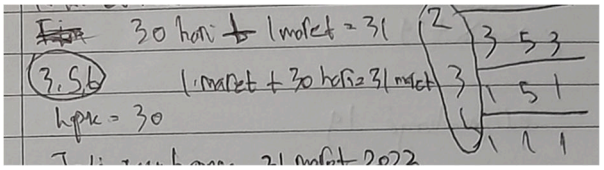

Figure 7. Student Answers Number 1 Problem Solving Stage

Question number 1 shows that student A is still unable to solve the problem in a structured and systematic way so in determining the answer there are problems. After being confirmed, student an experienced problems in using the concept and still did not understand the correct solution flow so the results obtained were not appropriate.

Indicator 5, as the last indicator, namely the ability to conclude logically can be found in student work. Some students can conclude from the results that have been obtained. For example, in question number 4, students succeeded in getting the conclusion from the completion which was carried out as follows.

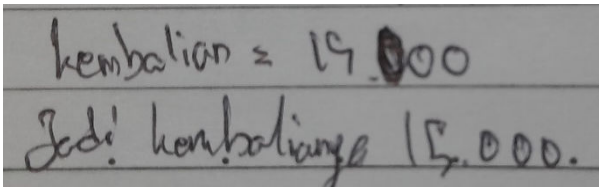

Figure 8. Student Answers Number 4 Concluding Stage

The ability to conclude can be done by most students because they are sure of the answers, they get even though the truth is not yet known. Student A said that the results of the work obtained were conclusions from the problems in the problem, even though student A was constrained in expressing it clearly.

Based on the results of student work analysis and confirmation to students, can be summarized in the following table.

Table 6. Analysis of Student Work Results and Interview Results

Indicator	Student's work	Interview Result
1	The ability to understand the problem is still not high. Some numbers can be understood but not written down coherently. Constraints are found in numbers 1, 3, and 5	Students are constrained in understanding the problem because of a lack of understanding of the concept and confusion in taking information from the problem. Students better understand the problems that are often encountered in everyday life
2	The ability to determine mathematical concepts is categorized as lacking in all questions.	Students experience problems in determining mathematical formulas or concepts because of minimal material knowledge and confusion about the correctness of the concepts to be used
3	Students do not test the formula on every problem presented	Students do not test the formula because of doubts about the formula or concept used
4	Students can solve problems even though they are not systematic and the truth is not found.	Students do not understand the correct solution flow so they do not find the appropriate results
5	Students can conclude the results of the completion obtained without knowing the truth of the answer	Students experience problems in expressing the conclusions of the complete results.

The table above shows that students' ability to think logically according to the specified indicators is at a low level with problems in understanding the questions and concepts used. Even though students have difficulty understanding questions and using mathematical concepts, students can conclude without knowing the truth of the answers. This happens because the students' ability to understand the problems in indicator 1 is in a low category. The results of this study are inversely proportional to research conducted by students with high initial abilities in class IV MI Darussalam Lembeyan Kulon, Magetan (Wulandari & Fatmahanik, 2020), students can think logically and mathematically well, indicated by students being able to understand the meaning of the questions, make connections logically, conjecture and test scientifically, solve rationally, and draw conclusions. This research is also in line with research in class IX E SMPIT Raudhatul Jannah (Zamani & Hendriana, 2022) on indicators of the ability to make meaning about answers to reasonable arguments.

Conclusion

Based on the results obtained and presented, it can be concluded that the ability to think logically mathematically in class 1G of Madrasah Mu'allimin Muhammadiyah Yogyakarta still has not reached the indicator of logical thinking ability. Students still think abstractly and do not carry out the stages of logical thinking in solving problems on a given instrument. Each of the specified indicators cannot be interpreted correctly based on the results of the scoring that has been done.

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