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EXPLORING 11TH-GRADE STUDENTS' MATHEMATICAL REASONING ABILITY ON SEQUENCES AND SERIES: A QUALITATIVE STUDY

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Abstract

This study aims to provide an analytical description of how students solve five essay questions aligned with indicators of mathematical reasoning ability. A descriptive qualitative method was employed, with a purposive sample of seven 11th-grade high school students in West Bandung Regency. Data were collected through students' written responses to test instruments and subsequently analyzed to identify errors in the problem-solving process and to measure mathematical reasoning skills. The measured indicators included: (1) formulating conjectures, (2) performing mathematical manipulations, (3) constructing evidence and providing justification for multiple solutions, (4) drawing conclusions from statements, and (5) verifying the validity of arguments. The findings show that indicator (1) reached the very good category with a percentage of 85.71%, while indicator (2) was categorized as good with 60.71%. Indicators (3) and (5) fell into the sufficient category with percentages of 32.14% and 46.43%, respectively. Indicator (4) was categorized as poor with 25.00%. Overall, the average percentage across all indicators was 50.00%, indicating that the mathematical reasoning ability of 11th-grade high school students in the school under study falls into the sufficient category. This study contributes to the existing body of knowledge by offering a detailed profile of students' reasoning performance across multiple indicators, providing empirical evidence of specific reasoning weaknesses often overlooked in quantitative assessments, and highlighting the need for targeted instructional interventions to strengthen conceptual understanding and argumentation in mathematics learning.

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INTRODUCTION

One of the goals of education is to cultivate an intelligent nation. Efforts to achieve this ideal can be pursued through various fields, with mathematics education serving as one of the concrete pathways. Accordingly, the government has implemented mathematics learning from elementary school through higher education, and even at the early childhood level, mathematics must already be introduced. Hewi and Shaleh (2020) emphasize that mathematics education should begin in early childhood, as 80% of intelligence develops at this stage, serving as a foundation for later levels. This aligns with Saleh, Prahmana, Isa, and Murni (2018), who highlight that mathematics plays a significant role in many aspects of life, and therefore must be learned from the earliest levels.

Several competencies must be mastered by students studying mathematics. The Indonesian Ministry of Education and Culture outlines these abilities, which include: (1) understanding concepts, (2) applying reasoning, (3) problem-solving, (4) communicating ideas, and (5) appreciating the value of mathematics (Oktaviana & Aini, 2021). Among these, mathematical reasoning is an essential skill to be developed. This is consistent with Wau, Harefa, and Sarumaha (2022), who argue that students with strong reasoning skills tend to find it easier to solve mathematical problems.

Mathematical reasoning has been defined by Sumartini as the ability to draw and prove conclusions, build new ideas, and solve problems in mathematics (Nababan, 2020). Similarly, Putri, Sulianto, and Azizah (2019) state that reasoning is the ability to connect problems to ideas or concepts that lead to mathematical problem solving. In line with this, Keraf describes reasoning as logical thinking, akin to the definition in the Longeot test, namely a process of drawing conclusions based on given phenomena (Isnaeni, Fajriyah, Risky, Purwasih, & Hidayat, 2018). From these perspectives, it can be concluded that mathematical reasoning is the cognitive process of articulating fundamental ideas, proving statements, solving problems, and drawing conclusions from problem-solving processes.

Like other competencies, mathematical reasoning requires indicators for measurement. According to Sumarmo, as cited in Fajriyah, Nugraha, Akbar, and Bernard (2019), these indicators include: (1) transductive reasoning, drawing conclusions from one particular case to another; (2) providing explanations for models, facts, properties, or patterns; (3) estimating answers, solutions, and trends; and (4) generalization, or drawing general conclusions from observed data. Meanwhile, Putri and Yuliani (2019) highlight the indicators of mathematical reasoning ability outlined by the Ministry of National Education (Depdiknas, 2004), namely: (1) representing mathematical statements verbally, in writing, through images, and diagrams; (2) making conjectures; (3) performing mathematical manipulations; (4) drawing conclusions, constructing arguments, and justifying solutions; (5) deriving conclusions from statements; (6) checking the validity of arguments; and (7) identifying patterns or properties of mathematical phenomena for generalization. Although the language used differs, both sets of indicators share certain similarities. In this study, several indicators from Depdiknas (2004) will be applied, specifically indicators 2 through 6.

One mathematical topic strongly associated with reasoning is sequences and series, as it involves formulas and elements of an algorithmic nature. Thus, this topic is closely linked

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to students' reasoning ability. Moreover, sequences and series frequently appear in real-life contexts, such as calculating the number of chairs in an arranged seating pattern or determining the total amount of savings over time with increasing deposits. Solving such problems requires strong reasoning and problem-solving skills to produce accountable solutions (Wau et al., 2022). Teachers have made various efforts to strengthen students' understanding of this topic, yet challenges remain in classroom practice. Therefore, this study aims to provide an analytical description of students' mathematical reasoning ability in the topic of sequences and series among 11th-grade senior high school students in West Bandung Regency.

METHOD

This study employed a descriptive qualitative method with the objective of obtaining an analytical description of how students solve problems that apply indicators of mathematical reasoning. The questions used had been validated for their alignment with the indicators by a mathematics education lecturer. The participants consisted of seven Grade XI students, selected through purposive sampling, who were given five essay questions designed according to the indicators of mathematical reasoning. Students' written responses were assessed using a mathematical reasoning ability rubric with a score range of 0 to 4, developed by Thompson as cited in Sulistiawati, Suryadi, & Fatimah (2015), as presented below:

Table 1. Rubric for Assessing Mathematical Reasoning Ability

Skor	Kriteria
4	Secara substansi jawaban benar dan lengkap
3	Terdapat satu kesalahan atau kelalaian yang signifikan
2	Terdapat satu atau lebih kesalahan atau kelalaian yang signifikan
1	Sebagian besar jawaban tidak lengkap tetapi paling tidak memuat satu argumen yang benar
0	Jawaban tidak benar berdasarkan proses atau argumen atau tidak ada respon sama sekali

After the students' answers were scored according to the scoring rubric in the table, the data were then processed to calculate the percentage for each indicator using the following formula:

$$P = \frac{n}{N} \times 100\%$$

Description:
- P: Percentage of each indicator
- n: Number of correct answers
- N: Total expected correct answers

The percentage obtained will indicate the interpretation of students' mastery of mathematical reasoning abilities in accordance with the criteria provided by Arikunto in Khadijah, Maya, & Setiawan (2018).

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Table 2. Data Criteria Boundaries by Arikunto

Percentage	**Criteria**
81% – 100%	Very Good
61% – 80%	Good
41% – 60%	Fair
21% – 40%	Poor
0% – 20%	Very Poor

RESULTS AND DISCUSSION

The test instrument, which had been aligned with the indicators of mathematical reasoning, was administered to the students at the research site. The results were then processed using the rubric described in the research method section. The students' scores for each item varied. Based on the assessment stages according to the applied method, the results are presented in Table 4.

Tabel 4. Interpretasi Persentase dari Tiap Indikator

Indicator	**Percentage**	**Interpretation**
Making conjectures	85.71%	Very Good
Carrying out mathematical manipulations	60.71%	Good
Constructing evidence, providing reasons or justification for several solutions	32.14%	Fair
Drawing conclusions from statements	25.00%	Poor
Checking the validity of an argument	46.43%	Fair
Average Percentage	**50.00%**	**Fair**

The indicator with the highest percentage is the first indicator, with a score of 85.71%. The second highest indicator is indicator number 2, with 60.71%. Indicator number 5 ranks third with a percentage of 46.43%. The fourth and fifth positions are occupied by indicators number 3 and 4, with percentages of 32.14% and 25.00%, respectively. The final conclusion is drawn from the overall average test percentage, which is 50.00%

The The question for the first indicator was designed in accordance with the domain of mathematical reasoning, namely making conjectures. This problem was presented in essay form. Students were expected to analyze the information presented in the problem so that they could conclude what was known and what was being asked (Ardhiyanti, Sutriyono, & Pratama, 2019).

Problem number one stated: *Muallim Resna became the committee of the Graduation Session for Grade XI. In the session room, there were 15 rows of chairs. The front row had 23 chairs, and each subsequent row had 2 more chairs than the previous row. Estimate the total number of chairs that Muallim Resna needs to prepare!*

For this first indicator, students had to analyze and interpret the information given in the problem into the elements of an arithmetic series. In this case, the 15 rows of chairs were interpreted as the number of terms (n), the 23 chairs in the front row were identified as

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the first term (a), and the 2 additional chairs in each subsequent row were recognized as the common difference (d). The next step required students to formulate what was being asked in the problem, namely the total number of chairs in the room, which corresponds to the sum of the series S_{15}.

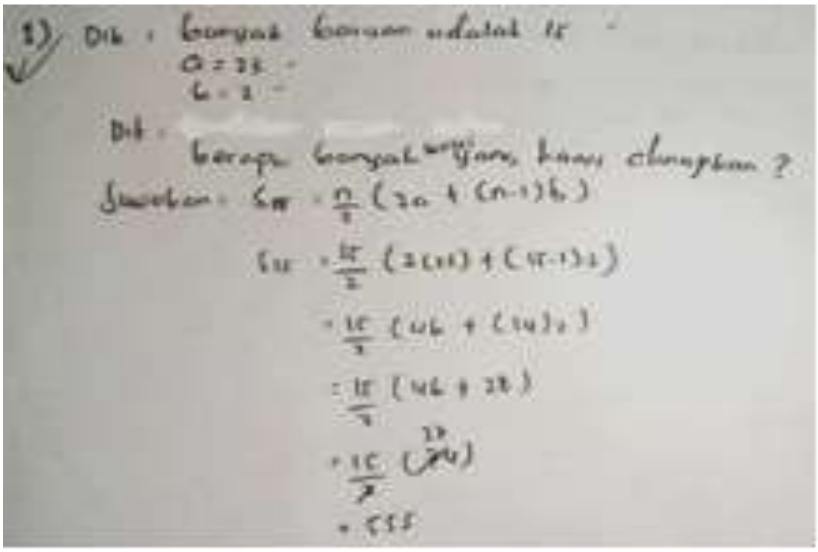

Figure 1. Answer of Student 1 on the First Indicator Question

The answer of Student 1 on the question for the indicator of formulating conjectures received a score of 4. This is because the student was able to state what was known, namely that 23 seats represent or the first term, and that the difference b is 2 seats more for each subsequent row. The total number of seats was correctly identified by the student as the problem's main question. Furthermore, the student was able to substitute the given information into the arithmetic series formula. This indicates that the student, who successfully solved the problem using the provided data, demonstrated a high level of mathematical reasoning ability. These findings are consistent with the study conducted by (Ardhiyanti et al., 2019).

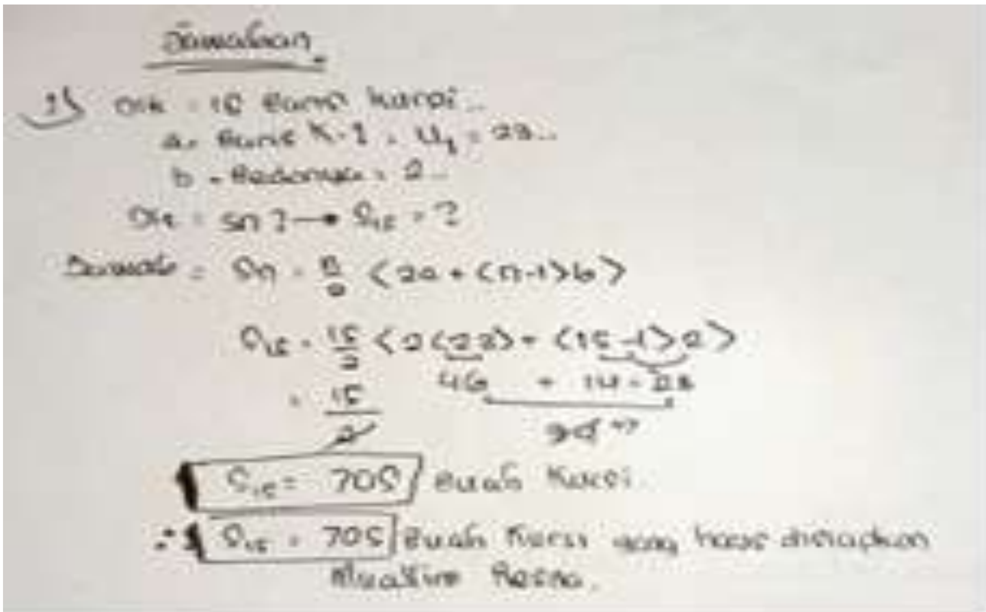

Figure 2. Student 2's answer to the first indicator question

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For student 2, who obtained a score of 3 on the item for the reasoning indicator of making a conjecture, the error occurred in the calculation process. It is evident that the student made a mistake when adding 2 with 46 with 28 producing the incorrect result of 94, whereas the correct result should have been 74. Consequently, when the result was divided by 2 and then multiplied by 15, the final answer was 705, which should have been 555. This error is in line with the study of Maryani & Chotimah (2021), which states that one factor influencing students' cognition is the *skills hierarchy problem*, with computational mistakes being one of the indicators as developed in Watson's criteria..

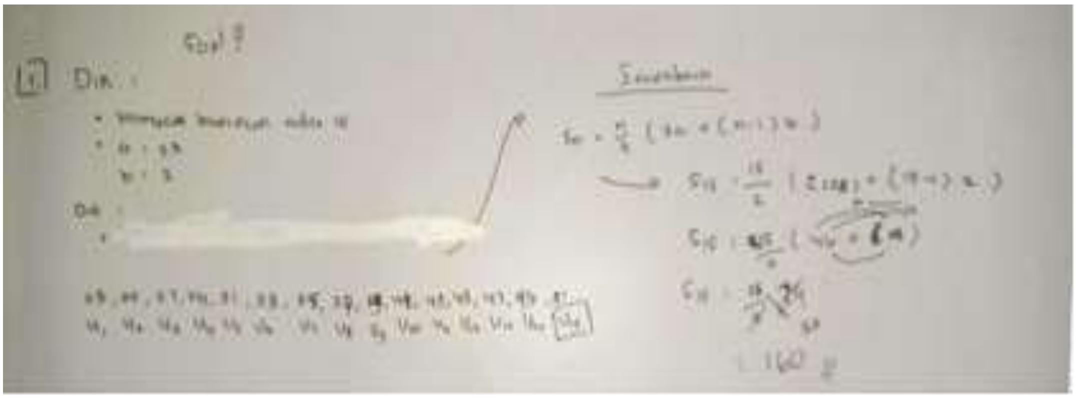

Figure 3. Student 4's answer to the first indicator question

Student 4 was able to present the known information from the problem. However, the student did not explicitly state what was being asked. From the student's written calculations U_1 until U_{15}, it is clear that they attempted to reason manually by computing step by step. If the student had directly identified what needed to be solved and applied the formula without relying on manual calculation, it would have indicated a stronger conceptual understanding. The score of 2 was therefore given due to a lack of conceptual mastery. This finding is consistent with Zebua, Rahmi, & Yusri (2020), who argue that insufficient understanding of the concepts of sequences and series leads to incorrect conclusions. Similarly, Student 4 also made errors in computing the arithmetic series formula.

The second indicator question asked students to determine the general term of an arithmetic sequence given $U4 = 7$ and $U7 = 16$. This item was designed to examine mathematical reasoning ability from the indicator of performing mathematical manipulation. According to the Directorate General of Primary and Secondary Education Regulation No. 56/C/PP/2004, performing mathematical manipulation means expressing a problem into a mathematical model and determining an appropriate problem-solving strategy. In this problem, students were expected to recall the formula for the nnn-th term of an arithmetic sequence, namely $Un = a + (n - 1)b$. Next, they needed to substitute U_4 and U_7 into the formula U_n resulting in two mathematical equations $7 = a + 3b$. From these equations, the student was required to determine a solution strategy by eliminating the system to find the values of aaa and bbb. Finally, these values could be substituted back into the formula $U_n = a + (n - 1)b$, producing the general term of the sequence.

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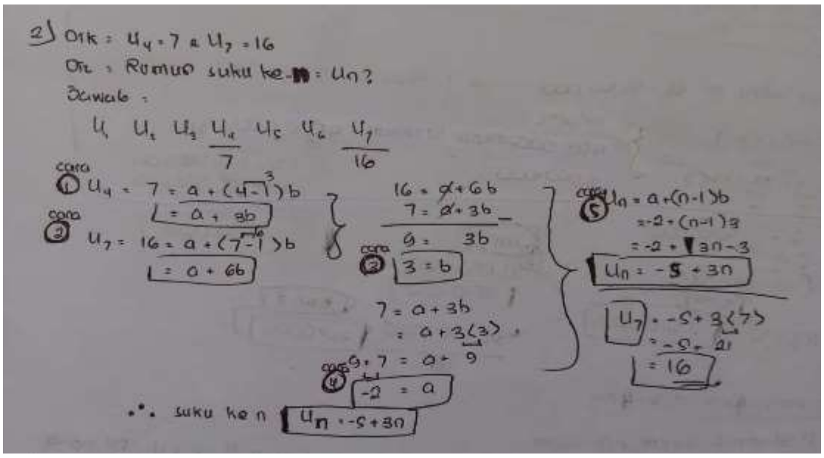

Figure 4. Student 2's Answer on the Second Indicator

In Figure 4, it can be seen that the student has fulfilled the criteria for the indicator "performing mathematical manipulations," resulting in a correct answer and the highest score of 4. The student successfully created new equations to determine the values of aaa and ddd. Subsequently, the student applied the elimination method as a problem-solving strategy. This finding aligns with Ikrimah & Darwis (2016), who stated that students with high-level reasoning are able to understand concepts rationally, meaning they can connect concepts and ideas at each stage of problem solving. Therefore, this explains why Student 2 achieved the highest score of 4 on the question for indicator 2.

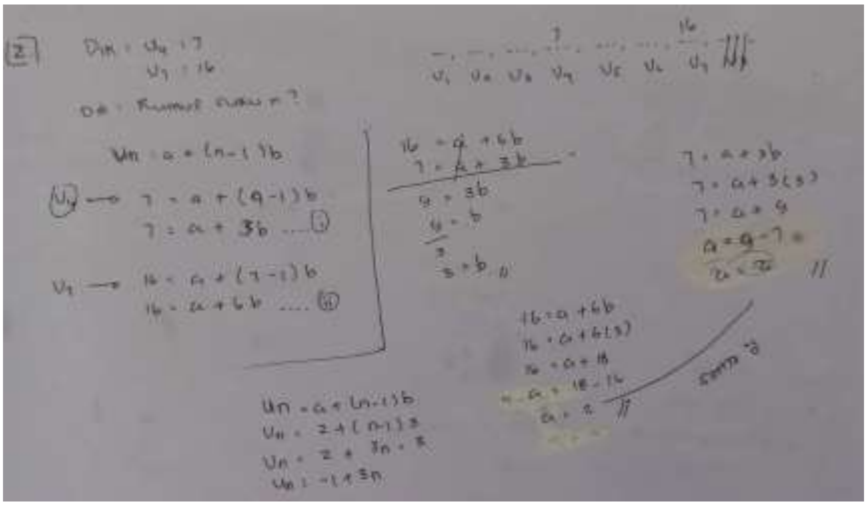

Figure 5. Student 4's Answer on the Second Indicator

Student 4's answer in Figure 5 above has a score of 3. This is because there is one significant error or omission. Upon analysis, the error occurs when the student determines the value of . When the equation is $7 = a + 9$, the next step to find the value of should be , with the final result being $a = 7 - 9$. Student 4 incorrectly calculates the equation 2, resulting in a final answer of $a = 9 - 7$. This error is very significant because when substituted into the formula for finding the term, it will automatically be different, so the student did not solve the problem even though the sequence was in accordance with the stages of mathematical manipulation.

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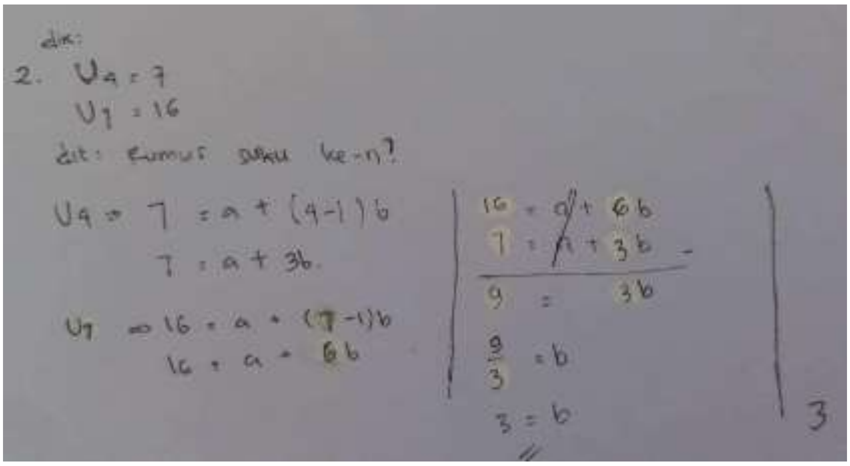

Figure 6. Student 7's answer to indicator question number 2

Student 7's answer received a score of 2. Based on the scoring criteria, most of the answers were incomplete but at least contained one correct argument. The correct argument can be seen when creating the equations for the 4th and 7th terms. Not only did the student create the equations, but he also managed to find the value b from the elimination of the two equations. However, there was no further solution after that. This was because the student did not understand what elements needed to be obtained in order to get the formula for the term . In the end, the student considered the task to be complete.

Question number 3 is a question designed with the indicator of compiling evidence, providing reasons or evidence for several solutions. The question is a type of error analysis, which is a type of essay question often used in schools where students are given a question with an incorrect statement and then need to analyze the location of the error in the question, provide the correct statement, and explain the reason. The question statement for this indicator is as follows. Salahuddin earned a profit of Rp. 3.000.000 from his cassava chip business called Domas in the first year. He always saved his profits because they increased by Rp. 450.000 every year. After ten years, Salahuddin had savings of Rp. 52.500.000.

In answering these questions, students need to provide answers in the specified format, as the question type is an error analysis, or what students at the school often refer to as error analysis. The answer format must include 1) error(s), which are the words that make the statement incorrect, 2) correct statements, which are the correct statements, and 3) reasons, which are the reasons why the words are incorrect. In the question in the form of an incorrect statement, there will be two possible answers in the error section and the correct section. The answers for the errors are Rp.450.000 or Rp.52.500.000. Then, the correct statements are Rp.500.000 or Rp.50.250.000. Next, students must provide reasons for the correct statements. The answer for the correct statements should be that the concept in this case is an arithmetic sequence and series. This can be seen from the same difference (b). To validate that this statement is correct, it must be proven that $a = 3.000.000, b = 450.000$ and$S_{10} = 52.500.000.$ Next, substitute into the formula with the aim of finding one of the elements, either b . For example, to prove that is correct using the formula , after substitution, the formula becomes. Next, students must provide reasons for the correct statements above.

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The answer for the correct statements should be that the concept in this case is an arithmetic sequence and series. This can be seen from the equal difference (b). To validate that this statement is correct, it must be proven that $a = 3.000.000$, $b = 450.000$ and $S_{10} = 52.500.000$. Next, substitute into the formula with the aim of finding one of the elements, either b or S_{10}. For example, to prove that is correct using the formula $s_n = \frac{n}{2}(2a + (n-1)b)$, after substitution, the formula becomes $s_{10} = \frac{10}{2}(2(3.000.000) + (10-1)\ 450.000)$. Next, operate 10 minus one, then multiply by 450,000, also 2 times 3.000.000, and 10 divided by 2 to get the result $s_{10} = 5(6.000.000 + 4.050.000)$. After further operations, the final result for S_{10} is 50.250.000. From this calculation, it is found that is not 52.500.000 but 50.250.000. Meanwhile, is 52,500,000 if b is 500,000. This is proven using the following equation from the known data, namely $52.500.000 = \frac{10}{2}(2(3.000.000) + (10-1)b)$. Next, it is operated again to become $52.500.000 = 5(6.000.000 + (9)b)$ so that the equation becomes $\frac{22.500.000}{45} = b$ and b has a final result of Therefore S_{10} is 52.500.000 if b is Rp.500.000.

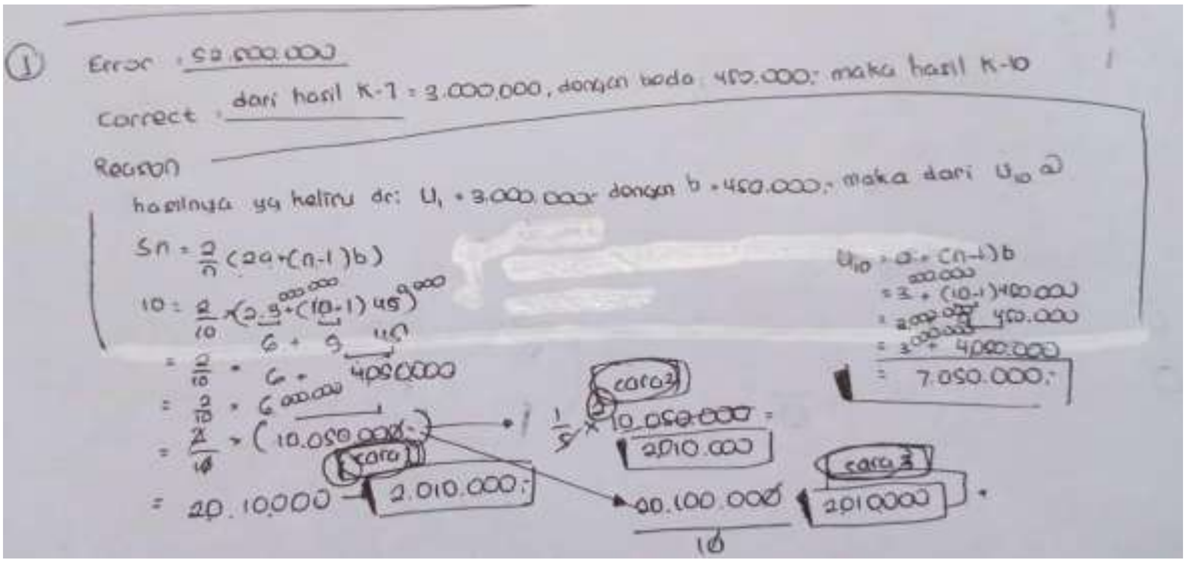

Figure 7. Student 2's answer to indicator question number 3

From Figure 7, it can be seen that student 2 can compile evidence by explaining what is known and what should be sought. However, this is considered insufficient because the student does not provide a written explanation of the steps. The previous explanation is in line with the research by Hidayati & Widodo (2015), which states that students who are highly capable of solving problems, as indicated by their ability to provide evidence or reasons for the correctness of their solutions, are able to show the steps of their work and draw the correct conclusions. Student 7 was indeed able to analyze the incorrect statement of Rp.52.500.000, although in the end there was a conceptual error in that they did not describe the correct statement. In addition, the reasons for using the formula and the sequence of steps were not explained, so they did not fully meet the indicator of providing reasons for the solution.

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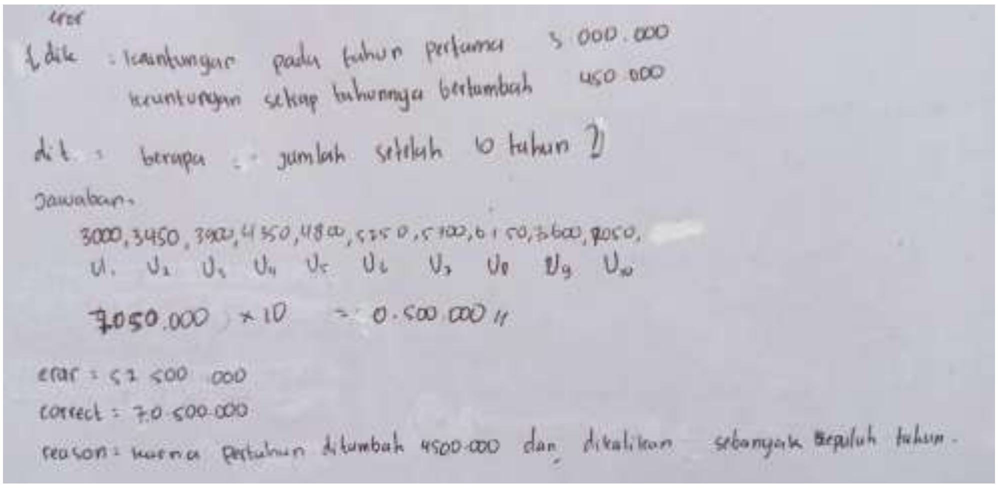

Figure 8. Student 6's answer to indicator question number 3

In line with the discussion in Figure 7, student 6 answered indicator question number 3 with the answer attached in Figure 8 with a score of 1. A score of 1 indicates that most of the answers are incorrect, but at least one argument is correct. The student did explain the errors in the statement and the correct statement. However, when the student began to provide evidence, it was apparent that their understanding of the material was still lacking. The student did not explain whether the case in the question belonged to a sequence or series, nor did they explain whether it was arithmetic or geometric. As a result, the answer showed that the student used a manual method to determine the difference between each term, which should have been found using the arithmetic series formula. A lack of conceptual understanding of sequences and series dominates the mistakes made by students. This is similar to what was described by Rosyidah, Setyawati, & Qomariyah (2021) in their research, which found that conceptual understanding is a factor in the mistakes made by students.

Indicator number 4 is drawing conclusions from statements. The question given is a description of geometric series material. The question describes how the monthly production of a craftsman increases according to the rules of geometric series. Production in the first month was 150 units of crafts, and in the fourth month it was 4,050 crafts. In the fifth month, the craftsman experienced a production failure of 98 units. Calculate the production results for 5 months. According to the Director General of Primary and Secondary Education Regulation No. 56/C/PP/2004, the indicator of drawing conclusions from statements is to find the answer from the problem-solving strategy that has been carried out. In this question, students need to find a strategy to calculate the production results for 5 months. The existence of a production failure of 98 units will make students draw new conclusions from the answers they will get for the total production for 5 months. The following are the students' answers, which can be seen in Figures 9 and 10.

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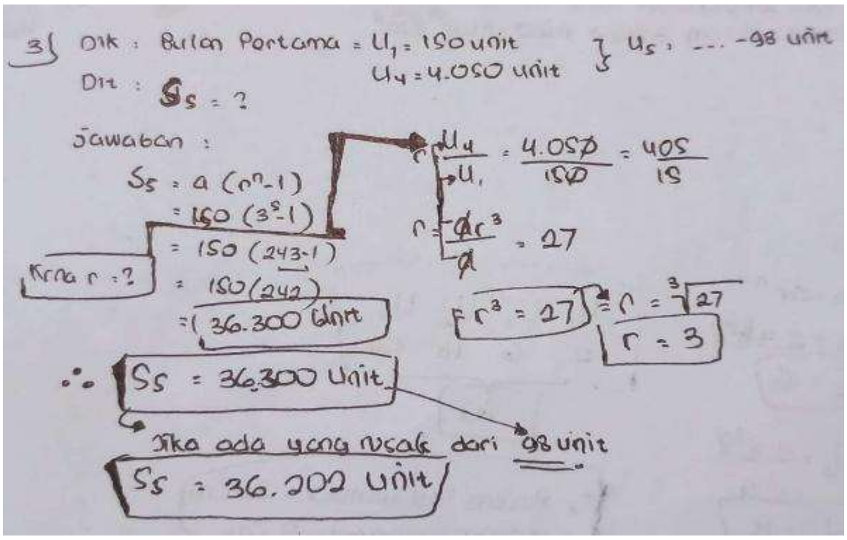

Figure 9. Student 2's answer to indicator question number 4

As shown in Figure 9, student 2 can describe the steps in finding the production results for 5 months. The production results are calculated using the geometric series formula, namely $S_n = \frac{a(r^n-1)}{r-1}$. In the middle of the process, the student successfully identified that or the ratio was unknown. To obtain it, the student searched for by utilizing the ratio between terms so that the value of obtained was 3. However, when substituting the value of into the geometric series formula, a miscalculation occurred which caused the final result of to be 36.300 instead of 18.150. One important thing in working on this problem is when the students realized that the value of had to be reduced by the number of production failures, which was 98. This ensured that the students met the indicator of drawing conclusions.

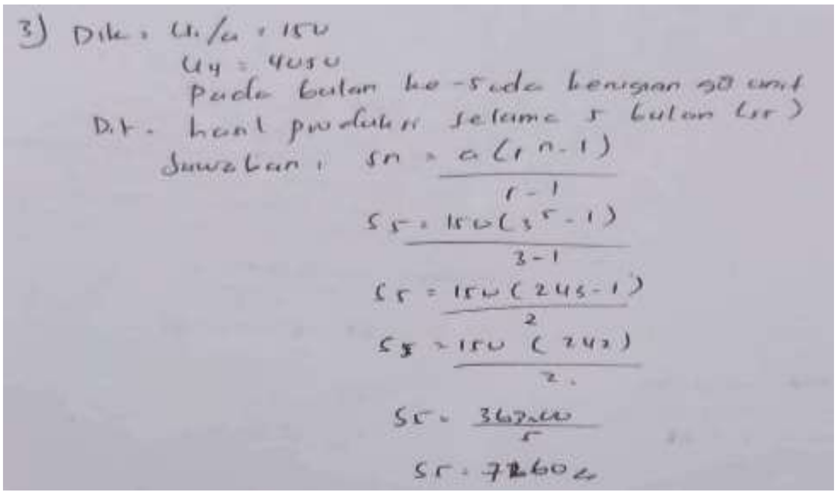

Figure 10. Student 1's answer to indicator question number 4

In Figure 10, the student answered the question by writing down the information known from the question, namely , and in the fifth month there was a loss of 98 units. Next, the student wrote down what they were looking for, which was the production results for 5 months. As a first step, the student wrote down the formula to find . Upon closer inspection, the ratio between the terms was not known to the student beforehand, but the student had already substituted it in the formula . This needs to be investigated because it is possible that the student accidentally guessed that 3 was the value for if they did not write down how to find the ratio between the terms. If there is a result from or a ratio, there must be a way to obtain that result. Proving this method is very important, in line with what NCTM states in Jesica, Asari, & Irawati (2021), that mathematical proof is a formal way to express certain types of reasoning and justification. Furthermore, it can be seen that the student made a computational error in the section $S_5 = \frac{36.300}{5}$ by giving a score of 7.260. The error stemmed from the student's carelessness in writing the divisor as 5 instead of 2.

Indicator number 5 is to check the validity of an argument. The question used was of the same type as indicator number 3, which was a description of error analysis where students needed to analyze incorrect statements and then write the correct statements accompanied by supporting arguments. Students understood the steps to answer this question. The description of the question was that a piece of rope was cut into 4 pieces, each forming a geometric sequence. If the shortest piece of rope is 2 cm and the longest piece of rope is 54 cm, it is certain that the original length of the rope is 90 cm with a ratio between the pieces of rope of 4 cm.

In this question, students must check the correctness by finding the error in the statement, which is located in the original length of the rope of 90 cm with a ratio between the pieces of rope of 4 cm. If students can find the ratio between the pieces of rope, they can determine the original length of the rope. To do this, students first need to determine the ratio between the pieces of string, followed by determining the second and third pieces because the first and last pieces are already known. The results of the students' answers can be seen in Figure 11.

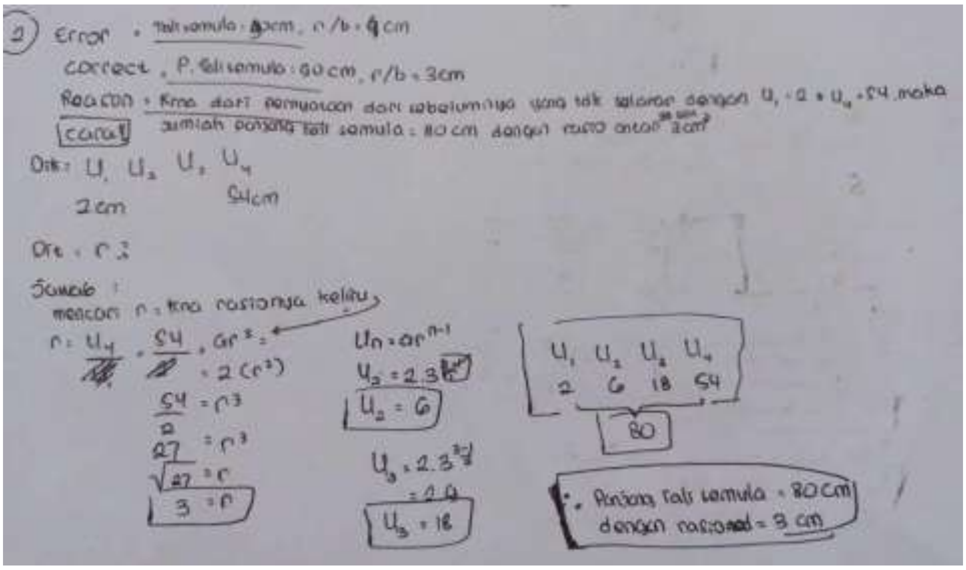

Figure 11. Student 2's answer to indicator question number 5

In the figure, the student wrote that the original rope was 90 cm and r/b 4 cm for the incorrect statement. For the correct statement, the student wrote 90 cm with r/b 3 cm. There is one mistake in writing the ratio variable. The student wrote when they should have written r because b applies to arithmetic sequences and the (slash) in mathematics indicates the multiplication operation, whereas it is not correct to divide by . Next, the student wrote down the known facts as an initial problem identification to determine the problem-solving strategy. The student then looked for the ratio first. As explained, if the

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student can find the ratio, it will be easy to find the value of the original rope length. The student successfully found the ratio value of 3 *cm* using the formula to find the nth term from the 2nd and 3rd terms. After substitution, the students found that the total length of the rope was 80 *cm*, not 90 *cm*. From this stage, it was certain that the students had checked the validity of the argument. In line with what Rohmah, Septian, & Inayah (2020) said, students are said to be able to check the validity of an argument as shown by their ability to present evidence of the truth of a statement based on known mathematical results.

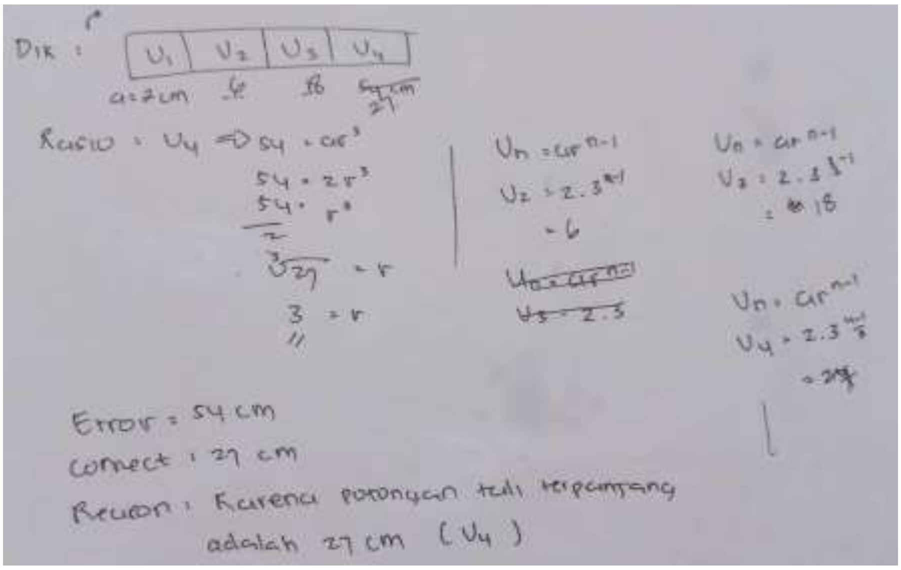

Figure 12. Student 4's answer to indicator question number 5

Next, student 4 analyzed the validity of the argument and received a score of 2. If we look closely, the student successfully found the ratio value of 3 *cm*. However, the student made a conceptual error by incorrecting the value of 54 *cm* as the longest string, even though this statement was confirmed by the ratio value that had been found. It can be seen from the answer that the student found the value of the 4th term to be 27 *cm*, which he used as a correct statement. However, the value of 27 is an incomplete calculation. The student did not multiply 27 by 2. When multiplied, the result would be 54, so the statement given by the student did not check the validity of the argument. In the research by Rohmah et al. (2020), students are said to be able to check the validity of an argument by being able to present evidence of the truth of a statement based on known mathematical results. In the case of student 4, they have not yet presented this evidence of truth.

This indicates a significant gap in students' understanding of mathematical proofs and their ability to apply concepts accurately, as highlighted in recent studies on students' errors in mathematical proof and misconceptions in reasoning (Arifin et al., 2024; Sitorus et al., 2024). Addressing these gaps through targeted instructional strategies may enhance students' understanding and application of mathematical concepts. Recent literature emphasizes the necessity of implementing instructional strategies that foster deeper comprehension of mathematical concepts, particularly in the context of error analysis and conceptual understanding (Septia & Kiromi, 2023). These strategies can significantly improve students' problem-solving skills and reduce misconceptions in mathematical reasoning (Yusup, 2023). Therefore, educators should consider integrating metacognitive approaches and problem-based learning to effectively address these issues and enhance

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students' mathematical reasoning abilities and overall academic performance in mathematics education (Naufal et al., 2017; Nurtamam & Jannah, 2025). By focusing on strategies that promote critical thinking and self-reflection, we can better equip students to navigate complex mathematical challenges and improve their reasoning skills (Sugita et al., 2024). Recent studies suggest that incorporating collaborative learning environments can further support students in overcoming misconceptions and enhancing their mathematical reasoning skills.

CONCLUSION

Based on the results and discussion presented, students' mathematical reasoning abilities in the subject of sequences and series varied for each indicator. Many students answered questions correctly on the indicator of making assumptions, while only a small number of students answered incorrectly on the indicator of performing mathematical manipulations. Furthermore, on the indicator of constructing evidence and examining the validity of an argument, most students answered incorrectly, and on the indicator of drawing conclusions from statements, almost all students answered incorrectly. The causes found include a lack of understanding of the concepts of sequences and series, a lack of understanding of basic mathematical operations, and a lack of thoroughness when performing calculations. The results of the study were dominated by many errors in almost four of the five indicators tested, so that the mathematical reasoning abilities of 11th grade high school students at a school in West Bandung Regency on the subject of sequences and series were in the adequate category. Thus, it is hoped that the analysis in this article can be a reference for future research.

REFERENCES

Ardhiyanti, E., Sutriyono, S., & Pratama, F. W. (2019). Deskripsi kemampuan penalaran siswa dalam pemecahan masalah matematika pada materi aritmatika sosial. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *3*(1), 90–103. https://doi.org/10.31004/cendekia.v3i1.82

Arifin, C. S., Aqfi, F., & Hasanah, R. U. (2024). *Jenis Kesalahan Pada Pembuktian Matematis*. https://doi.org/10.62383/bilangan.v2i3.44

Fajriyah, L., Nugraha, Y., Akbar, P., & Bernard, M. (2019). Pengaruh kemandirian belajar siswa smp terhadap kemampuan penalaran matematis. *Journal On Education*, *1*(2), 288–296. https://doi.org/https://doi.org/10.31004/joe.v1i2.66

Hewi, L., & Shaleh, M. (2020). Refleksi hasil PISA (the programme for international student assessment): upaya perbaikan bertumpu pada pendidikan anak usia dini). *Jurnal Golden Age*, *4*(01), 30–41. https://doi.org/10.29408/jga.v4i01.2018

Hidayati, A., & Widodo, S. (2015). Proses penalaran matematis siswa dalam memecahkan masalah matematika pada materi pokok dimensi tiga berdasarkan kemampuan siswa di SMA Negeri 5 Kediri. *Jurnal Math Educator Nusantara*, *1*(2), 131–143. https://repository.ciptamediaharmoni.id/index.php/repo/article/view/31

Ikrimah, & Darwis, M. (2016). Understanding student profile SMP IT Al-Fityan Gowa school class IX at problem solving viewed from the reasoning ability of mathematics. *Jurnal Daya Matematis*, *4*(2), 29–42. https://garuda.kemdikbud.go.id/documents/detail/574547

Print ISSN: 3031-9552, Online ISSN: 3031-9544

Isnaeni, S., Fajriyah, L., Risky, E. S., Purwasih, R., & Hidayat, W. (2018). Analisis kemampuan penalaran matematis dan kemandirian belajar siswa smp pada materi persamaan garis lurus. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *2*(1), 107–115. https://doi.org/10.31331/medives.v2i1.528

Jesica, A., Asari, A. R., & Irawati, S. (2021). Tahap-tahap berpikir dalam pembuktian dengan induksi matematika ditinjau dari teori berpikir Swartz. *Jurnal Kajian Pembelajaran Matematika*, *5*(1), 21–34. https://doi.org/10.17977/um076v5i12021p21-34

Khadijah, I. N. A., Maya, R., & Setiawan, W. (2018). Analisis kemampuan komunikasi matematis siswa SMP pada materi statistika. *Jurnal Pembelajaran Matematika Inovatif*, *1*(6), 1095–1104. https://doi.org/22460/jpmi.v1i6.p1095-1104

Maryani, A., & Chotimah, S. (2021). Analisis kesalahan siswa SMK dalam menyelesaikan soal materi barisan dan deret berdasarkan kriteria Watson. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(3), 2344–2531. https://doi.org/https://doi.org/10.31004/cendekia.v5i3.770

Nababan, S. A. (2020). Analisis kemampuan penalaran matematis siswa melalui model problem based learning. *Genta Mulia: Jurnal Ilmiah Pendidikan*, *XI*(1), 6–12. https://doi.org/10.36312/jisip.v4i3.1239

Naufal, M. A., Atan, N. A., Abdullah, A. H., & Abu, M. S. (2017). Problem solving, based on metacognitive learning activities, to improve Mathematical reasoning skills of students. *Man in India*. *97*(12), 213-220. https://api.semanticscholar.org/CorpusID:217231470

Nurtamam, M. E., & Jannah, A. N. (2025). A systematic qualitative review of teachers' strategies in enhancing mathematical reasoning in elementary schools. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*. *9*(2), 553-562. https://doi.org/10.31004/obsesi.v9i2.6936

Oktaviana, V., & Aini, I. N. (2021). Deskripsi kemampuan penalaran matematis siswa SMP kelas VIII. *Jurnal Pembelajaran Matematika Inovatif*, *4*(3), 587–600. https://doi.org/10.22460/jpmi.v4i3.587-600

Putri, A. D., & Yuliani, A. (2019). Analisis kemampuan penalaran matematis siswa ma di kabupaten bandung barat pada materi barisan dan deret. *Journal On Education*, *1*(2), 400–409. https://doi.org/https://doi.org/10.31004/joe.v1i2.80

Putri, D. K., Sulianto, J., & Azizah, M. (2019). Kemampuan penalaran matematis ditinjau dari kemampuan pemecahan masalah. *International Journal of Elementary Education*, *3*(3), 351–357. https://doi.org/10.23887/ijee.v3i3.19497

Rohmah, W. N., Septian, A., & Inayah, S. (2020). Analisis kemampuan penalaran matematis pada materi bangun ruang ditinjau dari gaya kognitif Siswa SMP. *Jurnal Prisma*, *9*(2), 179–191. https://doi.org/10.35194/jp.v9i2.1043

Rosyidah, U., Setyawati, A., & Qomariyah, S. (2021). Analisis kemampuan penalaran dan kemampuan pemahaman konsep matematis mahasiswa pendidikan matematika pada mata kuliah aljabar dasar. *SJME (Supremum Journal of Mathematics Education)*, *5*(1), 63–71. https://doi.org/10.35706/sjme.v5i1.4488

Saleh, M., Prahmana, R. C. I., Isa, M., & Murni. (2018). Improving the reasoning ability of elementary school student through the Indonesian realistic mathematics education. *Journal on Mathematics Education*, *9*(1), 41–53. https://doi.org/10.22342/jme.9.1.5049.41-54

Septia, T., & Kiromi, M. M. (2023). Analisis kesalahan siswa MA dalam pemecahan masalah matematika realistik materi barisan aritmatika dan geometri. *Jurnal Penelitian Ilmiah INTAJ*. https://doi.org/10.35897/intaj.v7i2.1041

Sitorus, C. W., Hasanah, R. U., & Ramadhani, S. H. (2024). Systematic literature review: Jenis kesalahan mahasiswa atau peserta didik pada pembuktian matematis. *Jurnal Arjuna*. https://doi.org/10.61132/arjuna.v2i3.776

Sugita, G., Nurhayadi, N., & Sukayasa, S. (2024). Ability reasoning mathematical students on solving problem. *International Journal of Current Science Research and Review*. https://doi.org/10.47191/ijcsrr/v7-i12-58

Sulistiawati, S., Suryadi, D., & Fatimah, S. (2015). Desain didaktis penalaran matematis untuk mengatasi kesulitan belajar siswa smp pada luas dan volume limas. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *6*(2), 135–146. https://doi.org/10.15294/kreano.v6i2.4833

Wau, H. A., Harefa, D., & Sarumaha, R. (2022). Analisis kemampuan penalaran matematis pada materi barisan dan deret siswa kelas XI SMK Negeri 1 Toma tahun pembelajaran 2020/2021. *AFORE: Jurnal Pendidikan Matematika*, *1*(1), 41–49. https://jurnal.uniraya.ac.id/index.php/Afore/article/view/435

Yusup, M. (2023). Students' errors in solving math problems in the form of stories on the topic of sequences and series. *Jurnal Inovasi Pembelajaran Matematika*. *2*(3), 269-280. https://doi.org/10.31980/pme.v2i3.1764

Zebua, V., Rahmi, & Yusri, R. (2020). Analisis kesalahan siswa dalam menyelesaikan soal barisan dan deret ditinjau dari kemampuan pemahaman konsep matematis. *Jurnal LEMMA: Letters of Mathematics Education*, *6*(2), 122–133. https://doi.org/10.22202/jl.2020.v6i2.4088

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