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# Students' Error Analysis in Solving Reasoning Problems on Sequences and Series Using Nolting's Theory

**Elsa Harini [1], Elfis Suanto [2,*], Nahor Murani Hutapea[3]**
[1,2,3] Riau University, Pekanbaru
*Corresponding Authors: elfis.suanto@lecturer.unri.ac.id

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## ABSTRACT

Mathematical reasoning ability is an essential competency emphasized in the *Merdeka Curriculum*, particularly in the Learning Outcomes (CP) for Phase E, which requires students to understand, generalize, and prove mathematical concepts. However, various studies have shown that Indonesian students' mathematical reasoning skills remain relatively low, including in the topic of sequences and series. This study aims to analyze students' errors in solving mathematical reasoning problems related to sequences and series in Grade 10, based on Nolting's error theory. The research employed a qualitative descriptive approach involving 20 tenth-grade students from Senior High School 12 Pekanbaru. The research instrument consisted of four mathematical reasoning essay questions covering arithmetic and geometric sequences and series, adapted from Fadillah. The analysis revealed four types of student errors: Careless Errors (34.30%), Connection Errors (31.20%), Test-Taking Errors (21.80%), and Application Errors (17.50%). These errors were attributed to various factors, including cognitive factors such as lack of conceptual understanding and affective factors such as low learning motivation. The findings highlight the importance of teachers in analyzing student errors to help minimize learning difficulties in mathematics and improve the overall quality of mathematics instruction.

Keywords: analysis; mathematical reasoning ability; nolting

## INTRODUCTION

One of the subjects taught in schools is mathematics. Mathematics is one of the scientific disciplines that is important to learn. In terms of classification, mathematics falls under the category of exact sciences, which require more comprehension than memorization (Asih, 2023). In the *Merdeka Curriculum*, the Learning Outcomes (CP) for Phase E state that students are expected to "develop reasoning skills to understand, generalize, and prove mathematical concepts." This statement emphasizes that mathematical reasoning is not merely a supporting aspect but is a primary goal in mathematics learning at the senior high school level. According to teachers, one of the fundamental skills students must possess in 21st-century learning is mathematical reasoning (Sujoko Waluyo, 2023). Mathematical reasoning allows students to understand concepts in depth, draw logical conclusions, and construct arguments and proofs in problem-solving (Erma Monariska, 2018; Hedi Budiman, 2020). Therefore, it is crucial for educators to pay serious attention to developing this ability through teaching strategies, assessments, and question design that demand critical and logical thinking. Without this skill, students tend to rely solely on memorizing formulas without understanding the underlying concepts, which limits their ability to apply mathematics functionally.

 

Reasoning not only helps students understand concepts more deeply, but also trains them to think critically, logically, and systematically when solving problems. The National Council of Teachers of Mathematics (NCTM, 2000) emphasized that reasoning is a fundamental component of mathematical thinking and evidence-based decision-making. Student achievement in mathematics learning is also strongly supported by their mathematical reasoning ability (Deby Ashri Khardita, 2023). However, international studies such as PISA 2018 have shown that Indonesian students' performance in mathematics, particularly in reasoning, is still relatively low. This is further supported by various local studies indicating that students often struggle with reasoning problems, including those related to sequences and series. This topic requires students to identify patterns, build generalizations, and apply concepts logically—skills that are highly related to mathematical reasoning (Kemendikdasmen, 2019). This serves as an indicator that students' mathematical reasoning ability remains generally low. At the national level, Linda and Asyura revealed that students in Pandeglang Regency had difficulty explaining models, stating facts, and constructing mathematical arguments when solving PISA-type problems (Linda & Asyura, 2021). According to Widyantari (as cited in Hartati), common student errors in solving mathematical problems can be attributed to several factors, including a lack of understanding of prerequisite or main materials, poor mastery of mathematical language, misinterpretation or misapplication of formulas, computational errors, lack of accuracy, and forgetting concepts (Hartati et al., 2024). Additionally, students need to solve as many problems as possible to better understand the concepts being studied (Enung Puryati, 2017).

A previous study relevant to the current research was conducted by Fadillah, who analyzed student errors in solving reasoning problems on sequences and series based on Newman's theory (Fadillah, 2024). The current researcher seeks to adapt that study by introducing novelty through the use of Nolting’s theory. Nolting’s theory was chosen because it not only analyzes errors from a cognitive (knowledge-based) perspective but also considers affective aspects such as learning attitudes, habits, and self-management. This provides a broader perspective than Newman's theory, which focuses only on the stages of information processing (question literacy) (Azizah & Khoiri, 2022). Therefore, this study uses Nolting’s theory as the approach for analyzing students' errors, which classifies them into several categories, including conceptual errors, process errors, and non-academic errors (such as anxiety or lack of self-confidence).

This study aims to analyze the types of errors made by Grade 10 students in solving mathematical reasoning problems on sequences and series based on Nolting’s theory. In the learning process, student errors in solving mathematics problems are common. However, systematically analyzing these errors can provide deep insights into students’ misconceptions, thinking strategies, and weaknesses in understanding and applying concepts. Such analysis is important to help avoid similar mistakes in the future when students encounter mathematical reasoning problems and to identify the root causes of their errors. By recognizing the dominant patterns of errors, teachers can design more targeted instructional interventions, thereby improving the overall quality of mathematics learning, particularly through the lens of Nolting’s theory.

## RESEARCH METHODS

This research employed a qualitative descriptive method aimed at accurately and systematically describing a population, situation, or phenomenon sistematis (Feny Rita Fiantika, 2022). The purpose was to analyze the errors made by students in solving mathematical reasoning problems. The subjects of this study were 20 tenth-grade students of Senior High School 12 Pekanbaru in the 2024/2025 academic year, conducted during the second semester. The research implementation utilized two techniques. The first was a test consisting of four mathematical reasoning essay questions adopted from Fadillah's article (Fadillah, 2024), covering the competencies of Arithmetic Sequences, Arithmetic Series, Geometric Sequences, and Geometric Series. The aim was to collect students' written responses, which were then observed and described to identify the types of errors students made when solving mathematical problems and to determine the underlying difficulties. In addition to the test, interviews were conducted to gather data related to the challenges and reasons perceived by the students that led to the errors. The test instruments used in this research had been validated and proven reliable. The reasoning questions adopted and administered by the researcher to the students are presented in Table 1 as follows: (Fadillah & dkk, 2024).

Table 1. Reasoning Test Instrument on Sequences and Series

| No | Test Item |
|---|---|
| 1 | A sequence has a first term of 4 and a common difference of 3. What is the 100th term of this sequence? Also, explain what type of sequence it is. |
| 2 | For two years, Ariani consistently saved money every month, except in the 11th month. In the first month, she saved Rp. 50,000; in the second month, she saved Rp. 55,000; and in the third month, she saved Rp. 60,000, and so on. How much money did Ariani save in total over the two years? |
| 3 | Insert five numbers between 4 and 2916 so that they form a geometric sequence! |
| 4 | Akbar has a rope that will be cut into 15 pieces with lengths as follows: 3, 6, 12, 24, and so on. What is the original length of the rope? |

The data obtained from the test were analyzed qualitatively with reference to Nolting's theory, which considers error-triggering factors such as mathematics anxiety, ineffective learning strategies, and time-management issues. The analysis was conducted by describing the types of errors students made according to Nolting's categories, as presented in Table 2, and then linking these findings to the interview results to strengthen the interpretation (Fitri Ulpa, 2021; Naval Setia Wibowo et al., 2024; Salsabila, 2024; Suci Sukmawati & Risma Amelia, 2020).

Table 2. Error Indicators Based on Nolting's Theory

| No | Indicator |
|---|---|
| 1 | *Careless Errors*<br>Errors caused by student carelessness, such as miswriting problem components, operation signs, or final answers. |
| 2 | *Concept Errors*<br>Errors made when students do not understand the mathematical concepts and principles needed to solve the problem |

| | |
|---|---|
| 3 | *Application Errors*<br>Errors that occur when students know the formula but are unable to apply it to solve the problem. |
| 4 | *Test Taking Errors*<br>Errors caused by specific conditions, such as leaving answers incomplete or not finishing the given problem |

Data collection was carried out using two techniques, namely: Written Test: Students were given a set of mathematical reasoning questions to be completed individually. Their written responses were analyzed to identify the types and forms of errors made. Interview: Conducted after the test, the interview aimed to explore the difficulties students experienced and the reasons behind the errors they made. This interview was intended to obtain deeper insights that could not be captured through the written test alone. The indicators of mathematical reasoning ability used in this study are based on those set by the Indonesian Ministry of National Education (Depdiknas) in 2004 as cited in Ariati, which include: (1) Expressing mathematical statements verbally, in writing, or through pictures or diagrams; (2) Making conjectures; (3) Performing mathematical manipulations; (4) Constructing proofs, providing reasons or justification for the correctness of a solution; (5) Drawing conclusions from statements; (6) Verifying the validity of an argument; (7) Identifying patterns or properties of mathematical phenomena to make generalizations. (Ariati & Juandi, 2022; Lestari et al., 2022; Nur Yuliany, 2021).

After scoring and grouping the students, their errors were analyzed based on the types of errors identified in Nolting's theory. The data analysis technique used includes data reduction, data presentation, and conclusion drawing. Student responses, which had been assessed using the error indicators from Nolting's Theory, were then processed using Microsoft Excel with the following formula: (Waskitoningtyas, 2016).

$$P = \frac{n}{N} \times 100\% \ldots (1)$$

Explanation:
P = Percentage of student errors for each indicator
n = Number of students who made errors in each specific indicator
N = Total number of student errors across all indicators

## RESULTS AND DISCUSSION

This study was conducted at SMA Negeri 12 Pekanbaru in May, during the even semester. In addition to presenting the results of data analysis, the researcher also documented the process while the students worked on the test questions in class. Direct interviews were conducted simultaneously to explore the students' difficulties and the reasons behind the errors they made in solving the problems. Below is a photo documenting the research activity:

Figure 1. Classroom Documentation

Based on the reasoning test administered to 20 students using four items focused on the arithmetic and geometric sequences and series competencies, the students' responses revealed error indicators based on Nolting's Theory. The analysis of the students' answers resulted in the percentage of errors for each test item and each type of error, as presented in Table 3.

Table 3. Data Processing Results of Student Error Indicators Based on Nolting's Theory

| No. | Type Of Error | Number Of Students | | | | Total | Kesalahan |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | |
| 1. | *Careless Errors* (Ca) | 3 | 7 | 0 | 1 | 11 | 34,3% |
| 2. | *Concept Errors* (Co) | 5 | 2 | 3 | 0 | 10 | 31,2% |
| 3. | *Application Errors* (Ap) | 0 | 3 | 1 | 0 | 4 | 12,5% |
| 4. | *Test Taking Errors* (Te) | 4 | 1 | 2 | 0 | 7 | 21,8% |
| | Total of Errors | 12 | 13 | 6 | 1 | 32 | |

Based on the data presented in Table 3, it can be seen that errors were found in each of the essay questions administered. In question item 1, which focused on arithmetic sequences and determining the *n-th* term, there were 12 errors distributed across all error types except for Application Errors according to Nolting's theory. In question item 2, related to arithmetic series, a total of 13 errors were found and were distributed across all four error categories. Question item 3, covering geometric sequences, showed a total of 6 errors, with no errors categorized under Careless Errors. Meanwhile, question item 4 on geometric series had only 1 error, which fell under Careless Errors. From the table, it is clear that the highest number of reasoning-related errors occurred in question item number 2, which covered arithmetic series. The primary cause was students' lack of understanding of the concept and misinterpretation of the problem statement. In total, there were 32 errors made by the students across all four reasoning questions related to sequences and series. To further illustrate the frequency of each error type from the highest to the lowest, see figure 1.

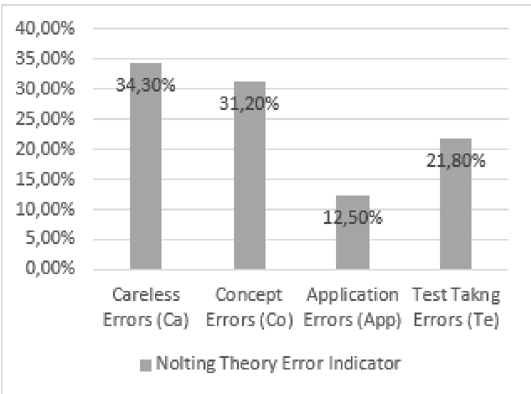


Figure 2. Graph of Percentage of Students' Errors in Completing Test Questions

Based on the chart shown in Figure 2, the order of student error indicators from highest to lowest can be identified as follows: Careless Errors: 34.30%, Concept Errors: 31.20%, Test Taking Errors: 21.80%, Application Errors: 12.50%. It is evident that the most frequent and dominant error made by students occurred in the Careless Errors category, while the least frequent was in Application Errors. This pattern is consistent with the findings of a similar analysis conducted by Fadhillah (Fadillah, 2024), which also showed that students commonly made mistakes under Careless Errors, and less so under Application Errors. To understand the specific forms of student errors for each error indicator, a detailed discussion will be presented in the following section.

Based on the research findings presented in Table 3, it is known that students made errors across various indicators of mistakes according to Nolting's Theory. The following are the types of errors made by students in each error category:

*Careless Errors*

The Careless Errors referred to in this study are mistakes caused by student carelessness, which fall into the category of non-cognitive errors. These include careless mistakes such as miswriting components of the question, mathematical operation signs, and final answers; lack of attention; rushing; or failure to double-check their work.

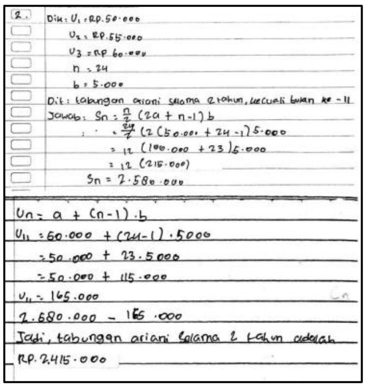


Figure 3. Careless Errors (Number 2)

As shown in Figure 3, a student made a mistake in Item 2, where the student's answer indicated a calculation error. The student was supposed to determine the 11th term using the formula$U_{11} = a + (11 - 1)b$, but due to lack of attention, the student incorrectly wrote "$U_{11} = a + (24 - 1)b$". This indicates that the student understood the concept needed to solve the problem, but was careless in the execution. This was confirmed by the following interview excerpt:

Student: "Ma'am, does this mean she only didn't save in the 11th month of the two years, or the 11th month of each year?"
Teacher: "Only the 11th month in the entire two-year period. So, how would you solve it?"
Student: "Well, just find the total savings for the two years and then subtract the amount from the 11th month."
Teacher: "Okay, good job."

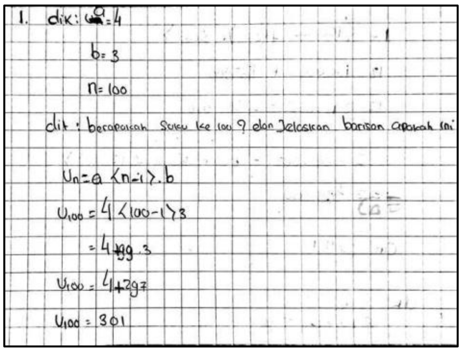


Figure 4. Careless Errors (Number 1)

As shown in Figure 4, a student made a mistake in Item 1. In the student's answer, it is clear that although the question asked the student to explain what type of sequence it is, the student rushed through and missed this part of the instruction, resulting in no explanation being provided about the nature of the sequence. This indicates that the student understood the concept needed to solve the problem but was careless in the process of completing the task. This was confirmed in the following interview excerpt:

Student: "Ma'am, is this correct?"

Teacher: "Now, why did you use the formula $U_n = a + (n - 1)b$?"

Student: "Because in the question, the common difference was given, and that's a characteristic of an arithmetic sequence, so I used that formula."

Teacher: "Ooh okay."

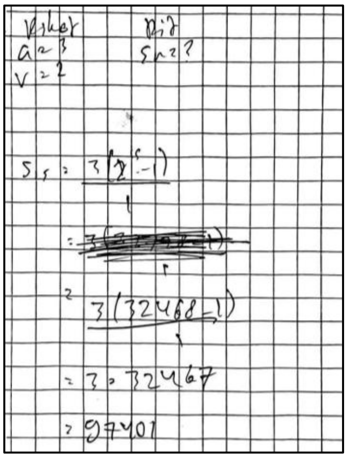


Figure 5. Careless Errors (Number 4)

As shown in Figure 5, a student made an error in Item 4, which is evident from their answer. The final answer was incorrect due to a miscalculation stemming from the previously written concept. The student wrote the result of $2^{15} - 1 = 32.468$, whereas the correct result is 32,767. Consequently, the final answer, which should have been 98,301, was incorrectly written as 97,401. Careless Errors had the highest percentage among the types of errors found in the students' responses according to Nolting's Theory. In general, students made these mistakes due to a lack of attention during the problem-solving process. These types of errors should not be ignored, as carelessness can significantly affect the final answer and, therefore, has a major impact on students' performance in solving mathematical problems. At this stage, teachers need to continuously remind and guide students to be more attentive and careful in working on problems.

*Concept Errors*

Concept Errors in this study refer to errors that occur when students do not understand or have misconceptions about the fundamental concepts and principles of mathematics used to solve a problem. These mistakes are not caused by carelessness or procedural errors, but rather by a lack of understanding of the core ideas underlying a mathematical topic.

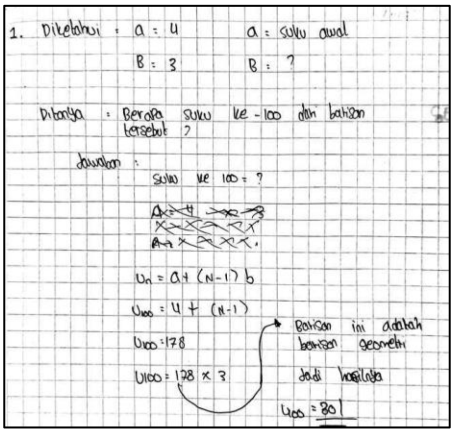

Figure 6. Concept Errors (Number 1)

As shown in Figure 6, a student made an error in Item 1, as evident in the student's response. The student did not understand the concept of Arithmetic and Geometric Sequences, as they wrote the arithmetic sequence formula $U_n = a + (n-1)b$, but explained that the sequence was a geometric sequence. This mistake is further supported by the results of the interview with the student:
Teacher: "Why did you answer that it's a Geometric Sequence?"
Student: "Because this is the formula for a geometric sequence, Ma'am!"
Teacher: "Are you sure? How sure are you, percentage-wise?"
Student: "I'm sure, Ma'am!"

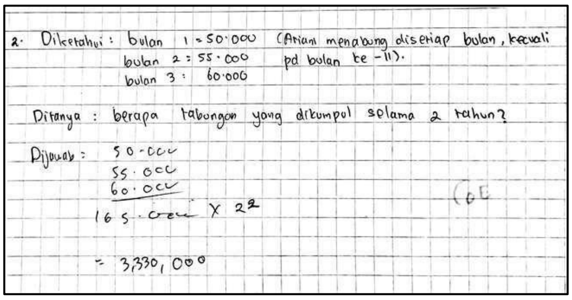

Figure 7. Concept Errors (Number 2)

As shown in Figure 7, a student made an error in Item 2, as seen in the student's response. The student did not understand the concept of Arithmetic Series, as they solved the problem by manually adding the known values instead of using the correct formula for the arithmetic series, which is: $S_n = \frac{n}{2}(2a + (n-1)b)$. This mistake is further supported by the results of the interview with the student:

Teacher: “Did you solve this manually?”

Student: “Yes, Ma’am.”

Teacher: “Why manually?”

Student: “Because only the amounts from the first to third months are given, Ma’am.”

Teacher: “Try reading again what is given and what is being asked.”

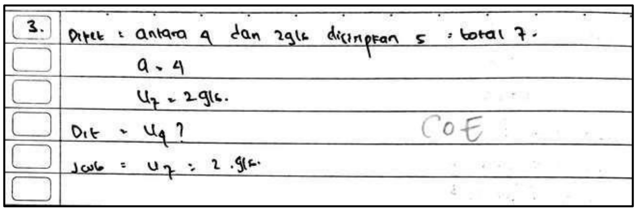


Figure 8. Concept Errors (Number 3)

As shown in Figure 8, a student made an error in Item 3, as seen in the student’s answer. The student did not write either the process or the final answer because, based on the interview between the teacher and the student, it was found that the student did not understand the concept of Geometric Sequences at all—neither recognizing what type of sequence it was nor knowing which formula should be used to solve the problem. The interview with the student revealed the following:

Teacher: “Why haven’t you filled it out yet?”

Student: “I don’t understand the question, Ma’am.”

Teacher: “Okay, before that, what kind of sequence do you think this is?”

Student: “I don’t know, Ma’am.”

Concept Errors are a type of mistake that arises when students do not understand the fundamental concept or mathematical principle required to solve a problem. This type of error is not caused by carelessness but rather by misconceptions or incorrect understanding of the topic. In general, students make conceptual errors due to a lack of deep understanding of the material, causing them to apply incorrect formulas or procedures. This type of error is critical to identify and address promptly because, if left uncorrected, it can hinder progress in subsequent mathematical learning. Therefore, teachers need to provide more in-depth conceptual explanations, use multiple approaches or representations, and offer varied practice to strengthen students' conceptual understanding and prevent further Concept Errors.

*Application Errors*

Application Errors in this study refer to a type of mistake that occurs when students are unable to accurately apply a rule, formula, or mathematical procedure in solving a problem. These errors are not due to a lack of understanding of basic concepts, but rather stem from inaccuracy in selecting or using the appropriate rule according to the problem's context. Students may already understand the concept being discussed but struggle to identify the correct problem-solving strategy or make mistakes in its application. Such errors indicate the need for consistent practice with a variety of questions, as well as teacher guidance in helping students choose the correct procedures based on the characteristics of each problem.

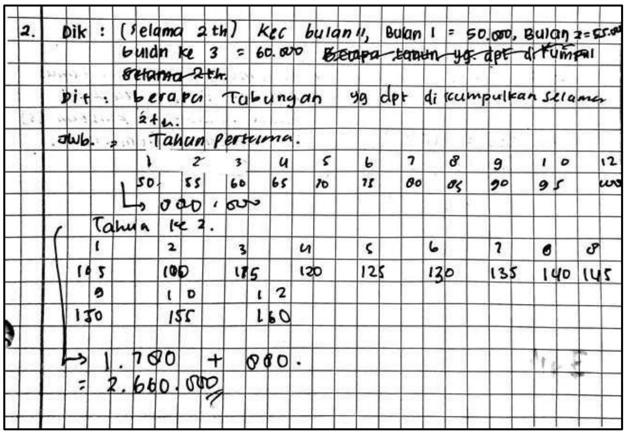


Figure 9. Application Errors (Number 2)

Based on Figure 9, it is evident that the student made an error on item number 2. The student understood that the question involved an arithmetic sequence, as seen from their solution where they added a common difference of 5 (5,000) to each term. This is further supported by the interview with the student:

Student: “Ma’am, is this correct?”

Teacher: “Before I say whether it's right or wrong, let me ask you first. Why did you add 5?”

Student: “Well, ma’am, because this is arithmetic, so I just added 5 to each term.”

Teacher: “That’s right. If you know it’s part of the arithmetic topic, why did you solve it manually?”

Student: “No particular reason, ma’am, I just wanted to do it manually.”

Application Errors occur when students fail to properly apply mathematical rules, formulas, or procedures in solving a problem. These errors are not due to carelessness or conceptual misunderstanding, but rather from an incorrect choice of problem-solving strategy or method that doesn’t align with the nature of the problem. Generally, students make this type of error because they lack the skills to identify relevant steps or are not accustomed to using the appropriate strategies. This type of error needs to be addressed immediately, as it can hinder students' ability to apply their knowledge across various types of problems. Therefore, teachers should train students by providing varied problem sets that emphasize the application of procedures and strategies, and offer direct guidance in selecting and applying the appropriate problem-solving methods based on the problem's context.

*Test Taking Errors*

Test-Taking Errors in this study refer to a type of mistake that occurs due to ineffective strategies when taking a test or exam—not because of carelessness, misconceptions, or procedural errors. These mistakes may be caused by non-academic factors such as nervousness, rushing, poor time management, or not reading the questions carefully. Students might actually have a good understanding of the concepts and procedures, but due to exam pressure or lack of focus, they end up answering incorrectly.

Therefore, it is important for teachers not only to develop students' academic skills but also to equip them with effective test-taking strategies, such as careful reading of questions, time management, and maintaining concentration during the exam.

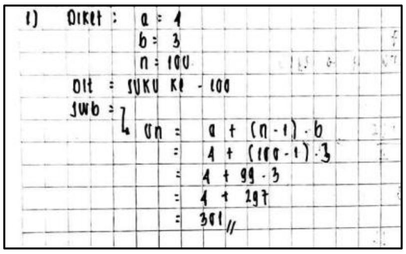


Figure 10. Test Taking Error (Number 1)

Based on Figure 10, it is apparent that the student made an error in responding to item number 3. The question asked for an explanation about the sequence type, but the student failed to write that explanation in their answer sheet. This happened because the student was rushing to complete the given questions quickly. The interview with the student revealed the following:

Student: "Ma'am, I want to ask—does 'difference' mean the gap, ma'am? In arithmetic?"

Teacher: "Yes, that's correct."

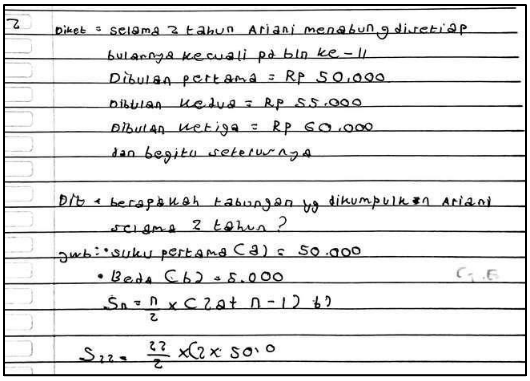


Figure 11. Test Taking Errors (Number 2)

Based on Figure 11, it was found that the student did not complete the answer for item number 2. However, interview results showed that the student actually had a solid understanding of the concept of the arithmetic series used in the question. This indicates that the difficulty experienced by the student was not related to conceptual understanding, but rather to non-academic factors such as time management during the test. The student stated that they understood the steps required to solve the problem but were unable to write down the entire process and answer due to time constraints during the exam. This finding suggests a potential Test-Taking Error, where factors like time management, test pressure, or a lack of execution strategy become the main causes of failure to complete the task, even when the conceptual understanding is sufficient. Therefore, it is necessary to provide students with training and practice in managing their time during exams, so they can complete all questions effectively.

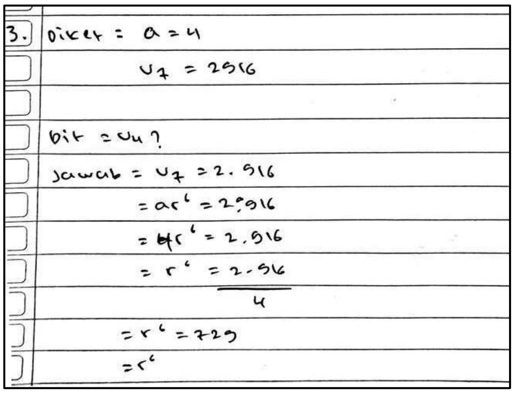

Figure 12. Test Taking Errors (Number 3)

Based on Figure 12, it was found that the student also did not complete the answer for item number 3. Again, the student showed an understanding of the question's concept, indicating that the obstacle was not a lack of understanding, but more likely a result of non-academic factors, such as poor time management during the test. The students reported that they knew how to solve the problem but did not have enough time to write out the full process and final answer. This reinforces the likelihood that this case also falls under the category of Test-Taking Errors, where factors such as time pressure, test anxiety, or poor strategy led to incomplete responses, despite adequate mastery of the subject. Thus, students need consistent training and exposure to time-constrained environments, so they can develop the ability to manage their time efficiently during exams.

Test-Taking Errors are a type of error that arises from ineffective strategies used when students are facing a test or exam. These errors are not caused by carelessness, misconceptions, or procedural mistakes, but are more related to non-academic factors such as anxiety, rushing, poor time management, or the inability to properly comprehend instructions under pressure. In general, students who commit this type of error have a good grasp of the material but are unable to demonstrate their understanding effectively during the test. If left unaddressed, these errors can continue to affect student performance even if their academic abilities are strong. Therefore, teachers need to equip students with effective test-taking strategies, such as careful question reading techniques, time management practice, and test simulation exercises to help them become more accustomed to handling exam pressure calmly and effectively.

**CONCLUSION**

Based on the findings of this study, it can be concluded that students made various types of errors in solving reasoning problems related to Sequences and Series, with the most frequent to least frequent being: Careless Errors (34.30%), Conceptual Errors (31.20%), Test-Taking Errors (21.80%), and Application Errors (17.50%). These errors were caused by multiple factors, including : Cognitive factors: weak conceptual understanding, limited procedural skills, and difficulties in translating word problems into mathematical models. Affective factors (attitudes and emotions): mathematics anxiety, negative self-belief, and low learning motivation. Metacognitive factors: lack of effective learning strategies, unawareness of one’s own mistakes, and inability to reflect on or evaluate the problem-solving process. Environmental factors: lack of academic support at home or school, such as the absence of additional guidance or an unconducive learning environment. For future researchers, it should be noted that this study focused only on a limited range of student errors through reasoning-based questions. Further research could explore student errors using other theoretical frameworks to better understand and minimize learning obstacles in mathematics, ultimately improving the overall learning process.

## REFERENCES

Ariati, C., & Juandi, D. (2022). Kemampuan Penalaran Matematis: Systematic Literatur Review. *LEMMA: Letters Of Mathematics Education*, *8*(2), 61–75.

Asih, N. W. R. K. et. al. (2023). Analisis Kesalahan Siswa Kelas VIII Dalam Menyelesaikan Soal Konstektual Pada Materi SPLDV Berdasarkan Teori Nolting. *Jurnal Pendidikan Matematika Undiksha*, *14*(1), 22–30.

Azizah, L., & Khoiri, M. (2022). Student Errors Analysis on the Subject of Class VII Algebraic Form Based on Nolting's Theory. *Journal Focus Action of Research Mathematic (Factor M)*, *5*(1), 78–96. https://doi.org/10.30762/f_m.v5i1.578

Deby Ashri Khardita, et. al. (2023). Analisis Kemampuan Penalaran Matematis Ditinjau Dari Kemandirian Belajar Pada Model Pembelajaran Student Facilitator And Explaining (SFE) Dengan Metode Flipped Learning Berbantuan Google Classroom. *Symmetry Pasundan Journal of Research in Mathematics Learning and Education*, *8*(2), 178–184.

Enung Puryati. (2017). Meningkatkan Hasil Belajar Siswa Dengan Menyelesaikan Soal Latihan Matematika Melalui Pembatasan Waktu Pada Setiap Pertemuan. *Prisma*, *7*(2), 192.

Erma Monariska. (2018). Upaya Meningkatkan Kemapuan Penalaran Matematis Siswa SMK Melalui Pembelajaran Kooperatif Tipe Numbered Head Together. *Prisma*, *7*(2), 217–226.

Fadillah, M. et. al. (2024). Analisis Kesalahan Siswa Kelas XI MA Ihsan Pekanbaru dalam Menyelesaikan Soal Penalaran Barisan dan Deret Berdasarkan Teori Newman. *Edumatnesia: Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika*, 175–189.

Feny Rita Fiantika, et. al. (2022). *Metode Penelitian Kualitatif*. PT. Global Eksekutif Teknologi.

Fitri Ulpa, et. al. (2021). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Konstektual pada Materi Bangun Ruang Sisi Datar Ditinjau dari Teori Nolting. *Square: Journal of Mathematics and Mathematics Education*, *3*(2), 67–80.

Hartati, S., Susanti, S., & Fera, M. (2024). Analisis Kesalahan Siswa SMP dalam Menyelesaikan Soal Penalaran Matematis Berdasarkan Jenis-Jenis Kesalahan Menurut Kastolan. *PHI: Jurnal Pendidikan Matematika*, *8*(1), 55. https://doi.org/10.33087/phi.v8i1.340

Hedi Budiman, et. al. (2020). Penerapan Teori Belajar Van Hiele Berbantuan Geogebra untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Prisma*, *9*(1), 47–56.

Kemendikdasmen. (2019). *Hasil PISA Indonesia 2018: Akses Makin Meluas, Saatnya Tingkatkan Kualitas*. Https://Www.Kemdikbud.Go.Id/Main/Blog/2019/12/Hasil-Pisa-Indonesia-2018-Akses-Makin-Meluas-Saatnya-Tingkatkan-Kualitas.

Lestari, M., Subanji, S., & Irawati, S. (2022). Analisis Kemampuan Penalaran Matematis Siswa SMA pada Materi Matriks. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(1), 550. https://doi.org/10.24127/ajpm.v11i1.4577

Linda, L., & Asyura, I. (2021). Students' mathematical reasoning ability in solving post-Covid-19 PISA model math problems. *Jurnal Riset Pendidikan Matematika*, *8*(2), 140–152. https://doi.org/10.21831/jrpm.v8i2.44739

Naval Setia Wibowo, R., Studi Pendidikan Matematika, P., & Keguruan dan Ilmu Pendidikan, F. (2024). *Analisis Kesalahan Nolting Pada Siswa Mengerjakan Soal Perbandingan Tingkat SMP*. *5*(2). https://doi.org/10.46306/lb.v5i2

Nur Yuliany, et. al. (2021). Analisis Kemampuan Penalaran Matematis Pada Mata Kuliah Aljabar Linear Elementer Mahasiswa Pendidikan Matematika Fakultas Tarbiyah Dan Keguruan UIN Alauddin Makassar. *Al Asma: Journal of Islamic Education*, *3*(2), 275–286.

Salsabila, A. (2024). *Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Teori Nolting*. *8*, 11–18.

Suci Sukmawati, & Risma Amelia. (2020). Analisis Kesalahan Siswa SMP dalam Menyelesaikan Soal Materi Segiempat Berdasarkan Teori Nolting. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *3*(5), 423–432.

Sujoko Waluyo. (2023). Analisis Kemampuan Penalaran Matematis Menggunakan Model PJBL Ditinjau Dari Kecerdasan Intrapersonal. *Pengabdian Masyarakat Dan Riset Pendidikan*, *2*(1), 286–290.

Waskitoningtyas, R. S. (2016). Analisis Kesulitan Belajar Matematika Siswa Kelas V Sekolah Dasar Kota Balikapapan pada Materi Satuan Waktu Tahun Ajaran 2015/2016. *Jurnal Ilmiah Pendidikan Matematika*, *5*(1), 24–32.