Analysis of Students' Errors in Solving Word Problems on Sequences and Series in a Wetland Context, Based on Kastolan's Error Theory

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DOI: https://doi.org/10.47772/IJRISS.2026.1026EDU0278

Received: 02 May 2026; Accepted: 07 May 2026; Published: 30 May 2026

ABSTRACT

Students frequently encounter difficulties solving word problems, particularly those that require contextual understanding, conceptual application, and procedural accuracy. This study aims to analyze the types of errors students make and identify the dominant errors in solving sequence and series word problems set within a wetland environmental context. A descriptive approach was employed within a mixed-methods explanatory design. Data were collected through written tests and structured interviews, and subsequently analyzed using Kastolan's error theory, encompassing conceptual, procedural, and technical errors. The research subjects comprised 29 Grade XI-4 students at State Senior High School 13, Banjarmasin. Quantitative analysis was conducted to calculate the percentages for each error type and to determine the interview subjects, while qualitative analysis was used to examine the underlying causes of student errors. The findings revealed that students committed all three error types, with conceptual errors accounting for 27.84%, procedural errors for 36.08%, and technical errors for 36.08%. Procedural and technical errors were identified as the dominant error types. Procedural errors were characterized by unsystematic solution steps and the omission of conclusions, whereas technical errors involved mistakes in arithmetic operations, mathematical notation, and value substitution. These dominant errors were primarily due to students' inability to interpret contextual information and translate it into appropriate mathematical models, as well as their lack of familiarity with systematically organizing solution steps. Interview data further confirmed that errors stemmed from insufficient understanding of mathematical modeling and computational inaccuracies. These findings underscore the importance of instructional approaches that prioritize conceptual understanding, procedural sequencing, and computational accuracy in solving contextual word problems.

Keywords: Student Errors, Story Problems, Sequences and Series, Kastolan Theory, Wetlands

INTRODUCTION

Education is the primary foundation for shaping a generation capable of facing the challenges of the times (Zahro, 2024). To address these challenges, the government has designed the Independent Curriculum (Curriculum Merdeka) as an educational policy focused on strengthening basic competencies and character building (Fauzan & Anshari, 2024; Nursafinah et al., 2024). One crucial aspect supporting this is mathematics learning within the Independent Curriculum, which emphasizes numeracy and contextual problem-solving skills as part of competency development. Numeracy is not only defined as the ability to calculate, but also the ability to understand quantitative information, analyze problems, and make logical decisions in various life contexts. Therefore, learning mathematics is expected to enable one to form systematic, critical, and reflective ways of thinking (Satriani et al., 2024; Tasya, 2025).

One topic with these characteristics is sequences and series. This material requires students to understand patterns, generalize relationships, and apply concepts to various situations (Handayani et al., 2020; Megarani et al., 2024; Nurjanah, 2023). In practice, sequences and series are often presented in the form of word problems so students can connect mathematical concepts to real-world problems. Such problems are intended to develop students' abilities to comprehend contextual information, translate situations into mathematical models, and solve them in a structured manner (Ndek et al., 2022; Satriani et al., 2024).

Ideally, eleventh-grade students should be able to solve word problems on sequences and series by understanding the known and requested information, determining the appropriate mathematical model, selecting the appropriate formula, and performing calculations carefully (Annisa & Kartini, 2021). However, field conditions indicate a gap between these expectations and the reality of learning. Initial observations at State Senior High School 13, Banjarmasin, showed that some students still had difficulty identifying key information in the problem, made mistakes in determining the type of sequence to use, and were not coherent in writing the solution steps. These findings align with research by Hasibuan et al. (2022), which found that students often make mistakes when selecting and applying concepts in sequence and series material.

Students' errors in solving word problems occur not only at the conceptual understanding stage, but also in the solution procedures and calculation accuracy. Annisa & Kartini (2021) and Abdurahman et al. (2026) found that procedural errors commonly arise when students fail to present solution steps systematically. Meanwhile, Ndek et al. (2022) stated that technical errors often result from inaccuracies in arithmetic calculations and algebraic manipulations. This condition indicates that students' difficulties are complex and require more in-depth analysis (Pirmanto et al., 2020).

To systematically identify and classify student errors, a clear theoretical framework is required. This study used Kastolan's error theory, which Fitriyah et al. (2020) divided into three categories: conceptual, procedural, and technical errors. Conceptual errors involve inaccuracies in understanding or applying concepts; procedural errors involve incoherent or incomplete solution steps; and technical errors involve errors in calculations or symbol writing. This theory has been widely used in error analysis research because it provides a systematic, operational classification (Hasibuan et al., 2022).

Several previous studies have investigated student errors in sequences and series using different analytical perspectives. Kurniasari et al. (2022) highlighted the role of contextual learning in supporting conceptual understanding, whereas Annisa & Kartini (2021) and Hasibuan et al. (2022) focused on error classification based on specific theoretical approaches. Nevertheless, most of these studies employed routine problems or general contexts without explicitly incorporating students' local environments.

In fact, using contexts close to students' lives can help them better understand the meaning of problems and increase learning engagement (Fahmi, Fajeriadi, 2024). In this study, story problems were developed in the context of wetlands, a typical environment in South Kalimantan and one close to students' lives. The integration of this local context is expected to provide a more meaningful learning experience and serve as a means to analyze how students model contextual problems in mathematical form. Thus, the novelty of this study lies in the analysis of student errors in solving sequence and series story problems, packaged in the context of wetlands, and examined in depth using Kastolan's error theory within a mixed-methods explanatory design. This approach allows analysis not only of the percentage of error types but also of their causes through in-depth interviews.

Based on this background, the present study aims to analyze the types of errors students make when solving sequence and series word problems in a wetland context, according to Kastolan's theory, and to determine the most dominant error category. The findings are expected to provide a comprehensive understanding of the forms and contributing factors of student errors, thereby informing the development of more effective, contextually relevant instructional strategies.

LITERATURE REVIEW

This study focuses on three main variables, namely student error analysis, Kastolan's Error Theory, and story problems in the context of wetlands.

Analysis of Student Errors

Error analysis is an approach used to identify and classify errors students make when solving mathematical problems. Through error analysis, researchers can identify the location and type of student difficulties, whether stemming from conceptual understanding, solution procedures, or calculation accuracy. Thus, error analysis not only assesses the final result but also evaluates students' thought processes in solving problems (Layn & Kahar, 2017; Lutvaidah & Hidayat, 2019).

Kastolan's Error Theory

This study uses Kastolan's Error Theory as an analytical framework. This theory classifies student errors into three categories: conceptual, procedural, and technical. Conceptual errors occur because students do not understand the concepts, definitions, or basic principles used; procedural errors relate to inaccuracies in systematically organizing solution steps; and technical errors are caused by calculation errors or lack of precision (Firdaus et al., 2021; Fitriyah et al., 2020; Hasibuan et al., 2022). This classification enables structured error identification, thereby revealing the most dominant error types and their underlying factors.

Story Questions in the Context of Wetlands

Word problems are mathematical problems presented in narrative form and related to real-life situations (Muntaha et al., 2020). Solving word problems requires the ability to understand information, model the problem mathematically, solve the model, and interpret the results in context (Rofi'ah et al., 2019; Utari et al., 2019). In this study, story problems were presented using the context of wetlands. Wetlands are areas naturally or artificially inundated with water, either permanently or seasonally, such as swamps, rivers, and tidal areas (Sari et al., 2022). Furthermore, wetlands are a unique environmental characteristic of South Kalimantan, possessing significant ecological, social, and cultural value (Mawaddah et al., 2022).

In the context of learning, wetlands serve as authentic contexts to connect mathematical concepts to students' environmental realities. This approach aligns with local wisdom-based learning, which aims to increase the material's relevance and meaningfulness (Martir et al., 2024; Sari et al., 2022). However, using a wetland context also requires students to abstract real-world situations into mathematical models, potentially leading to errors in both understanding and modeling.

METHODOLOGY

This study employed a descriptive design within a mixed-methods explanatory framework, in which quantitative and qualitative data are collected sequentially and subsequently integrated to yield a more comprehensive understanding of the phenomenon under investigation (Creswell, 2023). In the first, quantitative stage, written test data were analyzed to identify the types and relative frequencies of student errors. In the second, qualitative stage, semi-structured interviews were conducted to explore the underlying causes of the errors identified in the preceding stage.

The study was carried out at State Senior High School 13, Banjarmasin, during the odd semester of the 2025/2026 academic year. Participants comprised 29 students from Class XI-4 who had completed instruction on sequences and series. The central focus of the study was the classification of student errors in solving sequence and series word problems situated in a wetland context, analyzed through the lens of Kastolan's error theory.

The authors acknowledge that a sample of 29 students drawn from a single classroom in one school limits the generalisability of the findings. However, this study is intentionally designed as a qualitative-dominant descriptive investigation, in which analytical depth takes precedence over breadth. This approach aligns with established practice in qualitative mathematics education research, where purposive sampling from a specific setting enables in-depth exploration of error patterns rather than statistical generalization (Creswell & Creswell, 2023). Furthermore, the use of a single intact classroom ensures contextual homogeneity — all participants shared the same teacher, instructional materials, and learning environment — thereby reducing confounding variables that might otherwise obscure the relationship between error types and their underlying causes. The findings are therefore best understood as a rich, context-specific account that may serve as a theoretical foundation for subsequent larger-scale studies or inform instructional design within comparable educational settings in South Kalimantan.

Data were collected through written tests and semi-structured interviews. The written test comprised two open-ended items situated within a wetland context — one addressing arithmetic sequences and one addressing geometric sequences — each constructed to elicit multiple error indicators across all three of Kastolan's error categories simultaneously. Content validity was established through review by two mathematics education lecturers and one experienced mathematics teacher, who evaluated the items against the relevant learning objectives, the clarity of contextual language, and the alignment of each item with Kastolan's error indicators; their feedback was incorporated before administration. Construct validity was further supported by piloting the scoring rubric with a subset of student responses, confirming that error classifications remained consistent with the theoretical definitions articulated by Fitriyah et al. (2020). Scoring reliability was strengthened through intra-rater consistency checks, whereby the first author independently re-coded a random sample of responses on two separate occasions and resolved discrepancies through collegial discussion, yielding a high level of classification agreement. For the semi-structured interviews, reliability was supported through carefully prepared probing questions derived directly from each error indicator, ensuring that interview responses consistently captured information relevant to all three error categories. Data-source triangulation — systematically comparing written test results with interview evidence for each participant — served as a cross-validation mechanism to enhance the overall trustworthiness of the findings (Sugiyono, 2023).

Data analysis proceeded in two stages. In the quantitative stage, student responses were examined and classified into three error categories — conceptual, procedural, and technical — in accordance with Kastolan's error theory as operationalized by Fitriyah et al. (2020) and the indicators presented in Table 1. Error frequencies were then calculated to determine the percentages of each error type and identify the most dominant errors, while the overall error pattern informed the selection of interview participants.

Table 1: Castor error indicators

Type of Error	Type of Error
Conceptual Error	1. Students misunderstand the meaning of the question (including incorrectly writing down known and asked information). 2. Students make mistakes in creating models/equations from the statement in the question. 3. Students incorrectly determine the formula to be used. used in solving problems
Procedural Error	1. Students do not write down the solution steps according to the procedure. 2. Students carry out the wrong sequence of steps in solving the problem. 3. Students do not write the final conclusion of the answer.
Technical Error	1. Students make mistakes in performing calculation operations. 2. Students make mistakes in writing mathematical notation. 3. Students make mistakes in substituting values into formulas.

In the qualitative stage, interview data were analyzed through four sequential processes: data collection, data reduction, data presentation, and conclusion drawing. Following transcription, data reduction involved selecting and focusing on information directly relevant to each error type. The reduced data were then presented in descriptive narrative accounts that illustrated error patterns and their contributing factors. Conclusions were subsequently drawn by relating interview findings to the written test results.

The validity of the overall dataset was established through technical triangulation, which involved systematically comparing written test results and interview data to verify the consistency of findings across sources (Sugiyono, 2023). The integrated quantitative and qualitative analyses thus provide a comprehensive account of student errors in solving sequence and series word problems within a wetland context.

RESULTS AND DISCUSSION

Research data was obtained through written tests and interviews. Written tests were used to identify the types and dominant errors made by students, while interviews were conducted at different times to confirm and deepen the test findings as a form of triangulation.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue XXVI May 2026 | Special Issue on Education

Results

Based on the research conducted, the results of the study were obtained from the analysis of answers from 29 students working on sequence and series story problems in the context of wetlands. Each answer was classified according to Kastolan's Error Theory into conceptual, procedural, and technical errors. The types of errors students make when solving story problems in the context of wetlands, using material on sequences and series, are shown in Table 2.

Table 2: Classification of Types of Errors Made by Students

Type Error	Indicators	Question		Amount	Percentage (%)	Total	Percentage (%)
		1	2				
K	K1	11	13	24	9.41	71	27.84
	K2	2	13	15	5.88		
	K3	6	26	32	12.55		
P	P1	13	16	29	11.37	92	36.08
	P2	11	17	28	10.98		
	P3	11	24	35	13.73		
T	T1	18	16	34	13.33	92	36.08
	T2	13	18	31	12.16		
	T3	10	17	27	10.59		
Total				255	100.00	255	100.00

Based on the written test analysis, 255 errors were made by 29 students. These errors were spread across all Kastolan's error indicators, with procedural and technical errors at 36.08% and conceptual errors at 27.84%.

Based on the classification of errors made by students after working on story problems in the context of wetlands on the material of sequences and series, students were grouped again into several categories, namely, students who made high and low errors, to determine the subjects for interviews. high error categories (S1, S13 and S20) and low (S4, S12 and S22). This interview aims to obtain a more in-depth picture of the types of errors that appear in completing the written test, as well as

The reasons why students make these errors. The interview results were used to explain the previously obtained quantitative findings, particularly regarding the conceptual, procedural, and technical errors students made when solving word problems in the context of wetlands, as part of the material on sequences and series.

Conceptual Error

Conceptual errors are misunderstandings of concepts related to learning materials. Conceptual errors can also be interpreted as the misuse of formulas or problem-solving methods that do not comply with applicable rules or regulations (Hasibuan et al., 2022). Conceptual errors are errors related to conceptual understanding, formula use, and students' ability to model contextual problems in mathematical form.

Based on the analysis of written tests for 29 students, 71 conceptual errors (27.84%) were identified, distributed across three indicators: understanding the meaning of the question (K1), modelling the statement from the question (K2), and determining the formula used (K3).

Errors in the indicator of understanding the meaning of the question (K1)

Errors in the indicator of understanding the meaning of the question (K1) occurred in 24 errors (9.41%). These errors occur when students are unable to accurately identify known and asked-for information. One example is shown in subject S13's answer sheet in Figure 1.

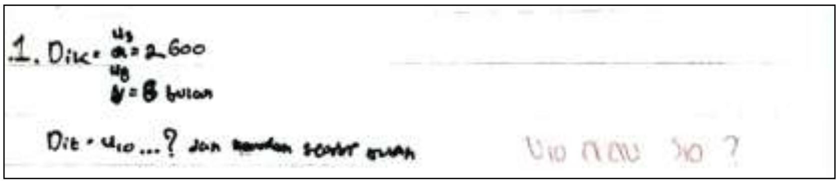

Figure 1: Conceptual Error of Indicator (K1)

Based on Figure 1, S13 was inaccurate in recording the known information, leading to an error in determining the time period used in the calculation. This misunderstanding of the initial information affected subsequent steps in the solution. This finding was strengthened by interview data. S13 admitted, “I was confused because the calculation was from the first month to August, so I directly used eight months”.

This statement indicates that students experience confusion in interpreting contextual information presented in narrative form. Students are unable to separate relevant from irrelevant information before entering the mathematical modelling stage.

Error in the indicator modeling the statement from the question (K2)

Errors in the indicator for modelling statements from questions (K2) were 15 (5.88%). These errors occur when students are unable to transform contextual information into an appropriate mathematical model. An example of an error is shown in subject S13's answer sheet in Figure 2.

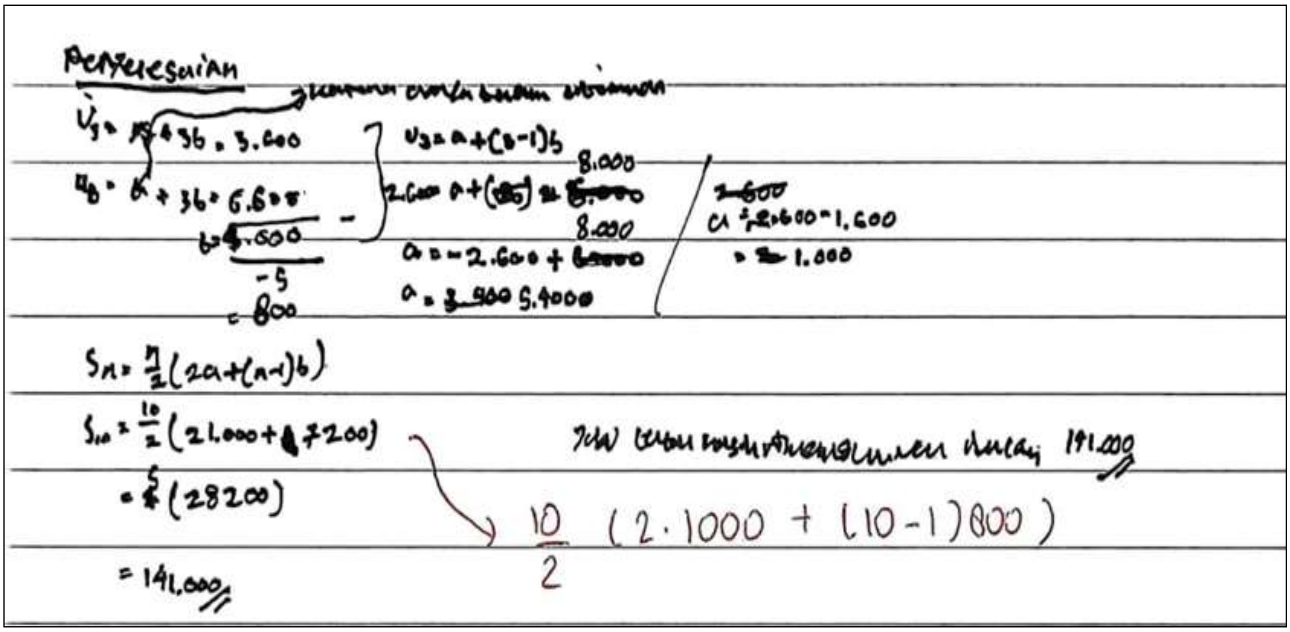

Figure 2: Conceptual error of indicator (K2)

Based on Figure 2, S13 was less precise in creating a mathematical model from the problem information, which must be linked to the formula. Interview data further revealed uncertainty in constructing mathematical models. S13 stated, “I didn’t know which model was correct, and maybe I wasn’t careful enough”. This shows that students do not understand the process, are not careful enough in mathematical modelling when solving story problems, and do not understand the concepts of sequences and series to solve these problems.

Errors in the Indicators Determining the Formula for Solving the Problem (K3)

Errors in the formula-determination indicator (K3) were the most common conceptual errors, accounting for 32 errors (12.55%). These errors occurred when students incorrectly selected or used the wrong sequence or series formula for the problem's characteristics. An example of this error is shown in S12's answer sheet in Figure 3.

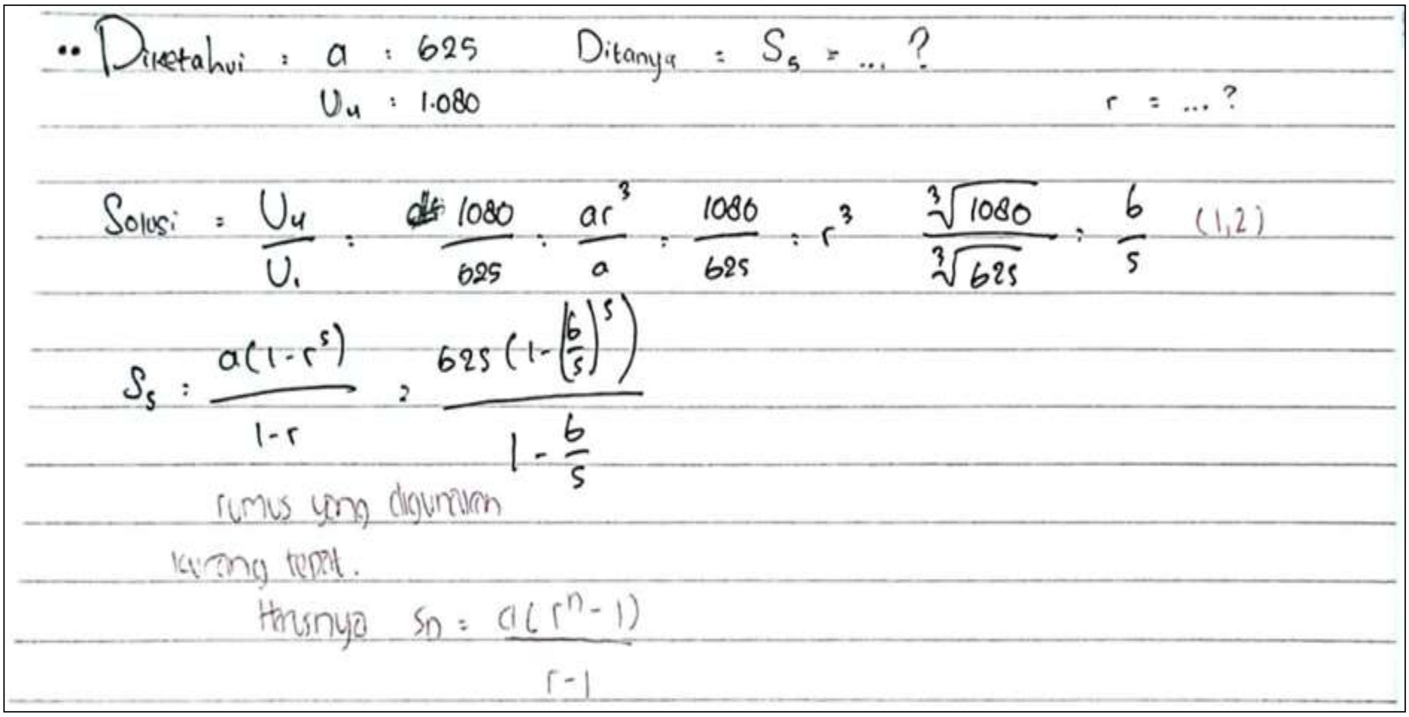

Figure 3: Conceptual error of indicators (K3)

Based on Figure 3, seen that S12 made a mistake because he was not precise in determining the formula used to solve the problem, where S12 used the geometric series formula with $r < 1$ even though the correct formula is the geometric series formula, $r > 1$. This makes students hesitate to continue solving the problem. This is reinforced by the results of the S12 interview, which stated: "I was mistaken because I was fooled by the ratio value, which was in fraction form, so I used the wrong formula."

These findings indicate that some students still memorize formulas, not yet fully grasping the concepts. When problems are presented in story form and in a local context, students struggle to identify the characteristics of appropriate sequences or series.

Overall, conceptual errors in this study indicate that students still experience difficulties in identifying important information from story problems, modeling contextual situations in mathematical terms, and selecting and using formulas appropriate to the characteristics of sequences or series. These errors indicate that students' conceptual understanding of sequences and series material has not been fully integrated with their ability to interpret problem context.

Procedural Error

Procedural errors are errors that occur in the stages or steps of solving a problem. According to Afdila et al. (2018), these errors are related to inaccuracies in the sequence of steps, the use of inappropriate procedures, or incomplete writing of the solution. Based on the written test analysis, 92 procedural errors (36.08%) were identified, making procedural errors one of the error types with the highest percentage, along with technical errors. Procedural errors in this study include three indicators: inappropriate solution steps (P1), incorrect sequence of solution steps (P2), and failure to write the conclusion (P3).

Error on Inappropriate Solution Step Indicator (P1)

Inappropriate solution step indicator (P1) errors were found in 29 cases (11.37%). Errors in the inappropriate solution step indicator (P1) are errors in writing solution steps that do not comply with the proper procedure. One example of an error in the inappropriate solution step indicator (P1) was demonstrated by student S4 based on his results on the problem. This error is shown in Figure 4.

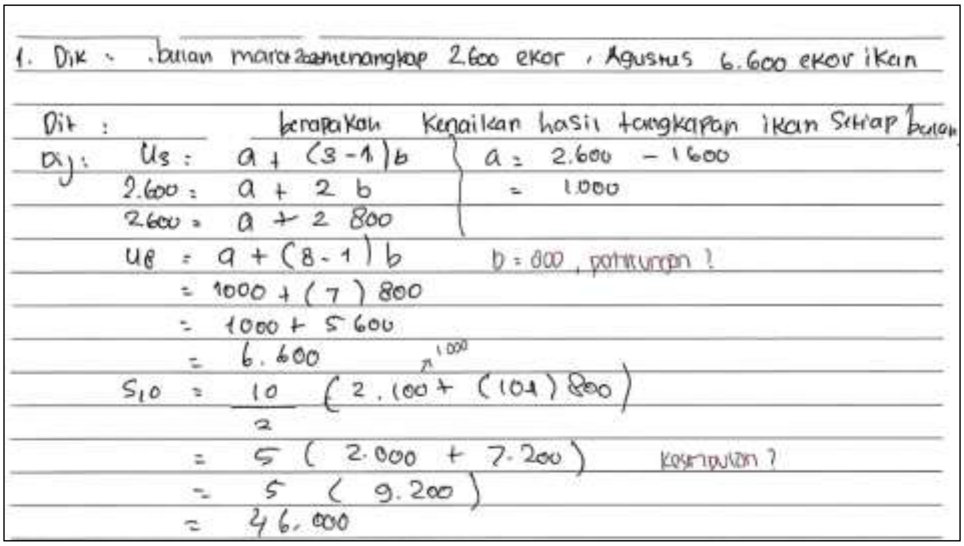

Figure 4: Procedural error indicator (P1)

Based on Figure 4, it can be seen that S4 made a mistake because he did not write down the solution steps systematically. S4 did not write down the calculation process in determining the difference value ($b = 800$). This procedural tendency was confirmed during the interview. S4 explained, “I thought the important thing was getting the final result, so I directly substituted the values into the formula”. This statement shows that students tend to be oriented towards the final result without paying attention to the accuracy and completeness of the solution procedure.

Error Indicator of Incorrect Sequence of Solution Steps (P2)

Errors in the incorrect sequence of solution steps (P2) indicator were found in 28 errors (10.98%). These errors occur when students perform the solution steps but do not follow a logical or systematic sequence. One example of an incorrect sequence of solution steps (P2) was demonstrated by an undergraduate student based on their work on the problem. This error is shown in Figure 5.

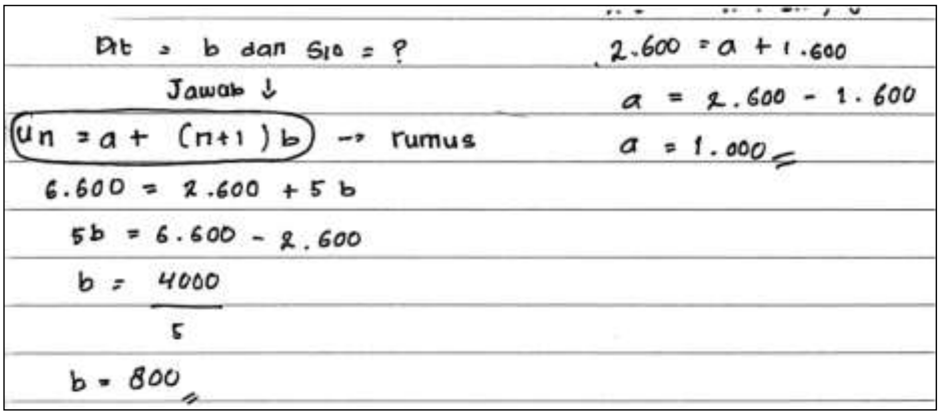

Figure 5: Procedural error indicator (P2)

Based on Figure 5, the answer sheet shows that S1 immediately calculated the sum of the series without first confirming the value of the first term or the difference/ratio. This incoherent step led to an inaccurate final result. This is reinforced by the interview results, where S1 stated: "I actually know the formula, but at that time I just calculated it straight away. I didn't think about the order."

This statement indicates that undergraduate students are not yet accustomed to developing structured problem-solving strategies. Students tend to focus on using formulas without considering the sequential steps required. This indicates that students' procedural understanding is not yet systematically integrated.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue XXVI May 2026 | Special Issue on Education

Indicator Error in Writing the Conclusion (P3)

The most common procedural error was failure to write a conclusion (P3), which occurred 35 times (13.73%). This error occurred when students completed calculations but failed to present the final answer in a statement appropriate to the story problem's context. One example of this error was demonstrated by subject S4, whose answer sheet is shown in Figure 6.

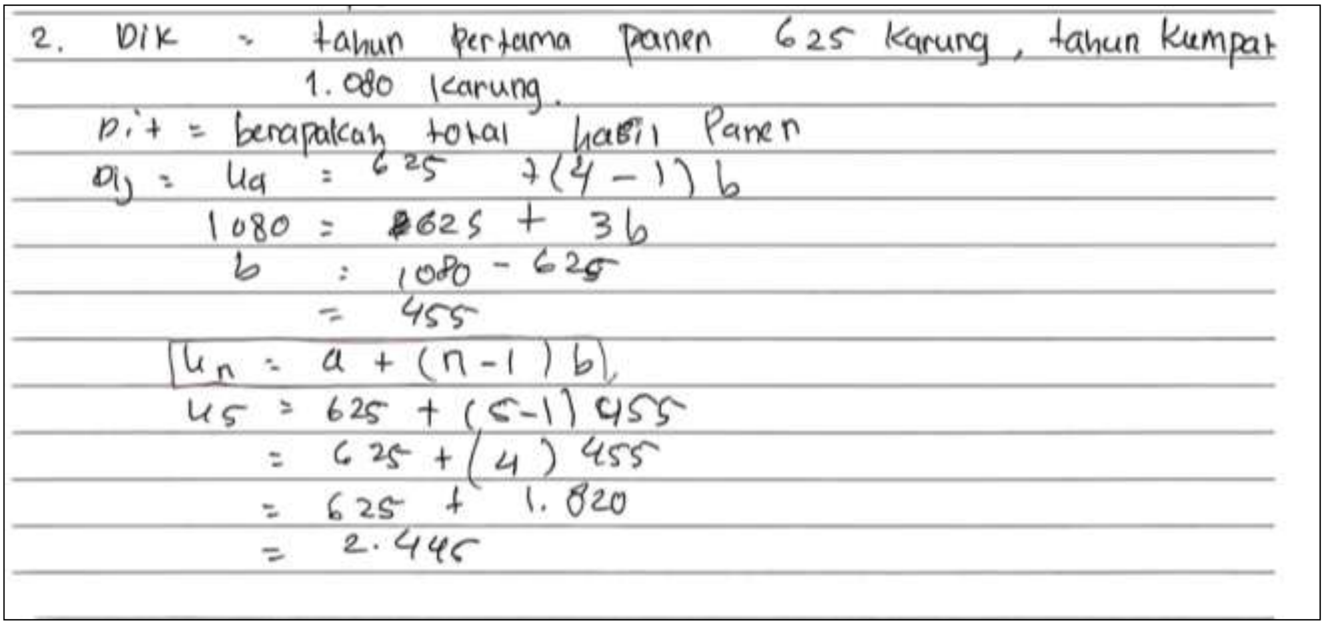

Figure 6: Indicator error in writing the conclusion (P3)

Based on Figure 6, the answer sheet shows that S4 stopped at the numerical calculation result without writing a conclusion that fully answers the question in the problem. The absence of a written conclusion was also clarified in the interview. S4 stated, “If I already have the numerical result, I think that already answers the question”. This statement shows that S4 considers the calculation result alone to be sufficient as a final answer. Students do not yet understand that, in story problems, the answer must be returned to the problem's context in the form of a complete sentence.

These findings indicate that some students are not yet accustomed to solving problems completely and systematically. Writing a conclusion is still considered an additional element, rather than a crucial part of the problem-solving process.

Overall, procedural errors indicate that students still experience difficulties in systematically organizing solution steps, determining a logical and structured sequence of work, and presenting final answers in the form of contextual conclusions. The predominance of procedural errors indicates that, in addition to conceptual mastery, students also need to become accustomed to solving word problems in a coherent, complete, and structured manner. This habituation is important so that students' thinking processes become more systematic and in line with the characteristics of mathematical problem-solving.

Technical Error

Technical errors are errors related to the accuracy of arithmetic operations, mathematical notation, and the accuracy of substituting values into formulas. Technical errors can also be defined as errors in calculations and in the use of symbols and signs during the problem-solving process (Firdaus et al., 2021). Based on the written test analysis, 92 technical errors (36.08%) were identified, making them, along with procedural errors, the most common type of error among students. Technical errors in this study include three indicators: calculation operation errors (T1), errors in writing mathematical notation (T2), and errors in substituting values into formulas (T3).

Error in calculation operation indicator (T1)

Errors in the calculation operation indicator (T1) were found to be 34 (13.33%). These errors occur when students have determined the concepts and formulas to be used but make mistakes in the calculation process. One example is shown in student S13's answer sheet, as shown in Figure 7.

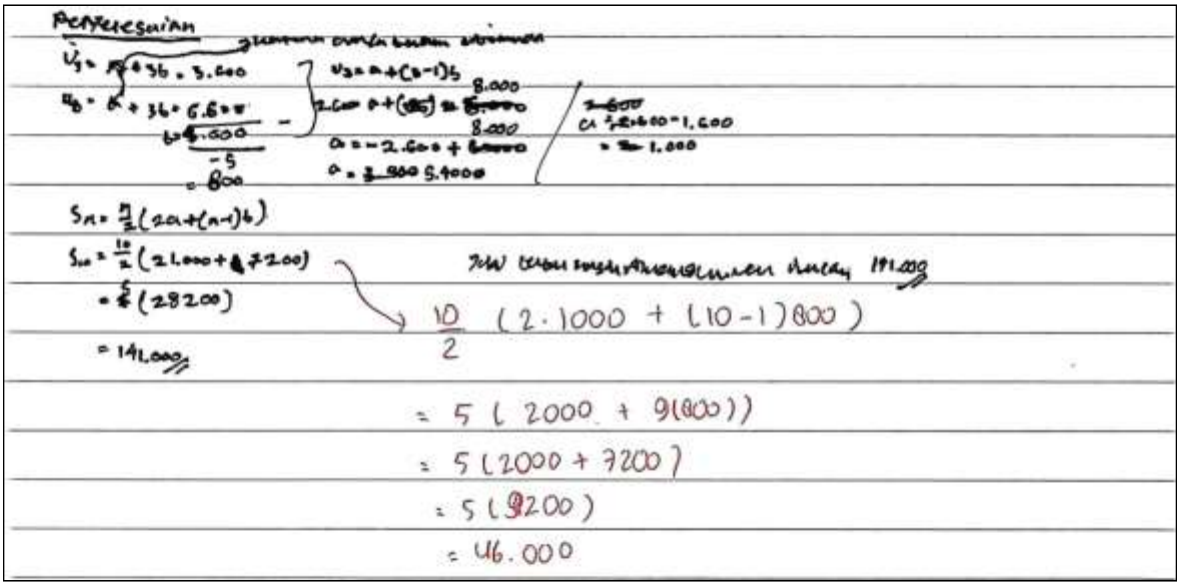

Figure 7: Error in the calculation operation indicator (T1)

Based on Figure 7, S13 used the correct formula for the problem, but the final result was incorrect due to an arithmetic error. This error affected the final result even though the initial steps were correct. It appears that S13 was not quite accurate in performing the calculation process in step $2a$, S13 wrote $2a = 21.000$, even though the correct calculation is $2a = 2 \cdot 1.000 = 2.000$. Interview data revealed that the error was related to accuracy rather than conceptual misunderstanding. S13 acknowledged, “Maybe I wasn’t careful when calculating”. This statement indicates that the technical error in this indicator is more due to the accuracy factor and the lack of rechecking of the calculation results.

Error in the Indicator of Writing Mathematical Notation (T2)

Errors in the mathematical notation writing indicator (T2) were found to be 31 (12.16%). These errors occur when students write the symbols, variables, or formulas used in the solution incorrectly. One example of an error demonstrated by student S4 on his answer sheet is shown in Figure 8.

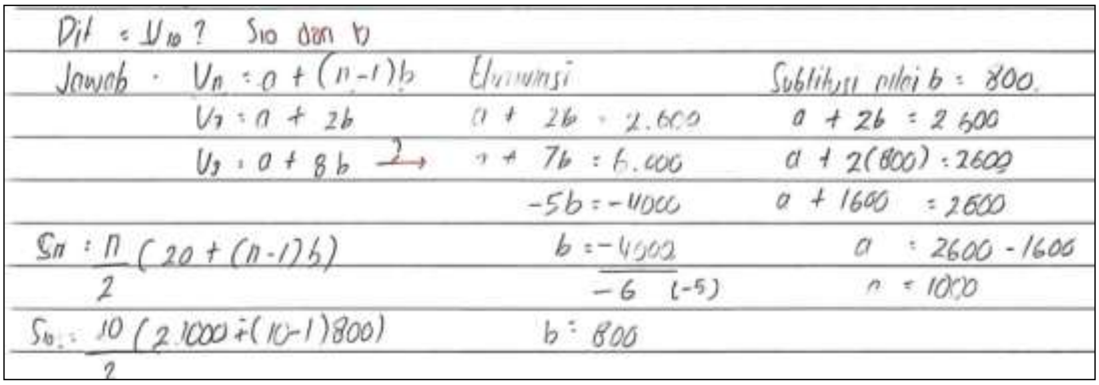

Figure 8: Error in writing mathematical notation (T2)

Based on Figure 8, on the S22 answer sheet, the number notation is not quite right due to inconsistent calculation steps. S22 wrote $-5b = -4000$, but in the next step write $b = \frac{-4.000}{-6}$, which shows inconsistencies in writing numbers and calculations. This is reinforced by the results of the interview with S22, who stated: "I was not thorough and rushed, and I also did not proofread the answers I wrote." This indicates that the error occurred due to a lack of thoroughness in the calculations, leading to incorrect numbers and insufficient time to double-check the results.

Error in Substitution Indicator Value into Formula (T3)

Errors in the indicator of substituting values into formulas (T3) were found to be 27 errors (10.59%). These errors occurred when students entered known values into the formula incorrectly. This was demonstrated by student S22 based on their results from the problem, as shown in Figure 9.

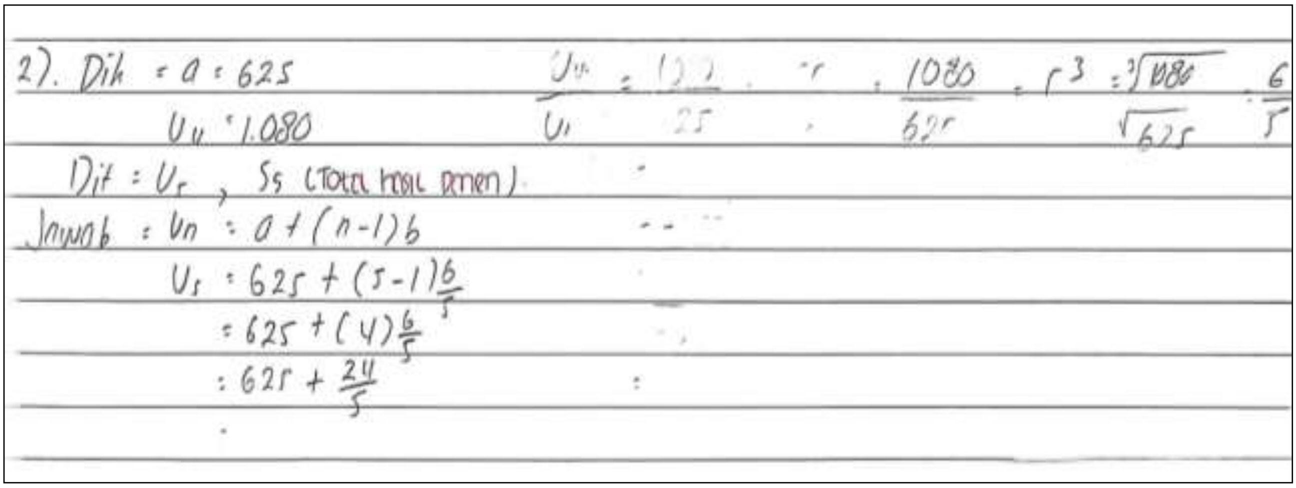

Figure 9: Error in the substitution of the indicator value into the formula (T3)

Based on Figure 9 on the answer sheet, S22 was not precise in substituting the obtained value for the requested value in the formula, which caused the final result to be inaccurate. The interview results showed that this error occurred because inaccurate or uncertain values were entered into the formula. S22 stated: "I was hesitant when entering the numbers, so maybe there was a mistake." This statement shows that substitution errors are not always due to ignorance of the concept, but rather to inaccuracies in the calculation process.

Overall, the technical errors in this study indicate that students still struggle to maintain accuracy during the problem-solving process. Although some students understood the concepts and procedures, errors in arithmetic operations, notation, and value substitution still led to inaccurate answers.

These findings indicate that, in addition to strengthening concepts and procedures, mathematics learning also needs to accustom students to working carefully and to rechecking calculation results.

DISCUSSION

The findings presented above reveal a consistent pattern of errors across all three of Kastolan's categories. These results are interpreted in relation to relevant theoretical frameworks and prior empirical studies, with particular attention to the factors underlying each dominant error type. The analysis confirms that students continue to experience substantial difficulties in solving sequence and series word problems embedded in a wetland context. The application of Kastolan's error theory provided a systematic, operationally transparent framework for classifying these difficulties into conceptual, procedural, and technical errors, as demonstrated in comparable studies on contextual mathematics error analysis (Ndek et al., 2022; Wusqo et al., 2025). This theoretical framework is particularly relevant for identifying the nature of student deviations in solving contextual mathematics problems (Afdila et al., 2018; Rofi'ah et al., 2019).

Based on percentage analysis, procedural and technical errors were the most prevalent, accounting for 36.08% of total errors, while conceptual errors accounted for 27.84%. Among procedural errors, the most frequent indicator was failure to write a conclusion to the answer (P3), at 13.73%. This finding is consistent with the study by Ugat and Pagara (2025), which demonstrated that although students were capable of performing calculations, they were not accustomed to solving problems systematically and comprehensively — particularly in presenting final answers in accordance with the problem's contextual requirements. This pattern suggests that student problem-solving remains oriented toward the computational process rather than toward the complete and coherent communication of results. The finding further aligns with Situmorang et al. (2023), who observed that students frequently neglect to write conclusions because they perceive the answer as having already been obtained through calculation alone. Interview data from the present study reinforce this finding, revealing that students regard the conclusion as a peripheral and dispensable component of the solution process — an attitude that underscores the need to cultivate habits of systematic problem-solving, as advocated by Damanik et al. (2025).

The technical error rate of 13.33% recorded for the calculation operation indicator (T1) further demonstrates that computational accuracy constitutes a critical factor in successful problem-solving. Even when students correctly identify and apply the appropriate formula, calculation errors yield inaccurate final results, indicating that conceptual mastery alone does not guarantee correct solutions unless accompanied by careful, accurate computation. Rofi'ah et al. (2019) attributed technical errors to weak prerequisite skills in arithmetic operations. Interview findings from this study corroborate that observation, revealing that students frequently work hastily, express uncertainty about their calculations, and neglect to verify their answers — a pattern consistent with Wusqo et al. (2025), who similarly found that calculation errors arise from insufficient care and the absence of answer-checking habits.

Regarding conceptual errors, the most prevalent indicator was the incorrect selection of the appropriate formula (K3), at 12.55%. This finding suggests that a considerable proportion of students do not fully understand the distinguishing characteristics of sequences and series as they apply to word problems, particularly when the relevant information is presented implicitly within the problem context. Wijaya et al. (2023) attributed errors in formula selection to students' inability to establish meaningful connections between problem contexts and relevant mathematical concepts. Interview data from this study indicate that students tend to memorize formulas without developing an understanding of their functions or the conditions under which they apply. This condition reflects an insufficient integration of conceptual understanding of sequences and series with the capacity to interpret contextual information. Handayani et al. (2020) and Zebua et al. (2020) similarly emphasized that sustained engagement with word problems and the adoption of instructional strategies that prioritize conceptual understanding are essential for reducing the frequency of such errors.

The wetland context employed in this study served a deliberate pedagogical and methodological purpose: to ground mathematical problems in an environment that is ecologically and culturally familiar to students in South Kalimantan. The contextual problems were developed through a systematic three-stage design process. In the first stage, authentic wetland scenarios were identified in consultation with the classroom teacher to ensure both ecological accuracy and cultural relevance to students' lived experiences. In the second stage, the mathematical content of each scenario was mapped onto specific learning objectives for arithmetic and geometric sequences, ensuring that each contextual narrative required students to identify relevant numerical information, construct an appropriate mathematical model, and apply the correct formula. In the third stage, the contextual problems were submitted to expert validation, during which mathematics education lecturers and a practicing teacher assessed the clarity of the narrative, the appropriateness of the embedded contextual information, the mathematical accuracy of the intended solution pathways, and the suitability of the difficulty level relative to the Grade 11 curriculum. Revisions were subsequently made in response to validator feedback before the instruments were administered. This design and validation process aligns with the principles of authentic contextual problem development advocated by Fahmi and Fajeriadi (2024) and Mawaddah et al. (2022), who emphasized that wetland-based learning materials must be both mathematically rigorous and ecologically meaningful in order to maximize student engagement and conceptual relevance.

Analysis of written test responses and interview data indicates that the wetland context was not identified as the primary source of student errors. Rather, errors were concentrated in the conceptual, procedural, and technical dimensions, suggesting that the context functioned effectively in situating the problems without introducing undue linguistic or cultural complexity. This finding indicates that a well-validated contextual framework can support problem comprehension, while a successful solution remains contingent on students' mastery of the underlying mathematical concepts and their capacity to execute solution procedures systematically and accurately.

Taken together, the findings indicate that students' errors in solving sequence and series word problems are attributable not only to gaps in conceptual understanding, but also to limited ability to organize solution steps systematically and to insufficient computational accuracy. Accordingly, mathematics instruction must strike a balance among conceptual reinforcement, procedural fluency, and the cultivation of disciplined habits for approaching word problems in a sequential, contextually grounded manner.

Viewed integratively, conceptual, procedural, and technical errors are inherently interrelated. Unresolved conceptual errors tend to precipitate procedural errors, which in turn give rise to technical errors. These three error types are therefore not isolated phenomena; rather, they constitute an interconnected chain within the broader process of word problem-solving.

CONCLUSION

This study identified three categories of errors students make when solving sequence and series word problems in a wetland context: conceptual, procedural, and technical. Conceptual errors manifested as students' inaccurate interpretations of problems, flawed construction of mathematical models, and inappropriate selection of formulas. Procedural errors were evidenced by incoherent solution steps and the consistent omission of concluding statements. Meanwhile, technical errors were observed in arithmetic operations, mathematical notation, and the substitution of values into formulas.

The percentage analysis revealed that procedural and technical errors were the most prevalent, accounting for 36.08% of all identified errors. This finding indicates that, beyond incomplete conceptual understanding, students experienced considerable difficulty in developing solution steps systematically and performing calculations with sufficient accuracy. Interview data corroborated these quantitative findings, demonstrating that students were unable to interpret contextual information into appropriate mathematical models and had not yet developed the habit of constructing coherent, well-organized solution steps. The convergence of quantitative and qualitative results confirms that student errors were attributable not solely to deficiencies in conceptual understanding, but equally to limitations in procedural competence and computational precision.

RECOMMENDATIONS

To mitigate these errors, several instructional strategies are proposed. First, teachers should prioritize developing a deep conceptual understanding of sequences and series, rather than encouraging rote memorization of formulas. Second, students should be systematically trained to approach word problems through structured procedures, including the explicit documentation of known information, the formulation of mathematical models, the execution of solution steps, and the articulation of conclusions. Third, teachers are encouraged to cultivate computational accuracy by instilling the habit of verifying calculations. Fourth, integrating locally relevant contexts — such as the wetland environment — is recommended to enhance students' contextual comprehension and engagement in mathematics learning. The consistent application of these strategies is expected to support students in developing disciplined, systematic problem-solving practices when confronted with contextual mathematical tasks.

ACKNOWLEDGEMENT

The author expresses sincere gratitude to the validators for their valuable feedback and suggestions on the research instruments. The author is deeply grateful to the supervisor for the guidance, support, and constructive input provided throughout the research process and the preparation of this article.

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