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Errors and Barriers Among Islamic Religious Education Students with Low Numeracy Literacy in Solving Zakat Problems

Leoni Lovi[1*], Wulandari Chintia P[2]

[1 2] *Tadris Matematika, UIN Sulthan Thaha Saifuddin Jambi, Provinsi Jambi, Indonesia.*

[*] Correspondence: lovileoni@uinjambi.ac.id

Abstract

This study aims to describe the errors and barriers encountered by Islamic Religious Education (PAI) students with low numeracy literacy in solving zakat problems, as examined through numeracy literacy indicators. A qualitative descriptive design was employed. The participants were PAI students at UIN Sulthan Thaha Saifuddin Jambi, selected purposively based on the results of a numeracy literacy diagnostic test. Data were obtained from a written zakat-context test, observations of the problem-solving process, and semi-structured interviews. The data were analyzed through data reduction, data display, and conclusion drawing. The findings indicate that, although students generally understand the zakat context, they experience barriers in several key numeracy literacy indicators: (1) interpreting quantitative information, (2) reasoning and modeling relationships among variables, (3) performing calculations in a systematic and structured manner, and (4) evaluating and reflecting on the reasonableness and completeness of the results. The dominant errors include neglecting nisab as a numerical decision threshold, selecting inappropriate data and operations, and producing incomplete solutions. These results suggest that efforts to strengthen zakat instruction should prioritize the comprehensive development of numeracy literacy, rather than focusing solely on computational proficiency.

Kata kunci: Numeracy Literacy; Error Analysis; Qualitative Study

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PENDAHULUAN

Numeracy is an essential competence involving the use of numbers and basic mathematical representations to interpret information, model real-world situations, perform calculations, and evaluate the reasonableness of results for decision-making in authentic contexts (K. E. Anggraini & Setianingsih, 2022). A growing body of research indicates that numeracy literacy is associated with critical thinking and the accuracy of contextual problem-solving, underscoring its importance as a key competence that should be developed meaningfully through everyday-life contexts (Ilmiah & Pendidikan, 2023).Literature review based studies further indicate that challenges in numeracy literacy in Indonesia remain substantial, particularly in contextual tasks comparable to PISA. Accordingly, instructional practices should strengthen students' capacity to interpret data, construct appropriate mathematical models, and critically evaluate their solutions (Ningrum et al., 2023).

Among students in the Islamic Religious Education (PAI) program, numeracy literacy extends beyond computational skills to include the ability to understand and apply quantitative concepts within religious contexts governed by specific rules and calculation parameters, such as zakat. Zakat requires condition-based decisions (e.g., nisab and haul) and involves diverse calculation procedures (including zakat al-fitr, zakat al-mal, professional zakat, trade zakat, and zakat in digital contexts), thereby demanding the ability to interpret information, select relevant data, determine appropriate operations, and draw accurate conclusions (Wahyu Cahyanta et al., 2025).

However, previous studies have shown that students still encounter difficulties in solving zakat-related problems involving numeracy components, including misunderstandings of problem contexts, errors in selecting relevant information and constructing appropriate computational models, procedural inaccuracies, and misinterpretation of results that lead to incorrect conclusions. Despite these findings, existing research has predominantly focused on factors influencing zakat behavior and general financial literacy, with limited attention given to the specific patterns of numeracy-related errors and the underlying cognitive barriers experienced by students in solving zakat problems. Similar patterns of error in contextual problem-solving have been widely reported in AKM/PISA-based numeracy literacy research employing error analysis frameworks (e.g., Newman's procedure), particularly at the stages of comprehension, model transformation, process skills, and final response encoding (Auliya et al., 2025a).

Nevertheless, research that explicitly examines numeracy literacy within zakat problem-solving contexts in Islamic Religious Education remains limited. Existing studies tend to emphasize general numeracy achievement or instructional effectiveness, while paying less attention to the specific error patterns and learning barriers experienced by students, particularly those with low numeracy literacy. As a result, there is a lack of empirical evidence that can inform targeted and context-sensitive zakat instruction grounded in students' actual difficulties (Y. N. Anggraini & Indrarini, 2022).

This issue warrants close examination among students with low numeracy literacy because their difficulties tend to stem from fundamental limitations in quantitative reasoning and in monitoring and regulating the problem-solving process. In this study, the mathematical problem-solving process refers to a series of cognitive and procedural stages undertaken by students, including understanding the problem context, interpreting and selecting relevant quantitative information, constructing an appropriate mathematical model, executing calculations systematically, and evaluating the reasonableness and completeness of the results. Examining this process is essential because errors in contextual problems such as zakat calculations often do not solely arise from computational weaknesses, but from breakdowns occurring at specific stages of the problem-solving process, which may remain undetected if only final answers are considered. Accordingly, the study entitled "Errors and Barriers Among Islamic Religious Education Students with Low Numeracy Literacy in Solving Zakat Problems" is needed to systematically map the types of errors and barriers they experience, thereby providing an empirical basis for improving more contextualized and effective zakat instructional strategies (Ramadhan et al., 2025).

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METHOD

This study employed a qualitative descriptive design to provide an in-depth account of the errors and barriers experienced by Islamic Religious Education (PAI) students with low numeracy literacy in solving zakat-related problems. This design was selected because it enables the researcher to examine participants' thought processes, the rationale underlying their solution steps, and the sources of difficulty that may not be evident from final answers (Creswell & Creswell, 2022).

The participants were Islamic Religious Education (PAI) students at UIN Sulthan Thaha Saifuddin Jambi who had completed the Fiqh course unit covering zakat. Participants were selected purposively, namely by identifying students classified as having low numeracy literacy based on researcher-defined criteria and initial test results (Kurniawan et al., 2025).Diagnostic test–based grouping of this kind is commonly used in numeracy literacy research to ensure that error analysis is focused on the characteristics of the target group(Ramadhan, Purnomo, Ruron, Tampubolon, et al., 2025).

Research data were collected through tests, observations, and interviews. The test was administered to obtain students' solutions to zakat problems and to identify error patterns across numeracy literacy indicators. The test items were developed based on a blueprint covering key numeracy literacy components, including (1) understanding zakat contexts (e.g., types of zakat and nisab conditions), (2) interpreting quantitative information, (3) constructing mathematical models, (4) performing calculations, and (5) evaluating the reasonableness and completeness of results. Observations were conducted to examine participants' processes, strategies, and step-by-step control while solving the tasks. The observation sheet was designed based on indicators of the mathematical problem-solving process, including students' ability to understand problems, select relevant data, organize solution steps, apply appropriate procedures, and monitor their progress during problem-solving. Semi-structured interviews were used to explore the rationale for selecting specific data and operations, difficulties encountered during the modeling stage, and participants' habits of checking the reasonableness and completeness of their answers. The interview guideline was developed to probe students' thinking at each stage of the problem-solving process, including understanding the problem, transforming it into a mathematical model, carrying out procedures, and evaluating the final results. The detailed instrument blueprints are provided in Appendix. Combining test and interview data is commonly adopted in AKM-oriented numeracy error analysis particularly within Newman's framework because it helps clarify the sources of errors from the participants' perspectives (Wardhani, 2024).

The collected data were processed and analyzed through the stages of data reduction, data display, and conclusion drawing. In the data reduction stage, students' written responses, observation notes, and interview transcripts were carefully reviewed, coded, and categorized to identify relevant segments related to numeracy literacy indicators and types of errors in solving zakat problems. Irrelevant or redundant data were eliminated to focus the analysis on meaningful patterns. In the data display stage, the reduced data were systematically organized in the form of descriptive matrices and narrative summaries to facilitate the identification of recurring error patterns and their distribution across problem-solving process. This stage enabled the researcher to compare findings across different data sources (tests, observations, and interviews) and to examine the consistency of students' responses and behaviors. In the conclusion drawing stage, interpretations were developed by linking the identified error patterns with the underlying barriers experienced by students at each stage of the problem-solving process. These conclusions were continuously verified by re-examining the data to ensure their validity and consistency. Test and observation data were used to identify recurring patterns of errors, whereas interview data served to clarify and substantiate findings regarding the barriers underlying errors at each stage of problem-solving. The trustworthiness of the findings was strengthened through source triangulation (tests, observations, and interviews), resulting in a more comprehensive and internally consistent account of the identified errors and barriers (Endradewi et al., 2025).

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RESULTS AND DISCUSSION

Results

The results are presented according to numeracy literacy indicators: (1) contextual understanding, (2) interpretation of quantitative information, (3) reasoning and modeling, (4) calculation and evaluation processes, and (5) evaluation and reflection. A similar set of indicators is consistently employed in many AKM/PISA-related studies that emphasize the ability to comprehend information, construct mathematical models, perform calculations, and evaluate solutions (Faridh Ricky Fahmy et al., 2025).

In general, students with low numeracy literacy were able to recognize the overall context of zakat problems (e.g., identifying the type of zakat involved). However, they remained weak on more critical indicators interpreting data, linking variables, constructing an appropriate calculation model, and evaluating the results.

Several mathematical concepts were found to be problematic. First, students had difficulty applying nisab as a decision threshold, as they often proceeded directly to calculations without prior comparison. For example:

"total wealth amount = Rp 50,000,000 → zakat amount = 2.5% × 50,000,000." (S1, written response)

Second, errors occurred in selecting relevant quantitative information, where students included inappropriate data, such as:

"zakat amount = savings + house + car ..." (S2, written response)

indicating a failure to distinguish between zakatable and non-zakatable assets.

Third, students showed weaknesses in mathematical modeling, particularly in determining appropriate operations. For instance:

"zakat amount = 2.5% + 50,000,000." (S3, written response)

Finally, students demonstrated limited procedural completeness and evaluation, as some stopped after identifying that zakat was obligatory without completing the calculation:

"... → zakat is obligatory." (S4, written response)

These findings indicate that students' errors are not merely computational but are rooted in weaknesses across multiple stages of the problem-solving process. Similar patterns have been reported in AKM-based numeracy literacy studies, in which students may recognize the context but fail to translate it into a complete and well-regulated numerical procedure (Ramadhan, Purnomo, Ruron, & Tampubolon, 2025).

1) Contextual understanding is present, but it has not been translated into a numerical decision (treating nisab as a decision threshold).

In several items, students recognized that *nisab* functions as a requirement or threshold that determines whether zakat is obligatory. However, *nisab* was not treated as an explicit numerical step namely, comparing net wealth against the threshold and making a decision based on that comparison. Instead, students often applied the zakat percentage immediately without demonstrating a data-driven decision process. For example, one student wrote:

"Total wealth amount = Rp 50,000,000 → zakat amount = 2.5% × 50,000,000." (S1, written response)

This response indicates that the student omitted the comparison step between total wealth amount and the *nisab* threshold before performing the calculation. Mathematically, this reflects a misunderstanding of the concept of inequality comparison and conditional decision-making, where the operation should only be applied after verifying that the condition (wealth ≥ nisab) is satisfied.

This "compute-first" pattern, in which calculation proceeds without a threshold-based decision, is consistent with findings from numeracy literacy research using Newman's procedure: the context may be verbally understood, yet it fails to be transformed into a mathematical decision (Auliya et al., 2025b).

Interview excerpt:

Researcher: "How do you ensure that the nisab requirement has been met?"
Student: "I know there is nisab, but I'm confused about how to compare it, so I just calculate it first."

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This excerpt indicates weak threshold reasoning. The student understands the concept verbally, but is unable to perform the required comparison step and to derive a decision from the comparison outcome (Yuda & Rosmilawati, 2024).

2) Weak interpretation of quantitative information: difficulty selecting relevant data and appropriate operations.

In problems containing multiple pieces of quantitative information, students often struggled to identify which data were relevant and which operations were appropriate (addition, subtraction, or multiplication). They tended to select numbers that "appeared important" or to rely on memorized examples, rather than interpreting the functional role of each value within the structure of the mathematical model. For example, one student wrote:

"Total wealth amount = savings + income + gold = Rp 50,000,000 + Rp 5,000,000 + Rp 10,000,000." (S2, written response)

without distinguishing whether each component was subject to zakat or whether certain elements required adjustment (e.g., deductions or different treatment based on zakat type). Another response showed inappropriate operation selection:

"zakat amount = total wealth amount − 2.5%." (S3, written response)

This indicates a misunderstanding of the role of percentage as a multiplicative operator rather than a value to be subtracted. Mathematically, these responses reflect difficulties in classifying quantitative information based on its function (e.g., assets, deductions, rates) and in selecting appropriate operations to represent relationships among variables within the model.

This finding aligns with AKM-oriented numeracy literacy research reporting dominant errors in selecting quantitative information, transforming situations into mathematical representations, and executing process skills (Faridh Ricky Fahmy et al., 2025).

Interview excerpt:

Student: "Sometimes there are many numbers, so I choose the ones I understand…"

Student: "I'm afraid of making a mistake, so I usually follow an example I remember."

These responses indicate barriers in interpreting quantitative information and in mathematical modeling. Students have not yet been able to classify data according to its function (e.g., wealth components, deductions, rates, and unit conversions), which leads to partial or incomplete models (Faridh Ricky Fahmy et al., 2025). In many cases, students treated all numerical values as equally relevant, without distinguishing their roles within the zakat calculation structure. As a result, important elements such as deductible assets or conversion factors were either ignored or incorrectly applied. This misclassification affects the selection of appropriate operations and disrupts the logical sequence of the solution process. Consequently, the resulting models fail to accurately represent the relationships among variables, leading to incorrect or incomplete solutions.

3) Inconsistent reasoning and modeling: solution steps are incomplete or stop midway.

Students often fail to develop the solution model fully to address all task demands. They tend to stop after obtaining an intermediate outcome (e.g., checking whether the zakat requirement is met) and do not proceed to the next required step (e.g., calculating the zakat amount). For example, one student wrote:

"Total wealth amount = Rp 90,000,000, nisab = Rp 85,000,000 → zakat is obligatory." (S4, written response)

This response shows that the student correctly performed the comparison step but did not continue to calculate the zakat amount (2.5% × total wealth amount), indicating an incomplete solution. Mathematically, this reflects a failure to complete a multi-step problem-solving process, where the task requires both decision-making (meeting the threshold condition) and subsequent computation. This "midway stopping" phenomenon suggests weak process monitoring and lack of awareness of task completeness. Similar patterns have been frequently reported in Newman-based error analyses of contextual problem-solving (Auliya et al., 2025a).

Interview excerpt:

Student: "Sometimes I stop because I think I'm done… I forget that the problem also asks me to calculate the zakat."

This response reflects weak process monitoring and inadequate evaluation of solution completeness both of which are key components of numeracy literacy in contextual problem-solving

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(Mandailina et al., 2025). Students tend to assume that obtaining a partial result indicates task completion, without verifying whether all required steps have been carried out. This suggests limited awareness of the sequential nature of multi-step problems, particularly in distinguishing between intermediate results and final answers. As a consequence, important procedures such as calculating the zakat amount after determining eligibility are often omitted. In addition, students rarely engage in reflective checking to ensure that their solutions are complete and consistent with the problem requirements. This lack of monitoring and evaluation ultimately leads to incomplete or inaccurate problem-solving outcomes.

4) Relationships among variables in tabular information are not yet established (the "quantity–rate–zakat amount–conversion" relation).

In table-based problems (e.g., zakat al-fitr), students were able to extract numerical values from the table but were not yet able to construct coherent relationships among variables. The table was treated as a collection of numbers rather than as a relational system (e.g., number of beneficiaries × rate per person = zakat amount, followed by conversion to monetary value when required). For example, one student wrote:

"Number of people = 4, rice per person = 2.5 kg → zakat amount = 6.5 kg." (S5, written response)

This response indicates an incorrect relationship among variables, as the student applied addition instead of multiplication (4 × 2.5 kg = 10 kg). Another student stated:

"zakat amount = 4 people." (S6, written response)

without incorporating the zakat rate per person, which shows a failure to construct a complete mathematical model. Mathematically, these responses reflect weaknesses in relational reasoning, particularly in understanding multiplicative relationships and maintaining unit consistency in contextual problems. This weakness in model transformation has been consistently reported in AKM/PISA-oriented numeracy literacy studies (Faridh Ricky Fahmy et al., 2025).

Interview excerpt:

Student: "I only take the number of people. Once I get the zakat amount, I assume that is the answer."
Student: "I often hesitate… I'm confused about where the multiplication should be done."

These responses indicate barriers in relational modeling (i.e., constructing a "situational formula"), resulting in multiplication, addition, or conversion steps that are either incorrect or incomplete. Students tend to focus on individual numerical values rather than understanding the relationships among variables required to form a coherent mathematical structure. As a result, they often apply operations based on surface features of the problem rather than on the underlying relationships between quantities. This difficulty suggests that students have not yet developed the ability to represent contextual situations as structured mathematical expressions. In addition, errors in unit conversion further indicate a lack of understanding of how different quantities are connected within the model. Consequently, the constructed solutions fail to accurately represent the problem context and lead to incorrect zakat amount calculations.

5) Limited evaluation and reflection: rarely checking reasonableness, conditions, and completeness

Students rarely provided evidence of checking the reasonableness of their results or verifying consistency with zakat requirements. They were also not accustomed to reviewing whether all relevant data had been used and whether all parts of the question had been answered. Numerous studies in numeracy literacy highlight the importance of evaluation and reflection such as checking reasonableness, completeness, and consistency as key features that distinguish mechanical computation from numerate problem-solving.

Interview excerpt:

Student: "Rarely. Once I get a number, I consider it finished."

This suggests that evaluation and reflection indicators have not yet developed adequately; consequently, errors in modeling and data use persist to the final answer (Syaepudin et al., n.d.). Students tend to accept their initial results without engaging in further verification or reconsideration of their solution steps. This indicates a limited ability to assess the reasonableness of the obtained zakat amount in relation to the problem context. In many cases, students do not recheck whether all relevant data have been used or whether the applied procedures are consistent with the given conditions. As a result, inaccuracies in earlier stages of problem-solving remain uncorrected and directly affect the final

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outcome. This lack of reflective evaluation highlights the need to strengthen students' critical disposition in numeracy-based problem-solving

Discussion

The findings confirm that the primary issue among students with low numeracy literacy lies in the quality of their numeracy literacy rather than merely their computational ability. In zakat-related tasks, students must integrate fiqh-based contextual understanding with numeracy processes: interpreting quantitative information, identifying variables and their relationships, constructing a context-appropriate model, and using the results to make accurate decisions. Weaknesses across these stages lead to solutions that are mechanical, poorly regulated, and prone to error. Similar patterns have been reported in AKM/PISA research, where dominant errors occur at the stages of comprehension, transformation, process skills, and final response encoding (Auliya et al., 2025a).

First, the findings regarding *nisab* reveal weak threshold reasoning. Students recognize *nisab* as a requirement but do not operationalize it as a comparison procedure that determines whether zakat is obligatory; instead, they tend to apply the zakat percentage immediately. From a mathematical perspective, this reflects difficulties in understanding inequality and conditional decision-making (i.e., determining whether wealth ≥ *nisab* before calculation). At the level of the problem-solving process, this indicates a breakdown in the transformation stage, where contextual conditions are not translated into explicit mathematical procedures. This suggests that terminology-based understanding is more dominant than operational numerical understanding (Susanti & Roza, n.d.).

Second, difficulties in selecting data and determining appropriate operations indicate weak interpretation of quantitative information. In numeracy literacy, reading data involves identifying the role of each quantity within the context (e.g., components, deductions, rates, and conversions), rather than merely extracting numbers (Faridh Ricky Fahmy et al., 2025). Mathematically, this reflects obstacles in classifying quantities, proportional reasoning, and selecting appropriate operations. From a problem-solving perspective, these difficulties indicate breakdowns in the comprehension and transformation stages, where students fail to organize relevant data into a coherent mathematical structure. As a result, the constructed models are incomplete or inconsistent, leading to incorrect calculations.

Third, the tendency to stop midway reflects limited process control and insufficient evaluation of solution completeness. Zakat problems often require multiple outputs—for example, determining whether zakat is obligatory and calculating the zakat amount. Mathematically, this indicates difficulties in handling multi-step procedures and sequential reasoning, where each step must logically follow from the previous one. In terms of the problem-solving process, this reflects weaknesses in the process skills and evaluation stages, particularly in monitoring progress and ensuring that all required steps are completed. Consequently, solutions are often partial and do not fully address the problem demands (Ramadhan, Purnomo, Ruron, & Tampubolon, 2025).

Fourth, in table-based tasks, the central weakness lies in relational reasoning: tables are treated as lists of numbers rather than as relationships among variables. From a mathematical standpoint, this reflects difficulties in understanding multiplicative relationships, variable connections, and unit consistency. Students are unable to construct a coherent "situational formula" that links quantities, rates, and results. At the level of the problem-solving process, this indicates a breakdown in the transformation stage, where students fail to convert structured data into mathematical models. As a result, operations such as multiplication and unit conversion are applied incorrectly or omitted altogether.

Fifth, limited reflection allows errors to persist throughout the solution process. Checking reasonableness, verifying conditions, and ensuring completeness are essential components of evaluation in numeracy literacy (Ayu et al., n.d.). Mathematically, this reflects a lack of understanding of verification procedures, such as assessing whether results are consistent with the given context and constraints. From a problem-solving perspective, this indicates weaknesses in the evaluation and reflection stages, where students do not re-examine their answers or detect earlier errors. Consequently, inaccuracies in modeling and data use remain uncorrected and affect the final results.

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Strengthening numeracy literacy in zakat instruction should focus on (a) converting requirements into explicit comparison steps, (b) classifying data based on its role, (c) writing a variable-relationship model before computing, and (d) habituating reasonableness and completeness checks before concluding. This aligns with AKM/PISA-oriented numeracy literacy research that emphasizes strengthening model transformation, process skills, and evaluation (Pasca et al., 2025).

The following table summarizes the dominant error patterns and the associated mathematical concept issues identified in this study.

Table 1. Dominant Error Patterns

Indicator	Dominant Error Patterns and Associated Mathematical Concept Issues	Mathematical Concept Issues	Impact on responses
Interpretation of quantitative information	Selecting inappropriate data and being uncertain about the appropriate operations	Students have difficulty classifying quantities based on their roles (e.g., zakatable assets, deductions, rates), indicating weak understanding of data classification and proportional reasoning in zakat contexts	The calculation model is not aligned with the context, resulting in distorted outcomes.
Reasoning and modeling	Failing to establish relationships among variables (treating a table as a list of numbers)	Students struggle to understand relationships among variables, particularly multiplicative relationships (e.g., number of beneficiaries × rate), and fail to construct a coherent mathematical model	Calculations are partial, and the solution steps are not logically sequenced.
Calculation process	Skipping steps, using incorrect operations, and omitting intermediate results	Students demonstrate weak understanding of procedural operations and multi-step calculations, including incorrect use of percentage and arithmetic operations in zakat formulas	The solution is difficult to trace and highly prone to computational errors.
Evaluation and reflection	Not using nisab as a numerical decision criterion; failing to check solution	Students lack understanding of inequality comparison and verification processes, such as checking whether wealth meets nisab before calculation and evaluating result reasonableness	The obligatory/non-obligatory decision is incorrect, and the response is incomplete.

CONCLUSION

Based on the urgency of strengthening numeracy literacy within zakat instruction for Islamic Religious Education (PAI) students, this study concludes that students with low numeracy literacy continue to demonstrate a range of errors and barriers when solving contextualized zakat problems. Although students are generally able to identify the overall zakat context, they have not yet been able to operationalize numeracy literacy processes comprehensively, particularly in interpreting quantitative information, engaging in mathematical reasoning and modeling, and evaluating results.

The dominant errors were identified in: (1) the inability to select relevant quantitative information and determine appropriate operations (addition, subtraction, multiplication, and conversion), (2) inconsistency in constructing zakat calculation models that align with the structure of the problem, and (3) limited verification of the reasonableness and completeness of responses, including failure to check the zakat obligation threshold before applying the zakat rate. Interview findings further corroborate that the primary barriers stem from weak integration between conceptual understanding of zakat and quantitative reasoning, coupled with a tendency to rely on procedural completion without adequate reflection and task monitoring.

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Table 2. Major Errors and Barriers Among Islamic Religious Education (PAI) Students with Low Numeracy Literacy in Solving Zakat Problems

Primary Errors	Mathematical Concept Obstacles	Underlying Barriers	Related Indicators	Impact on Responses
Nisab is not treated as a decision step (students directly calculate zakat)	Weak understanding of inequality and conditional reasoning (wealth ≥ nisab as a prerequisite for calculation)	Students understand nisab conceptually but fail to operationalize it as a comparison procedure	Reasoning and modeling; evaluation and reflection	Incorrect determination of zakat obligation and inappropriate calculation steps
Misinterpretation of data (selecting inappropriate values or omitting relevant data)	Difficulty in classifying quantitative information (assets, deductions, rates, conversions) and weak proportional reasoning	Students are unable to identify the role of each quantity within the zakat context	Interpretation of quantitative information	Incorrect mathematical models leading to distorted zakat amount calculations
Weak relationships among variables (especially in tables)	Limited understanding of multiplicative relationships and variable connections (e.g., number × rate = zakat amount)	Tables are treated as collections of numbers rather than relational structures	Reasoning and modeling	Incomplete or incorrect modeling and calculation steps
Unstructured calculation procedures (incorrect operations or skipped steps)	Weak understanding of procedural operations and multi-step reasoning, including percentage calculations	Students rely on guesswork or memorized examples instead of structured procedures	Calculation process	Inaccurate and inconsistent results that are difficult to verify
Limited evaluation and reflection (no checking of results or conditions)	Lack of understanding of verification and validation concepts, including checking reasonableness and completeness	Students tend to accept initial results without reviewing their solutions	Evaluation and reflection	Errors persist to the final answer, leading to incomplete or invalid conclusions

Thus, this study confirms that efforts to enhance PAI students' numeracy literacy in zakat instruction should prioritize strengthening data interpretation skills, modeling relationships among variables, and developing habitual evaluation and verification of results. This conclusion is consistent with the theoretical view that numeracy literacy extends beyond computational proficiency to encompass the ability to use quantitative information to make accurate decisions in contextual problems, including zakat calculations.

This study reinforces the conceptualization of numeracy literacy as a contextual problem-solving process that involves interpreting quantitative information, modeling relationships among variables, performing calculations, and evaluating/validating results—rather than merely executing arithmetic operationssupported by evidence from zakat problem contexts.

Methodologically, the study integrates a context-based numeracy literacy diagnostic test with work-sample–elicited interviews to more precisely identify points of error and underlying barriers at each stage of the numeracy process. This approach is replicable for other contextual topics in mathematics education.

Practically, the findings provide a basis for strengthening numeracy instruction through targeted exercises in data selection, model construction, and habituated verification (reasonableness, completeness, and decision consistency) prior to drawing conclusions. Compared with prior studies

that tend to rely on final scores, this study is distinctive in mapping error patterns and barriers specifically across numeracy literacy stages, thereby demonstrating its originality and significance within the academic discourse.

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