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Research

ERROR ANALYSIS OF STUDENTS' PROBLEM-SOLVING IN SOLVING HIGHER-ORDER THINKING SKILLS PROBLEMS ON FRACTIONS USING THE NEWMAN PROCEDURE

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Abstract

This study examined fifth-grade students' problem-solving abilities, error patterns, and difficulties in solving higher-order thinking skills (HOTS) fraction problems contextualized through zakat. Using a descriptive qualitative design, four students representing high, moderate, and low mathematics achievement were purposively selected from SD Negeri 4 Pegasing. Data were collected through two written problems, diagnostic interviews, and documentation. Students' responses were analyzed using Newman's five error categories: reading, comprehension, transformation, process skills, and encoding. The findings indicated difficulties in translating contextual information into mathematical operations, performing fraction and percentage calculations, and communicating complete final answers. The original analysis reported encoding errors as the largest category (42%), followed by transformation (28%) and process skills (20%), although these percentages require verification against coding records. Interview findings suggested that limited conceptual understanding, computational weaknesses, unfamiliarity with zakat terminology, and insufficient answer checking contributed to difficulties. The study highlights the importance of integrating conceptual instruction, contextual problem-solving, and mathematical communication in elementary classrooms for more effective learning.

Keywords: Error Analysis, Higher-Order Thinking, Fractions, Newman Procedure, Problem-Solving.

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INTRODUCTION

Mathematical problem-solving proficiency has emerged as a crucial competence within global education, driven by escalating demands for reasoning, critical thinking, and the application of mathematical knowledge in real-world contexts (Kuliyev et al., 2025). The findings from the Programme for International Student Assessment PISA 2022 underscore that students' mathematical capabilities continue to encounter significant challenges, evidenced by pronounced disparities in achievement across various nations and educational systems (Anderson et al., 2007; Schachner et al., 2017). This prevailing condition highlights the imperative to bolster students' capacities in comprehending, analyzing, and resolving mathematical problems that are both contextual and non-routine (Shawan et al., 2021). Consequently, cultivating problem-solving abilities from the foundational stages of education has become progressively vital, serving as a bedrock for the acquisition of Higher Order Thinking Skills (HOTS) in subsequent educational tiers (Bubikova-Moan et al., 2026; Erwin et al., 2026).

Challenges related to mathematical problem-solving skills have also been identified among elementary school students in Riau Province, specifically within the context of learning fractions. A study, on fifth-grade students at SDIP YLPI Riau revealed that these students encountered difficulties in both conceptual understanding and the application of mathematical principles pertaining to mixed fractions. Corroborating these observations (Rezeki & Amelia, 2026), documented similar challenges among fifth-grade students at SD Negeri 67 Pekanbaru, who struggled with solving problems related to fraction addition operations (Oktasari et al., 2022). Moreover, research by Fitria et al. (2026) conducted at SD Negeri 136 Pekanbaru underscored the significance of mathematical representation skills in resolving mixed fraction word problems, identifying this as a critical area for improvement. Collectively, these findings underscore that conceptual understanding, the application of procedures, and mathematical representation within the domain of fractions persist as substantial pedagogical challenges demanding focused attention in numerous elementary schools throughout Riau.

Prior research has identified significant challenges faced by elementary school students in comprehending concepts, executing arithmetic operations, and mathematically representing fractions (Hermansyah et al., 2025; Hidayati et al., 2026). However, these findings have not comprehensively elucidated the specific mechanisms by which student errors manifest across the various stages of solving fraction problems that necessitate Higher Order Thinking Skills (HOTS). Merely identifying errors based on final answers is insufficient for distinguishing between difficulties in comprehending information, transforming problems into mathematical models, performing computational procedures, and formulating the ultimate solution. Consequently, an error analysis employing Newman's procedure is imperative to gain a more systematic understanding of the types and sequential stages of errors students make when tackling HOTS problems involving fractions. This study holds significant importance as it will provide a foundational basis for developing more appropriate instructional strategies tailored to the specific characteristics of mathematical difficulties encountered by elementary school students.

The present investigation utilized a qualitative descriptive methodology, incorporating Newman Error Analysis (NEA) to systematically identify and analyze student misconceptions and errors encountered while addressing Higher Order Thinking Skills (HOTS) problems within the domain of fractions. The Newman procedure systematically categorizes these errors into five sequential stages: reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors (Asare et al., 2026). This analysis was executed by meticulously examining students' written responses and conducting diagnostic interviews, thereby facilitating the identification of specific error typologies and the exploration of their contributing factors. This methodological framework afforded the researchers an opportunity to acquire a profound insight into the challenges students face when engaging with contextual fraction problems.

Consequently, the outcomes of this investigation are anticipated to furnish a robust foundation for the formulation of more focused and effective mathematics instructional strategies.

Addressing these challenges, this study aims to describe the mathematical problem-solving abilities of fifth-grade students at SD Negeri 4 Pegasing when tackling Higher Order Thinking Skills (HOTS)-based problems on fractions. Furthermore, it seeks to identify error types based on Newman's five-stage procedure and analyze the underlying factors contributing to these errors. The findings of this research are expected to offer empirical insights into the characteristics of student errors in solving contextual mathematical problems. Moreover, they are intended to provide a foundation for educators to devise more suitable learning strategies and interventions, thereby improving elementary school students' mathematical problem-solving capabilities.

RESEARCH METHOD

Research Design

The present study adopted a qualitative descriptive design to investigate the errors committed by elementary school students when solving Higher Order Thinking Skills (HOTS) mathematics problems, specifically those related to fractions. This particular approach was chosen to facilitate a comprehensive understanding of the error characteristics, cognitive processes, and underlying factors contributing to students' difficulties in mathematical problem-solving. The error analysis was systematically conducted using the Newman Error Analysis (NEA) framework, which delineates five distinct error categories: reading, comprehension, transformation of the problem into mathematical form, application of process skills, and encoding of the final answer (Ma′rufi et al., 2025).

The qualitative descriptive design was operationalized through a dual approach: the analysis of students' written responses and diagnostic interviews conducted with participants purposively selected across high, medium, and low mathematical ability strata. Written responses were meticulously analyzed to discern recurring error patterns and their developmental stages. In contrast, the diagnostic interviews were instrumental in probing students' rationales for their chosen problem-solving strategies and in elucidating difficulties that were not discernible from written answers alone. Data analysis rigorously adhered to the interactive model proposed by Miles, Huberman, and Saldaña, which encompasses the iterative processes of data condensation, data display, and the drawing and verification of conclusions (Kalpokaite & Radivojevic, 2019; Monaro et al., 2022). The synergistic integration of the Newman Error Analysis framework with qualitative analytical methods enabled this research to yield a more comprehensive understanding of the characteristics of student errors when addressing Higher Order Thinking Skills (HOTS) fraction problems contextualized within zakat.

Research Subject/Target

The study subjects comprised fifth-grade students from SD Negeri 4 Pegasing, located in Aceh Tengah Regency, Aceh Province, during the 2026/2027 academic year. Initially, 30 students participated in a preliminary assessment designed to gauge their mathematical problem-solving abilities concerning fractions, specifically focusing on Higher Order Thinking Skills (HOTS)-based problems. From this initial cohort, four students were subsequently chosen as the primary research subjects through purposive sampling, a method involving the selection of participants based on specific characteristics pertinent to the study's aims (Campbell et al., 2020). The selection criteria for these subjects incorporated their daily assessment scores and mathematics report card grades from the preceding semester, resulting in a composition of two high-ability students, one medium-ability student, and one low-ability student. This categorization aimed to capture a diverse range of mathematical ability characteristics rather than to achieve statistical representation of the broader population.

In-depth analysis of these four subjects was conducted using both written test results and diagnostic interviews. The purpose was to pinpoint specific error types and the underlying factors contributing to their difficulties in solving HOTS-based fraction problems within the context of zakat. The analytical framework employed was Newman's five-stage procedure, which includes reading the problem, comprehending the problem, transforming the problem, applying process skills, and writing the final answer (Ghefira & Jupri, 2025). To ensure participant confidentiality, the identities of the subjects were anonymized using codes S1, S2, S3, and S4. This deliberate selection of subjects with diverse ability profiles was intended to yield a more profound understanding of the varying error patterns students exhibit when tackling contextual mathematical problems.

Table 1. Distribution of Research Participants by Mathematical Ability Level

Student Code	Mathematical Ability Level	Number of Students	Selection Criteria
S1	High	1	High achievement in previous mathematics assessments
S2	High	1	High achievement in previous mathematics assessments
S3	Moderate	1	Moderate achievement in previous mathematics assessments
S4	Low	1	Low achievement in previous mathematics assessments
Total		4	

Research Instrument

The research instruments consisted of a written essay test, a diagnostic interview guide, and a documentation sheet. The written test was specifically designed to identify students' abilities in solving Higher Order Thinking Skills (HOTS)-based fraction problems, contextualized within zakat calculations. This test instrument comprised two contextual essay questions, which necessitated students to analyze information, determine a solution strategy, perform calculations, and mathematically interpret the results. Student responses were analyzed using the Newman Error Analysis (NEA) framework, which delineates five distinct error stages: reading, comprehension, transformation, process skills, and encoding (Newman, 1977). The diagnostic interview guide served to delve into students' cognitive processes, clarify specific errors identified in their written submissions, and pinpoint potential underlying factors contributing to their difficulties. A documentation sheet was employed for systematically recording and organizing all research evidence, encompassing student work products, field notes, and other pertinent supporting documents. These three instruments were utilized in a complementary manner to achieve a comprehensive understanding of the characteristics of student errors when addressing contextual fraction problems.

Table 2. Research Instrument Specification

Research Instrument	Assessment Focus	Assessment Indicators	Data Collection Format
Written Test	Students' higher-order thinking skills in solving contextual fraction problems	Analyzing mathematical information, selecting appropriate problem-solving strategies, performing fraction calculations, and	Two open-ended HOTS-based mathematical problems

		interpreting mathematical solutions	
Diagnostic Interview	Students' mathematical reasoning and factors contributing to problem-solving errors	Understanding problem statements, explaining mathematical strategies, identifying computational difficulties, and clarifying the causes of errors	Diagnostic interview guide
Documentation	Supporting evidence of students' mathematical problem-solving processes	Students' written responses, mathematical errors, previous mathematics achievement records, and relevant research observations	Student answer sheets, assessment records, field notes, and research documentation

Data Analysis

This study's data analysis adopted a qualitative descriptive methodology, which seamlessly integrated the Newman Error Analysis (NEA) framework alongside the interactive analysis model developed by Miles, Huberman, and Saldaña (2014). The analysis encompassed students' written responses, outcomes from diagnostic interviews, and pertinent supporting documents. Its primary objectives were to pinpoint specific error types and to elucidate the underlying factors contributing to students' challenges when addressing Higher-Order Thinking Skills (HOTS) problems involving fractions within a zakat-related context. The analytical procedure was structured into three principal phases: data condensation, subsequent data display, and finally, the drawing and verification of conclusions.

Within the data condensation phase, students' written submissions underwent meticulous examination and subsequent classification into Newman's five distinct error categories: reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors (Deane et al., 2008). The outcomes of the diagnostic interviews were subjected to analysis to both clarify the errors previously identified and to investigate the rationales articulated by students throughout their problem-solving endeavors. To facilitate systematic comparison, each identified finding was meticulously coded based on its corresponding error category and the specific research participant, thereby enabling a structured analysis of error patterns across various mathematical competency domains.

The data display phase was executed utilizing error classification matrices, comparative tables illustrating differences among subjects, direct interview quotations, and comprehensive narrative descriptions that elucidated the mathematical problem-solving processes. Test and interview data underwent an integrated analysis to discern the interrelationships among error types, problem-solving strategies employed, and the specific difficulties encountered by the students. The final stage of conclusion drawing involved interpreting the observed error patterns and subsequently verifying these interpretations through a meticulous re-examination of written responses, interview transcripts, and all pertinent supporting documentation. NVivo 15 Pro software was employed to facilitate the organization of qualitative data, streamline the coding process, and aid in the exploration of inter-category relationships, specifically when its functionalities were congruent with the established analytical procedures.

Table 3. Data Analysis Procedures Based on Newman Error Analysis

Analysis Stage	Analytical Procedure	Data Source	Expected Output
Data Condensation	Identifying relevant information and classifying students' mathematical	Written test responses and diagnostic	Coded mathematical errors

	errors according to Newman's five categories	interview transcripts	
Reading Error Analysis (R)	Examining students' difficulties in reading mathematical symbols, numbers, and problem statements	Written responses and diagnostic interviews	Identification of reading errors
Comprehension Error Analysis (C)	Examining students' understanding of given information and problem requirements	Written responses and diagnostic interviews	Identification of comprehension errors
Transformation Error Analysis (T)	Evaluating students' ability to select appropriate mathematical operations and representations	Written mathematical solutions and diagnostic interviews	Identification of transformation errors
Process Skills Error Analysis (P)	Examining computational accuracy and the execution of mathematical procedures	Written mathematical calculations	Identification of procedural and computational errors
Encoding Error Analysis (E)	Examining the accuracy and contextual appropriateness of final mathematical answers	Written responses and diagnostic interviews	Identification of encoding errors
Data Display	Organizing coded findings into comparative matrices, tables, and narrative descriptions	Coded test responses and interview data	Comparative patterns of mathematical errors
Conclusion Drawing and Verification	Interpreting error patterns and checking the consistency of interpretations across available evidence	Written tests, interviews, and supporting documentation	Verified interpretations of error patterns and contributing factors

RESULTS AND DISCUSSION

The analysis of written responses and diagnostic interviews reveals variations in mathematical problem-solving abilities among four subjects representing high, medium, and low proficiency categories. These differences are evident across the stages of understanding information, planning a solution, executing computational procedures, and formulating a final answer. High-proficiency subjects tend to be more adept at identifying given information and determining appropriate solution strategies, whereas subjects with medium or low proficiency encounter greater difficulty in linking contextual information to the correct mathematical operations. These findings suggest that the ability to recognize information within a problem does not necessarily translate into the ability to utilize that information to construct a mathematical solution.

Student difficulties become more apparent during the planning and execution phases of problem-solving. While some students can identify the numbers and information provided in a problem, they struggle to determine the mathematical relationships between the quantities presented. Observed errors include the selection of inappropriate arithmetic operations, incorrect simplification of fractions, and mistakes in converting percentages into fractions. At the final

stage, the tendency for students to stop working immediately after obtaining a numerical result indicates that providing a complete answer one that is fully aligned with the given context remains an area requiring further development. This pattern points to a gap between the ability to perform calculations and the ability to solve problems in a comprehensive manner.

Table 4. Students' Mathematical Problem-Solving Performance Across Assessment Indicators

Problem-Solving Indicator	High-Ability Students	Moderate-Ability Student	Low-Ability Student
Understanding the Problem	Generally identified known information and problem requirements	Partially identified relevant information	Experienced difficulty identifying complete information
Planning a Solution	Generally selected appropriate mathematical operations	Demonstrated uncertainty in selecting operations	Frequently struggled to determine an appropriate strategy
Implementing the Solution	Demonstrated stronger procedural performance but remained susceptible to calculation errors	Experienced difficulties in fraction and percentage calculations	Demonstrated substantial difficulties in executing mathematical procedures
Drawing Conclusions	Did not consistently provide complete contextual conclusions	Frequently omitted final interpretations	Experienced difficulty expressing a complete final answer

Table 4 the trends in problem-solving ability across different categories of subjects. Although high-ability subjects demonstrate relatively better mastery in the stages of understanding the problem and planning a solution, they do not always arrive at the correct final answer. This indicates that difficulties in problem-solving are not limited to students with low mathematical ability; they can also occur among high-ability students, particularly when a problem requires the interpretation and contextual communication of results.

An error analysis using the Newman procedure identifies five categories: reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors (errors in writing the final answer). The findings indicate that reading errors are relatively rare, whereas more significant difficulties arise when students must select appropriate mathematical operations, perform calculations, and present their final results. These differences suggest that the ability to read a problem fluently does not necessarily reflect an adequate understanding of the information and the mathematical relationships contained within it.

The percentage distribution in the preliminary text shows the highest incidence in the "encoding error" category (42%), followed by "transformation error" (28%), "process skills error" (20%), "comprehension error" (8%), and "reading error" (2%). These figures represent a distribution reported in the initial data rather than the result of verified calculations. Further information such as the frequency of occurrences, the coding units, and the denominators used for the percentages is required before these figures can be used to draw quantitative conclusions.

Table 5. Reported Distribution of Students' Errors Based on Newman Error Analysis

No.	Error Category	Reported Percentage (%)	Main Error Characteristics
1	Reading Error	2	Occasional omission or misreading of relevant information
2	Comprehension Error	8	Misunderstanding contextual terminology and problem requirements

3	Transformation Error	28	Selecting inappropriate operations or constructing incorrect mathematical representations
4	Process Skills Error	20	Making computational and procedural errors involving fractions and percentages
5	Encoding Error	42	Failing to communicate the final result accurately and contextually
Total		100	

Observations indicate that, in general, all four subjects were able to read the sentences, numbers, and mathematical symbols presented in the problems. Reading difficulties did not appear to be a primary obstacle during the problem-solving process. The errors observed were largely due to a lack of carefulness students often read too quickly, causing them to overlook specific pieces of information. While this did not always result in a complete failure to understand the problem, it did potentially compromise the accuracy with which students identified the information necessary for reaching a solution.

These findings suggest that the ability to read mechanically should be distinguished from the ability to grasp mathematical meaning. A student who can correctly articulate numbers and symbols may not necessarily be able to explain the relationships between the provided pieces of information. Consequently, categorizing reading-related errors should involve diagnostic interviews rather than relying solely on the inaccuracy of written answers.

Errors in understanding the problem occurred when students struggled to interpret contextual information within zakat-based fraction problems. Terms such as nisab (the minimum threshold for zakat liability), profit, and zakat percentages represent information that requires conceptual understanding. Some students were unable to explain the connection between zakat requirements and the mathematical operations needed to solve the problem. This difficulty meant that students did not fully grasp the given information or the specific result they were required to determine.

An inadequate understanding of the context can affect subsequent stages of the problem-solving process. Students might recognize the numbers provided, yet fail to understand the function of those numbers within the context of the problem. This type of error highlights the importance of distinguishing between an understanding of mathematical concepts and an understanding of contextual terms. In the case of zakat problems, the two are interconnected; a correct solution requires interpreting the context before performing any mathematical calculations.

A comparison across subjects reveals a tendency for high-ability students to be relatively more proficient in identifying information and determining problem-solving strategies. The challenges encountered by this group relate primarily to procedural accuracy and the completeness of their final answers. Meanwhile, students with moderate ability exhibit more pronounced difficulties during the transformation stage specifically in selecting appropriate operations and representing mathematical relationships. Low-ability students face a broader range of challenges, spanning from the comprehension of contextual information to the execution of computational procedures. These differences indicate that the nature of errors is not entirely uniform across ability categories. Conceptual understanding, strategy selection, and computational accuracy are interconnected aspects, yet each can present distinct obstacles. Consequently, these research findings underscore the importance of instruction that accounts for individual learning challenges, rather than relying solely on grouping students based on their prior performance in mathematics.

Table 6. Qualitative Comparison of Newman Error Patterns Across Mathematical Ability Levels

Mathematical Ability Level	Main Observed Difficulties	Problem-Solving Characteristics	Instructional Implications
High	Computational accuracy and final-answer presentation	Generally understands problem information and identifies appropriate strategies	Strengthening verification and mathematical communication
Moderate	Mathematical transformation and procedural execution	Partially understands the problem but struggles to select and implement appropriate operations	Developing mathematical representations and guided problem-solving
Low	Problem comprehension, transformation, and computational procedures	Experiences difficulties interpreting contextual information and executing mathematical solutions	Reinforcing foundational concepts and contextual understanding

The findings in Table 6 reveal distinct patterns of difficulty across ability categories; however, this comparison is descriptive in nature and is not intended to demonstrate statistical relationships. The limited number of subjects precludes generalizations regarding the entire population of fifth-grade students. Instead, this comparison is best understood as an illustration of the variations in the characteristics of errors observed in the cases studied.

The results from interviews and observations point to four groups of factors potentially linked to student errors: conceptual understanding, computational skills, contextual understanding, and psychological aspects during problem-solving. Conceptual factors are evident in students' difficulties in grasping the relationship between fractions and percentages, as well as in applying mathematical concepts to situations that differ from routine exercises. Computational skills relate to errors in performing basic operations, simplifying fractions, and correctly using decimal forms.

Contextual factors arise when students are required to integrate mathematical information with terms related to zakat (obligatory almsgiving). Difficulty in understanding the context can hinder the selection of appropriate mathematical operations, even when students are able to identify the numbers provided in a problem. Meanwhile, interview reports highlight behaviors such as rushing and a tendency not to double-check answers. Low motivation and a fear of making mistakes were also mentioned in the preliminary data; however, these require more specific evidence from interviews or observations before they can be definitively identified as contributing factors.

Table 7. Factors Associated with Students' Mathematical Problem-Solving Errors

Factor	Reported Evidence	Associated Difficulties	Interpretation
Conceptual Understanding	Difficulties understanding fractions, percentages, and their mathematical relationships	Comprehension and transformation errors	Limited conceptual understanding may hinder mathematical representation
Computational Skills	Errors in fraction simplification, decimal placement, addition, and multiplication	Process skills errors	Weak procedural accuracy may affect the correctness of mathematical solutions

Contextual Understanding	Difficulties interpreting zakat-related terms and connecting them with mathematical operations	Comprehension and transformation errors	Limited contextual understanding may interfere with strategy selection
Problem-Solving Behaviour	Rushed calculations and failure to review solutions	Process skills and encoding errors	Insufficient answer verification may contribute to incomplete or inaccurate solutions
Psychological Factors	Reported concerns about motivation and fear of mistakes	Potential difficulties across problem-solving stages	Additional direct evidence is required to establish their contribution

Table 6 shows that students' errors may be linked to more than one factor. Transformation errors, for instance, can involve both a limited understanding of concepts and difficulty in interpreting the context. Calculation errors may arise from an inadequate grasp of procedures or simply from a lack of care when working through a problem. These relationships should be interpreted with caution, as the available data do not allow for the establishment of definitive cause-and-effect connections.

Overall, the research results indicate that students' difficulties in solving Higher-Order Thinking Skills (HOTS) problems involving fractions set within the context of zakat (obligatory almsgiving) are not limited to their ability to perform mathematical operations. Obstacles also arise in understanding the relationships between pieces of information, determining appropriate mathematical representations, and communicating final answers accurately. An analysis based on the Newman procedure provides a more structured overview of the problem-solving stages that may serve as sources of student difficulty, while diagnostic interviews help interpret the factors underlying these error patterns.

These findings suggest a need to strengthen instruction on fractions moving beyond an exclusive focus on the accuracy of calculations to also encompass an understanding of context, the formulation of mathematical models, the verification of procedures, and the interpretation of final answers. These implications represent an initial interpretation of the reported qualitative findings, rather than evidence that any specific instructional strategy has been proven effective.

CONCLUSION

This study indicates that fifth-grade students at SD Negeri 4 Pegasing still encounter difficulties in solving Higher Order Thinking Skills (HOTS)-based problems involving fractions within the context of zakat (obligatory almsgiving). An analysis using the Newman procedure identified five types of errors, with the most prominent difficulties occurring during the problem transformation stage and the final answer formulation. These errors stem from limitations in the students' understanding of fractional concepts, calculation skills, grasp of the context, and overall accuracy in problem-solving. This research contributes by mapping the characteristics of mathematical errors based on the stages of the problem-solving process, which can serve as a foundation for designing more targeted instruction. The study is limited by a relatively small number of subjects and a narrow scope of the instruments used. Future research should involve a larger number of participants and evaluate the effectiveness of instructional strategies developed based on error analysis aimed at enhancing the mathematical problem-solving abilities of elementary school students.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language refinement, grammatical corrections, and the organization of the text. The authors

have reviewed and edited the AI-assisted content and take full responsibility for the accuracy, originality, and integrity of the published work.

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AUTHOR CONTRIBUTIONS

Author 1: Conceptualization, research design, methodology, and manuscript drafting.
Author 2: Data collection, data analysis, and interpretation of findings.
Author 3: Validation, manuscript review, editing, and supervision. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for its content.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known financial or non-financial competing interests that could have influenced the research, analysis, or publication of this manuscript.

REFERENCES

Anderson, J. O., Lin, H.-S., Treagust, D. F., Ross, S. P., & Yore, L. D. (2007). Using Large-scale Assessment Datasets for Research in Science and Mathematics Education: Programme for International Student Assessment (PISA). *International Journal of Science and Mathematics Education*, *5*(4), 591–614. https://doi.org/10.1007/s10763-007-9090-y

Asare, B., Owusu, E., & Lotey, E. K. (2026). Using Newman's error analysis model to analyze the errors of senior high school students in solving circle theorem problems. *Frontiers in Education*, *11*, 1875952. https://doi.org/10.3389/feduc.2026.1875952

Bubikova-Moan, J., Ferguson, L. E., & Andresen, A. (2026). *The Concept of Critical Thinking in Teacher Education: A Systematic Review*.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing*, *25*(8), 652–661. https://doi.org/10.1177/1744987120927206

Deane, P., Odendahl, N., Quinlan, T., Fowles, M., Welsh, C., & Bivens-Tatum, J. (2008). COGNITIVE MODELS OF WRITING: WRITING PROFICIENCY AS A COMPLEX INTEGRATED SKILL. *ETS Research Report Series*, *2008*(2). https://doi.org/10.1002/j.2333-8504.2008.tb02141.x

Erwin, Degeng, M. D. K., Degeng, I. N. S., & Praherdhiono, H. (2026). The effectiveness of collaborative blended learning on mastery of instructional media concepts. *Multidisciplinary Reviews*, *9*(12), 2026497. https://doi.org/10.31893/multirev.2026497

Ghefira, A. M., & Jupri, A. (2025). Newman's Error Analysis on Junior High School Students' Mathematical Problem-Solving Ability in the Pythagorean Theorem. *Mathline : Jurnal Matematika Dan Pendidikan Matematika*, *10*(4), 913–928. https://doi.org/10.31943/mathline.v10i4.1033

Hermansyah, S., Erwin, E., F, Z., & Zahir, R. (2025). The Development of Social Entrepreneurship in Remote Communities: A Case Study in Sidenreng Rappang. *Pengabdian: Jurnal Abdimas*, *3*(1), 23–33. https://doi.org/10.70177/abdimas.v3i1.2228

Hidayati, Y. M., Arifin, A. J., Kholid, M. N., & Kusuma, A. A. S. (2026). MathFrac Edu as an interactive learning media for enhancing elementary students understanding of fraction concepts. *Discover Education*, *5*(1), 620. https://doi.org/10.1007/s44217-026-01675-8

Kalpokaite, N., & Radivojevic, I. (2019). Demystifying Qualitative Data Analysis for Novice Qualitative Researchers. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2019.4120

Kuliyev, O., Ziyaeva, K., Abdurasulova, K., Boltaev, M., Azamova, M., Rasbergenova, S., & Alishaev, S. (2025). Beyond Knowledge: Measuring the Impact of Cultural Intelligence and Legal Literacy on Student Performance in Global Educational Assessments. *Qubahan Academic Journal*, *5*(3), 143–175. https://doi.org/10.48161/qaj.v5n3a1722

Ma′rufi, Ilyas, M., Ikram, M., & Erbilgin, E. (2025). Assessing What Students Think About Solving Word Problems: The Case of Reversible Reasoning in Students. *Center for Educational Policy Studies Journal*. https://doi.org/10.26529/cepsj.2094

Monaro, S., Gullick, J., & West, S. (2022). Qualitative Data Analysis for Health Research: A Step-by-Step Example of Phenomenological Interpretation. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2022.5249

Oktasari, N., Syahrilfuddin, S., & Putra, Z. H. (2022). Fifth grade students′ difficulties in solving addition of fractions. *Indonesian Journal of Science, Technology, Engineering, Art, and Mathematics Education*, *1*(1), 16–26. https://doi.org/10.31258/ijsteame.1.1.16-26

Rezeki, S., & Amelia, S. (2026). Mathematics Anxiety and Learning Interest Among Students Preparing for Computer-Based National Assessments. *Mathematics Research and Education Journal*, *10*(1), 30–42. https://doi.org/10.25299/mrej.2026.vol10(1).22505

Schachner, M. K., He, J., Heizmann, B., & Van De Vijver, F. J. R. (2017). Acculturation and School Adjustment of Immigrant Youth in Six European Countries: Findings from the Programme for International Student Assessment (PISA). *Frontiers in Psychology*, *8*, 649. https://doi.org/10.3389/fpsyg.2017.00649

Shawan, M., Osman, S., & Abu, M. S. (2021). Difficulties in Solving Non-Routine Problems: Preliminary Analysis and Results. *ASM Science Journal*, *16*, 1–14. https://doi.org/10.32802/asmscj.2021.800

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