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Mathematical Literacy Challenges: Third-Grade Students' Difficulties in Solving Multiplication Word Problems

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Abstract: This qualitative study analyzed the difficulties experienced by third-grade elementary school students in solving multiplication word problems and identified the stages at which those difficulties occurred. Eighteen students from SD Salsa, Indonesia, completed five multiplication word problems. Students whose written work showed difficulty were then examined through semi-structured interviews and document analysis. The evidence was organized according to five problem-solving stages: understanding the problem, identifying relevant information, selecting an operation, performing the calculation, and stating the final answer. Thirteen students (72.22%) completed the tasks without identified difficulty, whereas five students (27.78%) demonstrated recurring obstacles. Calculation and final-answer difficulties were the most frequent, affecting five students (27.78%) at each stage. Difficulties in understanding the problem, identifying key information, and selecting an appropriate operation each affected two students (11.11%). Two profiles emerged: conceptual difficulty, in which students could not interpret the problem or determine a strategy, and procedural difficulty, in which students selected multiplication correctly but could not calculate accurately. The findings show that success with word problems depends on the integration of mathematical language comprehension, conceptual understanding, and multiplication fluency. The study contributes a stage-based diagnostic framework that teachers can use to plan contextual practice, targeted scaffolding, and differentiated support in elementary mathematics classrooms.

Keywords: Elementary School, Mathematical Literacy, Multiplication Word Problems, Problem-Solving Difficulty

A. Introduction

Mathematical problem solving is a central goal of elementary education because it requires students to coordinate language comprehension, conceptual knowledge, numerical procedures, and reasoning. Multiplication word problems are particularly demanding for third-grade students. Unlike direct numerical exercises, they require learners to interpret a situation, determine which quantities are related, select an operation, complete the calculation, and communicate a meaningful answer.

Performance on these tasks therefore provides more information than a correct-or-incorrect score; it reveals how students use mathematics to understand everyday situations (Lemmo, 2021; Ulitzsch et al., 2022).

A word problem presents a mathematical relationship through verbal or contextual information (Pongsakdi et al., 2020). Solving it involves translating the situation into a mathematical representation and then evaluating whether the answer is reasonable in relation to the original context. This process is closely connected to mathematical literacy, which includes formulating, employing, and interpreting mathematics. It also involves higher-order thinking because students must make decisions about relevant information and strategy rather than merely follow a stated procedure.

This study uses a stage-based problem-solving framework derived from Polya’s four broad processes: understanding the problem, devising a plan, carrying out the plan, and looking back. For a more detailed diagnosis of multiplication word problems, these processes were operationalized into five observable stages: understanding the problem, identifying key information, selecting the mathematical operation, performing the calculation, and stating the final answer. Cognitive-load principles also inform the interpretation. When multiplication facts are not sufficiently fluent, the calculation process consumes working-memory resources that could otherwise be used to interpret the problem and monitor the solution.

Previous national and international research has repeatedly shown that elementary students may experience difficulty at different points in the word-problem process. Some students misinterpret linguistic information or fail to identify what is known and what is being asked. Others understand the situation and select the correct operation but make procedural errors because basic multiplication facts are not secure (Schulz, 2024). Instructional studies have proposed contextual tasks, concrete media, structured problem-solving prompts, and repeated practice; however, interventions are less effective when teachers do not first distinguish the specific source and stage of each student’s difficulty.

The existing literature often reports overall achievement or evaluates the effectiveness of a teaching model. Fewer classroom-based studies connect students’ written answers with interview evidence to distinguish conceptual difficulty from procedural difficulty across successive problem-solving stages (Shimizu & Kang, 2025). This gap is important because students who obtain the same incorrect answer may require different forms of support (Saifan et al., 2021; Yilmaz & Karaoglan Yilmaz, 2023). A student who does not understand the situation needs language and representation scaffolding, whereas a student who understands the strategy but calculates inaccurately needs fluency-building and error-monitoring support.

Accordingly, this study aimed to identify the types, stages, and contributing factors of difficulties experienced by third-grade students when solving multiplication word problems. The analysis was intended to provide a practical diagnostic basis for designing more targeted and contextual mathematics instruction (Säfström et al., 2024). This study addresses the following research questions: 1) What types of difficulties do third-grade elementary school students experience in solving multiplication word problems? 2) At which stages of the problem-solving process do these difficulties most frequently occur? 3) What factors contribute to students' difficulties in solving multiplication word problems?

B. Methods

Research design

This study employed a descriptive qualitative design supported by simple descriptive percentages. The design was selected because the research sought to examine students' problem-solving processes, error patterns, and explanations rather than to test the effect of an intervention. Quantitative summaries were used only to show how frequently each identified difficulty occurred, while the interpretation remained qualitative and case-oriented (Finn, 2022; Rönkkö et al., 2025).

Setting and participants

The study was conducted with 18 third-grade students at SD Salsa, Indonesia. The class was selected purposively because the participants had encountered multiplication word problems in their mathematics learning and could provide evidence relevant to the research questions. All 18 students completed the written test. Five students whose responses showed recurring errors were selected as focal interview participants because their work represented the two dominant profiles found in the class: procedural difficulty and conceptual difficulty. Demographic variables beyond grade level, including age, sex distribution, and prior achievement, were not recorded in the study dataset and are therefore not reported (Dunton et al., 2020).

Instruments

The written instrument consisted of five multiplication word problems. Each item was examined through five indicators: understanding the problem, identifying relevant information, selecting an appropriate mathematical operation, performing the calculation, and stating the final answer. The semi-structured interview protocol asked focal students to explain the problem in their own words, identify what was known and asked, justify their choice of operation, describe their calculation steps, and explain why they believed the final answer was correct. Student worksheets and classroom learning documents were used as supporting documentation. The study did not conduct a separate pilot test or formal psychometric validation of the five-item instrument; this limitation is considered when interpreting the findings (Lomas et al., 2025; Shrestha et al., 2024).

Data collection

Students first completed the written tasks individually. Their answers were reviewed to identify error locations and recurring patterns. Focal students were then interviewed using their own written responses as prompts. This stimulated-recall procedure enabled the researchers to compare what students wrote with how they explained their reasoning. Documentation was used to confirm the sequence of work and the learning context (Rojas-Sánchez et al., 2023; Xu et al., 2021).

Data analysis

The written responses were coded deductively according to the five problem-solving stages. Interview data were then reviewed repeatedly, condensed into meaning units, and compared with the written evidence. Codes were grouped into two higher-order themes: conceptual difficulty, involving interpretation, information identification, and strategy selection; and procedural difficulty, involving multiplication calculation and final-answer production. Percentages were calculated using $P = f/N \times 100$, where f represents the number of students displaying a category and N represents the total number of participants. Because a student could experience difficulty at more than one stage, indicator percentages are not mutually exclusive and should not be summed to 100% (Shaughnessy et al., 2021).

Trustworthiness

Source and technique triangulation were implemented by comparing evidence from written tests, student interviews, teacher information, and documentation. A conclusion was retained only when it was supported by more than one form of evidence. Participants were identified using codes S1-S18 to protect their identities. No formal inter-coder reliability coefficient was calculated; the absence of pilot testing, psychometric evidence, and formal inter-coder statistics is acknowledged as a methodological limitation (Cherney & Belton, 2020; O'Connor & Joffe, 2020).

C. Results and Discussion

1. Result

Overview of Student Performance

The analysis showed three mutually exclusive performance profiles. Thirteen students completed the five tasks without an identified difficulty (Ouyang et al., 2023). Three students understood the situations and selected multiplication but made recurring calculation errors (Wennberg-Capellades et al., 2022). Two students experienced difficulty from the comprehension stage and therefore also struggled with later stages (Merga, 2020).

Table 1. Distribution of Student Performance Profiles

No	Performance profile	Number of Students	Percentage
1	No identified difficulty	13	72.22%
2	Procedural multiplication difficulty	3	16.67%
3	Problem-comprehension difficulty	2	11.11%
	Total	18	100.00%

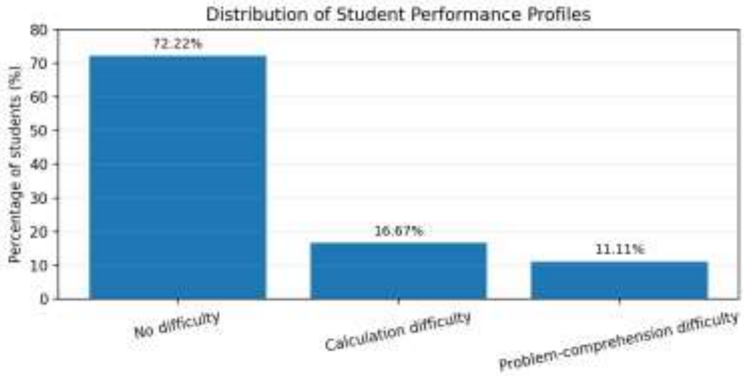

Figure 1. Distribution of Student Performance Profiles

Difficulty by Problem-Solving Stage

The stage-based analysis revealed that calculation and final-answer production were the most frequent points of difficulty. Five students displayed difficulty at each of these stages (Chang et al., 2024; Faisal et al., 2022; Onieva-Zafra et al., 2020). Two students also experienced difficulty in understanding the problem, identifying relevant information, and selecting the operation. The overlap across stages reflects the sequential nature of word-problem solving: difficulty at an early stage can affect all subsequent work (Daroczy et al., 2020; Roth et al., 2025).

Table 2. Student Difficulties by Problem-Solving Stage

No	Difficulty indicator	Number of Students	Percentage
1	Understanding the problem	2	11.11%
2	Identifying relevant information	2	11.11%
3	Selecting the mathematical operation	2	11.11%
4	Performing the calculation	5	27.78%
5	Stating the final answer	5	27.78%

Note. Indicator categories are non-mutually exclusive; one student may appear in more than one row.

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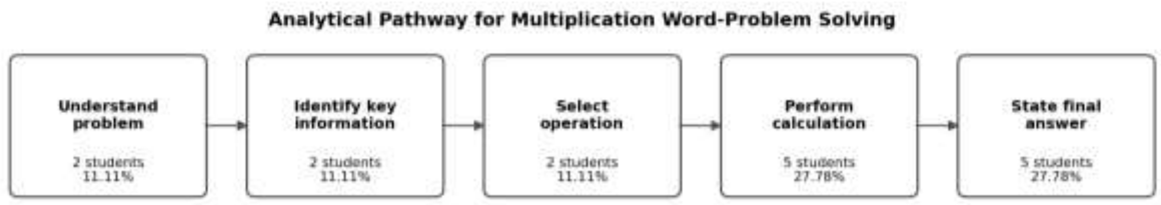

Figure 2. Stage-Based Analytical Pathway and Observed Difficulties

Patterns of Difficulty by Student Group

Students S1-S13 met all five indicators. They explained the situation, identified relevant quantities, selected multiplication, completed the calculation, and stated an answer consistent with the problem context. Students S14-S16 represented a procedural profile. They understood the problem and selected the correct operation but made errors in multiplication or failed to convert their calculation into an accurate final statement. Students S17-S18 represented a broader conceptual profile. Their difficulty began with interpreting the language of the problem, continued through information identification and operation selection, and affected the calculation and final answer (Hassija et al., 2024).

Qualitative Findings from Interviews

Theme 1 Difficulty Interpreting the Problem: Student S17 stated, "I am confused about the question. I do not know what needs to be calculated." The student's written work also omitted the known information and contained a guessed answer. Student S18 similarly said, "I do not know whether to multiply or add because I do not understand the story." These statements show that the problem was not transformed from verbal information into a mathematical relationship.

Theme 2 Difficulty Identifying a Strategy**:** Students who could not determine the relationship among quantities were unable to select the operation. Their uncertainty was not merely a calculation problem; it originated in understanding what each number represented and how the quantities were connected.

Theme 3 Limited Multiplication Fluency: Students S14-S16 generally selected multiplication correctly but struggled to complete it accurately. S14 explained, "I know I have to multiply, but I forgot the multiplication result." This indicates that the strategy was conceptually appropriate, yet weak fluency in basic facts disrupted execution and final-answer accuracy.

Theme 4 Incomplete Answer Monitoring**:** Several students did not check whether the numerical result answered the question in the original context (Deslis & Desli, 2023). Consequently, calculation errors were carried directly into the final answer, or the answer was written without an appropriate unit or explanatory statement.

Summary of Key Findings

The quantitative and qualitative evidence converged on two distinct but related forms of difficulty. Conceptual difficulty appeared when students could not understand the language, identify relationships, or select a strategy. Procedural difficulty appeared when students understood the intended operation but lacked sufficient multiplication fluency or answer-monitoring skills. Calculation and final-answer stages were the most visible obstacles, but the interview data showed that some late-stage errors originated earlier in comprehension.

2. Discussion

Interpretation through the Problem-Solving Framework

The findings support a stage-based interpretation of multiplication word-problem solving. In Polya's terms, S17 and S18 encountered difficulty during understanding and planning, whereas S14-S16 encountered difficulty primarily while carrying out the plan and reviewing the result. This distinction is instructionally important. An incorrect answer alone does not reveal whether the student misunderstood the situation, selected the wrong operation, or executed a correct strategy inaccurately (Chen et al., 2025). Diagnostic teaching therefore requires attention to the sequence of reasoning, not only the final product (Reuker & Künzell, 2021).

Conceptual Understanding, Mathematical Literacy, and Cognitive Load

The conceptual profile demonstrates the role of mathematical literacy. Students must interpret ordinary language, identify relevant quantities, and express relationships mathematically before computation begins (Zhao & Schuchardt, 2021). The procedural profile illustrates a different mechanism. When multiplication facts are not fluent, students devote substantial working-memory resources to basic calculation. This additional cognitive load reduces their capacity to monitor the process, check the reasonableness of an answer, and connect the result back to the context (Krebs et al., 2022; Nückles et al., 2020).

Comparison with Previous Research

The pattern is consistent with previous national and international studies that identify language comprehension, mathematical modelling, operation selection, and arithmetic fluency as recurring barriers in elementary word problems. The present study extends those findings by showing how written work and interview explanations can be combined to distinguish two students who fail at the comprehension stage from three students who understand the strategy but fail procedurally. This distinction provides a more precise basis for intervention than a single total score(White et al., 2020).

Practical Implications

Teachers should use short diagnostic prompts that make each problem-solving stage visible (Säfström et al., 2024). Students can be asked to restate the problem, underline relevant information, represent equal groups with drawings or manipulatives, justify the operation, show the calculation, and write a contextual final sentence. Students with conceptual difficulty need support with vocabulary, visual representation, and comparison of addition and multiplication situations. Students with procedural difficulty need structured practice in multiplication facts, estimation, and checking. Contextual word problems should be integrated regularly rather than presented only after students complete routine calculations (Bolstad, 2023).

Limitations and Future Research

The findings are limited by the small sample of 18 students from one school, the absence of detailed demographic and prior-achievement data, the use of only five test items, and the lack of formal instrument validation, pilot testing, and inter-coder reliability statistics. The results therefore describe this classroom context and should not be generalized statistically. Future studies should involve larger and more diverse samples, validated instruments, multiple coders, and experimental or longitudinal designs. Intervention studies should test whether stage-specific scaffolding improves conceptual interpretation, multiplication fluency, answer monitoring, and long-term transfer to other operations. The results therefore describe this classroom context and should not be generalized statistically

D. Conclusions

This study analyzed the difficulties experienced by 18 third-grade students in solving multiplication word problems by examining five stages of the problem-solving process. Thirteen students (72.22%) completed the tasks without an identified difficulty, whereas five students (27.78%) demonstrated recurring obstacles. The most frequent difficulties occurred when performing calculations and stating final answers, each affecting five students (27.78%). Understanding the problem, identifying relevant information, and selecting an appropriate operation each affected two students (11.11%). The evidence showed that students with incorrect answers did not form a single homogeneous group. Students S17-S18 displayed conceptual difficulty because they could not interpret the verbal situation, identify relationships among quantities, or determine the correct strategy. Students S14-S16 displayed procedural difficulty because they selected multiplication appropriately but lacked sufficient fluency to calculate accurately and monitor the final result. This distinction confirms that multiplication word-problem performance depends on the integration of mathematical literacy, conceptual understanding, procedural fluency, and answer evaluation. The practical implication is that teachers should diagnose the stage at which difficulty begins before selecting instructional support. Comprehension-focused scaffolds, visual representations, and guided restatement are appropriate for conceptual difficulty, whereas repeated fact practice, estimation, and checking routines are more appropriate for procedural difficulty. Word problems should also be embedded regularly in contextual instruction so students learn to connect multiplication with everyday relationships. The study is limited by its small, single-school sample, five-item instrument, incomplete demographic information, and absence of formal psychometric and inter-coder reliability evidence. Consequently, the results should be interpreted as a classroom-based diagnostic account rather than a general estimate of prevalence. Future research should validate the stage-based indicators with larger and more diverse samples, test targeted interventions through experimental or quasi-experimental designs, and examine whether improvements are sustained and transferred to division, fractions, and multi-step problems. across diverse educational contexts.

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