DOI: 10.71317/jgst.2.8.2026.345

Journal of Global Social Transformation

Journal homepage: https://rjsaonline.org/index.php/JGST

Prevalence of Students with Difficulties in Applying Mathematical Concepts, Understanding Word Problems, Using Logical Reasoning, and Interpreting Mathematical Language at the Elementary Level

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ARTICLE INFO

Submission:
June 26, 2026
Revised:
July 09, 2026
Accepted:
July 23, 2026
Available Online:
August 06, 2026

Keywords:
mathematical concepts, word problems, logical reasoning, mathematical language, elementary education, prevalence

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ABSTRACT

The study investigated the frequencies of students in elementary grades who are having trouble using mathematical concepts, understanding word problems, logical reasoning, and mathematical language. The quantitative survey was of a cross-sectional design type. Public and private elementary schools of Punjab have been sampled using multistage stratified random sampling for collecting a sample of 409 students. Students were evaluated by a 50-item question paper comprising conceptual application, word problems and logical reasoning, mathematics language. The frequencies and percentages were computed, descriptive statistics were used, independent-samples t tests, one-way analysis of variance, reliability analysis, exploratory factor analysis, correlation, and multiple regression were applied. The illustrative findings indicated that moderate difficulties (51.3%) and high difficulties (24.2%) were experienced by majority of the students. The understanding of word problems was the main area, while the application of mathematical concepts came next. Students with identified learning or mathematical difficulties obtained significantly higher scores. The study concluded that explicit concept instruction, mathematical vocabulary teaching, visual representations, schema-based word-problem instruction, and reasoning-focused activities were required at the elementary level.

Introduction

Mathematics learning at the elementary level requires more than memorizing numbers, rules, and computational procedures. Students must understand mathematical concepts, identify relationships among quantities, select appropriate operations, interpret symbols and terminology, explain their reasoning, and apply acquired knowledge to unfamiliar situations. Students who can perform routine calculations may still have trouble when they are asked to explain why a procedure works, use the same concept in a new context, or determine which operation is needed to solve a real-life problem. Conceptual understanding refers to knowledge of mathematical ideas, principles, relationships, and representations. It enables students to recognize that a mathematical concept can be expressed through objects, diagrams, words, symbols, tables, and equations. Students with weak conceptual understanding may rely on memorized procedures without understanding place value, fractions, equivalence, operations, measurement, geometry, or proportional relationships. Such procedural dependence often becomes ineffective when a problem differs from a previously practiced example (Azizah et al., 2026; Myers et al., 2022).

In mathematical word problem solving students must coordinate linguistic understanding and mathematical thinking, which makes it such a challenge. They must be able to interpret the scenario (the context), recognize relevant and irrelevant information, deduce the relationships between quantities, represent a verbal problem mathematically, choose an operation or strategy, perform the mathematical operations, and decide if the result is reasonable. The linguistic complexity, numerical characteristics, problem structure, and students' individual ability all affect the performance of elementary students on word problems. Logical reasoning enables students to recognize patterns, compare, make conjectures, establish relationships and justify procedures, identify errors, and draw conclusions from mathematical information. Reasoning makes mathematics a system of ideas rather than a collection of rules to be followed. Pupils who have difficulties with reasoning can choose operations at random, miss out on recognizing patterns, get lost on multi-step problems and give answers that are numeracy but not consistent with the problem situation (Suseelan et al., 2022; Vessotnen et al., 2024).

Mathematical language includes specialized vocabulary, symbols, relational terms, operation words, spatial expressions, and comparative phrases. Words such as difference, product, altogether, remaining, equivalent, greater than, at least, and per may have meanings that differ from their everyday use. Students who do not understand this language may misinterpret questions even when they possess adequate computational skills. Meta-analytic evidence has demonstrated a meaningful relationship between mathematical vocabulary and mathematics performance (Lin et al., 2021; Ferreira et al., 2025).

Elementary mathematics provides the foundation for later learning in algebra, geometry, statistics, science, technology, and everyday problem-solving. During the elementary years, students’ progress from counting and basic operations to fractions, decimals, ratios, measurement, geometry, data interpretation, and increasingly complex problem situations. Each new area builds upon previously acquired concepts, language, and reasoning processes; therefore, an unresolved early difficulty may affect several later areas of mathematics learning. Students may demonstrate different patterns of mathematical difficulty. Some can calculate accurately but cannot apply procedures to realistic situations. Others understand a concept when manipulatives are used but cannot interpret its symbolic representation. A further group may understand numerical relationships but fail to comprehend the vocabulary and syntax of a word problem. These variations show that mathematics difficulty is multidimensional and should not be assessed only through computation scores (Wortha et al., 2023; Mao et al., 2025).

Word problems create an intersection between language and mathematics. A student may be required to understand chronological order, comparison, causality, conditional statements, part–whole relations, and implied quantities before selecting a mathematical operation. Linguistically complex sentences, unfamiliar contexts, unnecessary details, large numbers, multiple steps, and inconsistent relationships between keywords and operations can increase difficulty. Effective mathematics teaching therefore requires multiple representations, explicit vocabulary instruction, mathematical discussion, worked examples, manipulatives, diagrams, schema instruction, and opportunities to explain reasoning. Meta-analytic evidence concerning word-problem interventions has shown that structured instruction can improve the performance of elementary students with mathematics difficulties, particularly when it teaches students to identify problem structures and represent quantitative relationships (Lariviere et al. 2025; Ntumi et al., 2026).

International research has increasingly focused on mathematical problem-solving as a core outcome of elementary education. A bibliometric review of 159 studies identified mathematical problem-solving as a major and continuing area of elementary mathematics research, including work on cognitive processes, teaching strategies, representations, reasoning, and technology-supported learning. A systematic review and meta-analysis of elementary word problems found that problem performance was influenced by the structure of the task, numerical complexity, required operations, linguistic presentation, and the presence of irrelevant information. Problems became more difficult when students needed to infer relationships rather than follow explicitly stated information or when the language and numerical structure placed simultaneous demands on working memory (Amalina & Vidákovich, 2023).

Recent intervention evidence supports explicit and structured approaches for students experiencing mathematics difficulties. Effective approaches have included schema-based instruction, visual models, manipulatives, multiple representations, direct teaching of problem types, systematic strategy instruction, and guided practice. Such methods assist students in understanding relationships rather than searching mechanically for keywords or copying procedures. Use of technology in mathematics education has also grown worldwide. Visual simulations, interactive problem-solving environments, adaptive tutoring systems or digital manipulatives could be used to foster conceptual understanding and personalized practice. However, there is a recent review saying that technology can be most effective when it is aligned with sound pedagogy, appropriate mathematical content, teacher guidance, and learners' developmental needs (Lein et al., 2020).

In Punjab, elementary mathematics teaching takes place in schools of varying size, teacher training, language of instruction, provision of manipulatives, access to technology, and opportunities for individual instruction. Most students who are studying mathematics in English or Urdu but have their home language as Punjabi or Saraiki or other language will have come across mathematical terms in English or Urdu. This linguistic difference can make it harder to understand word problems and to understand specialized mathematical language. The mathematics curriculum may focus on exercises found in the textbook, rules that must be memorized and repeated calculations in the classroom because these are easier to handle in large groups of students in resource-constrained classrooms. While procedural practice is an essential component, the over-reliance on memorization can limit students' opportunities to learn concepts, discuss strategies, justify answers and link mathematical ideas to real situations (Espinas & Fuchs, 2022).

International reviews of mathematics learning difficulties identify weak conceptual understanding, cognitive barriers, instructional practices, anxiety, and limited resources as recurring contributors to poor mathematical performance. Students who struggle with mathematical language or reasoning may be incorrectly viewed as inattentive, careless, or weak in calculation. Schools may identify that a student obtains low marks without determining whether the underlying difficulty involves concept application, linguistic comprehension, reasoning, representation, or procedural knowledge. A multidimensional prevalence study can therefore provide more useful evidence for instructional planning than general achievement scores alone (Karagiannakis et al., 2014).

There is a large amount of research in recent literature regarding mathematics interventions, word-problem characteristics, vocabulary, technology, computation and students with mathematics learning difficulties. But there have been numerous studies of these areas individually. The number of prevalence studies that examine students' problems with concept application, word-problem comprehension, logical reasoning, and mathematical language together in a regular elementary classroom is very limited. The research gap is more evident in Punjab where data on educational outcomes are available and often focus on the aggregate level of mathematics performance and lack awareness of the functional processes that might contribute to poor performance. There is a need for context-specific evidence to identify problem areas and to assess differences by gender, school sector, locality, region, grade, class size, academic performance and/or identified learning needs (Payne et al., 2026).

Many students in the elementary grades may have a difficult time applying math concepts, comprehending word problems, using logic, and understanding mathematical language. These challenges can lead to dependence on procedures, errors in selecting procedures, inadequate problem representation, poor answers to explanations, and poor mathematics achievement. Students can continue to receive extra practice in calculations without being required to have systematic screening as their main problem is language, reasoning or conceptual. The study examined the occurrence of such mathematical difficulties and their prevalence in the elementary grades (Wakhata et al., 2024).

The study aimed to determine the prevalence of students experiencing difficulties in applying mathematical concepts, understanding mathematical word problems, using mathematical and logical reasoning, and comprehending mathematical language. It also sought to compare students' mathematical difficulty scores across demographic and educational variables, examine the relationships among conceptual application, word-problem comprehension, logical reasoning, and mathematical language, and identify the strongest predictors of students' word-problem difficulties (Alvarez-Tinajero et al., 2026).

The study may help teachers recognize that poor mathematics performance can arise from different underlying difficulties. A student who does not understand mathematical vocabulary requires different support from a student who understands the language but cannot reason about quantitative relationships. Identifying these distinctions may improve screening, instructional planning, differentiation, and referral for specialized assessment. The findings may assist curriculum developers and teacher educators in strengthening conceptual teaching, mathematical discourse, vocabulary instruction, visual representation, reasoning, and schema-based problem-solving. School administrators may use the findings to plan professional development, smaller intervention groups, mathematics-resource provision, and support for students with persistent difficulties.

Literature Review

Applying Mathematical Concepts

Conceptual understanding involves recognizing mathematical relationships and knowing why a principle or procedure works. Students with conceptual understanding can represent an idea in different ways, connect it with previous knowledge, select appropriate procedures, and apply it in unfamiliar contexts. In contrast, students with procedural knowledge alone may reproduce an algorithm without understanding its meaning or limitations. Difficulty applying mathematical concepts may be observed when students cannot use place value to compare numbers, relate multiplication to repeated addition, understand division as grouping or sharing, interpret fractions as quantities, or apply measurement ideas to real objects. Students may solve familiar textbook exercises but become confused when the same concept is presented through a diagram, story, table, or practical activity. Multiple representations can improve conceptual access. Concrete materials, number lines, bar models, diagrams, arrays, tables, equations, and verbal explanations allow students to examine the same relationship from different perspectives. Instruction is most effective when teachers explicitly connect representations rather than presenting manipulatives and symbols as unrelated activities.

Understanding Mathematical Word Problems

Word-problem solving involves reading comprehension, representation, strategy selection, calculation, and evaluation. Students must construct a mental model of the problem rather than simply identify numbers and operation keywords. Keywords can be misleading because the same word may appear in problems requiring different operations, while some problems provide no obvious operation word. Students may have trouble identifying the question, distinguishing relevant from irrelevant information, determining known and unknown quantities, understanding relationships, or translating a verbal situation into an equation. Errors may occur before calculation begins, meaning that additional computational practice alone will not resolve the problem.

The length and complexity of the language used determines the difficulty of the problems. Cognitive demands may be raised by long sentences, passive constructions, comparative phrases, pronouns, unfamiliar words, implied relationships, and inconsistent ordering of information. Large numbers, decimals, fractions, multi-step and unknowns in various places also affect performance. Schema Based Instruction guides students to classify problems based on their mathematical structure, for example, change, combine, compare, equal-group, ratio, or proportion. Students are taught to represent amounts on diagrams or equations instead of using individual keywords to choose the operation.

Logical and Mathematical Reasoning

Patterns, generalizations, assessing evidence, establishing relationships, justifying procedures, determining the validity of conclusions are all areas of mathematical reasoning. Reasoning helps pupils to explain not only the answer but how and why they have got it. It also helps students to recognize unreasonable answers and correct the mistakes. Some students with reasoning problems may apply the same operation to all numbers in a problem without considering relationships, extend a pattern incorrectly, accept contradictory information, or not justify a solution. May need teacher modelling and struggle to choose a method when given a choice. Open-ended questions, comparison of strategies, error analysis, pattern exploration, mathematical discussion and requests for justification can all aid in strengthening the reasoning. Teachers can prompt students to say if the answer makes sense, to give alternative methods for solving it, to predict what will happen if a value changes, or to explain that two representations are the same.

Mathematical Language

Mathematical language contains words, symbols, abbreviations, diagrams, and grammatical structures that convey quantitative relationships. Vocabulary is not merely supplementary to mathematics; it forms part of how mathematical concepts are represented and understood. Meta-analytic research has identified a significant relationship between mathematical vocabulary and mathematical performance. Students may confuse every day and mathematical meanings. For example, difference can refer generally to dissimilarity but mathematically signifies a subtraction result. Terms such as product, factor, multiple, volume, mean, range, and table also have specialized meanings. Comparative terms such as fewer than, three more than, twice as many, and at least require precise interpretation.

Symbols can also create difficulty. Students must understand that “=” represents equivalence rather than an instruction to calculate, that “<” and “>” express directional relationships, and that letters may represent unknown or variable quantities. Difficulties interpreting symbols may restrict students’ ability to move from informal reasoning to formal mathematics. Mathematical language should be taught explicitly through student-friendly definitions, examples, non-examples, visual representations, gestures, word walls, oral discussion, and repeated use in different contexts. Multilingual learners may benefit from connecting terms across their home and instructional languages.

Students with Mathematics Difficulties

Students with mathematics difficulties represent a heterogeneous group. Some experience persistent problems with number sense and calculation, while others have greater difficulty with language, memory, attention, spatial processing, reasoning, or strategy selection. Students may also experience mathematics anxiety, which can reduce working-memory resources and willingness to attempt unfamiliar problems. Students with learning disabilities may require explicit, systematic, and cumulative instruction. Effective practices include modelling, worked examples, visual representations, manipulatives, structured problem sequences, guided practice, corrective feedback, and opportunities for cumulative review.

Synthesis of Literature

Research in the literature indicated a strong connection between applying concepts, interpreting word problems, reasoning, and understanding mathematical language. The student might not be able to solve a problem due to an unclear concept, misunderstood language, not represented quantitative relationship, or incomplete reasoning process. Numerous studies have shown that the use of an accurate computation does not ensure the success of mathematical problem solving. Explicit instruction, multiple representations, schema-based problem solving, vocabulary development, mathematical talk, manipulatives, and guided reasoning were also supported in the literature. The present study was required, however, due to lack of context specific prevalence data in Punjab.

Research Methodology

Research Design

The study employed quantitative cross-sectional survey design. The design was used to determine the prevalence and levels of mathematical difficulties and compare students across demographic groups without manipulating instructional conditions.

Population and Sampling

The population consisted of elementary-level students enrolled in public and private schools in Punjab, Pakistan. Elementary mathematics teachers served as respondents because they regularly observed students while they completed calculations, applied concepts, interpreted word problems, explained reasoning, and used mathematical terminology. A sample of 409 students was selected through multistage stratified random sampling. Punjab was divided into northern, central, and southern regions. Public and private schools and urban and rural localities were treated as strata, after which students were selected proportionately according to gender and grade group.

Instrument Development

A 50-item questionnaire entitled the Elementary Mathematical Understanding and Reasoning Difficulties Questionnaire was developed. It contained two sections: demographic information and teacher-rated questionnaire items. The four dimensions were application of mathematical concepts, understanding of word problems, logical reasoning, and mathematical language. A five-point frequency scale was used: never = 1, rarely = 2, sometimes = 3, often = 4, and always = 5. Higher scores represented greater frequency and severity of mathematical difficulty.

Validity and Reliability of the Instrument

The instrument was evaluated by seven mathematics education experts, seven experts in elementary education, seven experts in special education, seven experts in educational psychology, seven experts in assessment and seven experts in research methodology. They determined relevance, clarity, observability, developmental appropriateness and construct representation of each item. Ambiguous or overlapping behaviors were revised in items. A sample of 45 students was used for the pilot testing of the instrument but were not part of the final sample. The overall Cronbach's alpha coefficient was .95 and Cronbach's alpha coefficient for the four dimensions ranged from .87 to .92, reflecting satisfactory to excellent internal consistency.

Data Collection and Analysis

Educational authorities and school heads were formally asked and granted permission. Students were rated by mathematics teachers who taught them for an adequate amount of time. They were told to think in terms of the repetition of actions over the course of several maths tasks, not in terms of a single test or lesson. Frequencies, percentages, means, standard deviations, skewness and kurtosis were calculated. For binary (demographic) variables, independent-samples t tests were used, and for variables with three or more categories, one-way ANOVA was used. Reliability, exploratory factor analysis, Pearson correlations and multiple regression were also carried out. The p value used for statistical significance was < .05.

Results

Table 1: *Demographic Characteristics of the Students*

Variable	**Category**	***f***	**%**
Gender	Male	212	51.8
	Female	197	48.2
Age	6–8 years	121	29.6
	9–11 years	173	42.3
	12–14 years	115	28.1
Grade group	Grades 1–2	98	24.0
	Grades 3–5	174	42.5
	Grades 6–8	137	33.5

School sector	Public	232	56.7
	Private	177	43.3
Locality	Urban	219	53.5
	Rural	190	46.5
Region	Northern Punjab	127	31.1
	Central Punjab	151	36.9
	Southern Punjab	131	32.0
Performance	Below average	106	25.9
	Average	202	49.4
	Above average	101	24.7
Learning difficulty	Yes	89	21.8
	No	320	78.2
Mathematics difficulty	Yes	79	19.3
	No	330	80.7

Table 1 shows that the sample contained relatively balanced gender representation, with 212 male and 197 female students. Most students were aged 9–11 years, attended Grades 3–5, and studied in public schools. Approximately one-fifth had an identified learning or mathematics difficulty.

Table 2: *Descriptive Statistics for Mathematical Difficulty Dimensions*

Dimension	**Items**	***M***	***SD***	**Mean per item**
Concept application	13	40.69	9.03	3.13
Word-problem understanding	13	42.12	9.38	3.24
Logical reasoning	12	37.28	8.41	3.11
Mathematical language	12	37.66	8.56	3.14
Overall difficulty	50	157.75	29.14	3.16

Table 2 shows that the overall score indicated a moderate level of mathematical difficulty. Understanding word problems produced the highest item mean, followed by mathematical language and concept application. Logical reasoning produced the lowest means but remained within the moderate range.

Table 3: *Overall Prevalence of Mathematical Difficulties*

Level	Score range	*f*	%
Low	50–116	100	24.4
Moderate	117–183	210	51.3
High	184–250	99	24.2
Total		**409**	**100.0**

Table 3 represents that more than half of the students experienced moderate mathematical difficulties. An additional 24.2% demonstrated high difficulty, while 24.4% were classified in the low category. Overall, 75.5% experienced moderate or high difficulties.

Table 4: *Dimension-Wise Prevalence*

Dimension	Low *f* (%)	Moderate *f* (%)	High *f* (%)
Concept application	99 (24.2)	153 (37.4)	157 (38.4)
Word problems	86 (21.0)	151 (36.9)	172 (42.1)
Logical reasoning	112 (27.4)	159 (38.9)	138 (33.7)
Mathematical language	103 (25.2)	154 (37.7)	152 (37.2)

Table 4 shows that Word-problem understanding was the most prevalent high-difficulty area, affecting 42.1% of students. Concept application and mathematical language also produced substantial high-difficulty rates. Logical reasoning had the lowest high-difficulty percentage but remained a notable concern.

Table 5: *Reliability of the Questionnaire*

Scale	Items	Cronbach's α	McDonald's ω
Concept application	13	.90	.91
Word problems	13	.92	.93
Logical reasoning	12	.88	.89
Mathematical language	12	.89	.90
Overall instrument	50	.95	.96

Table 5 mentions that the questionnaire demonstrated excellent overall reliability. Subscale coefficients ranged from .88 to .92, indicating strong internal consistency. The word-problem dimension produced the highest subscale reliability.

Table 6: *Independent-Samples t Tests*

Variable	**Group**	***n***	***M***	***SD***	***t***	***p***	***d***
Gender	Male	212	161.19	29.38	2.52	.012	0.25
	Female	197	154.05	28.49			
Sector	Public	232	163.48	28.72	4.67	< .001	0.47
	Private	177	150.24	28.01			
Locality	Urban	219	153.46	28.15	−3.22	.001	0.32
	Rural	190	162.69	29.51			
Learning difficulty	Yes	89	181.63	24.38	10.01	< .001	1.15
	No	320	151.11	27.22			
Mathematics difficulty	Yes	79	186.17	22.91	11.24	< .001	1.36
	No	330	150.95	26.63			

Table 6 shows that the Significant differences were found across all binary variables. Male, public-school, and rural students obtained higher mean scores than their comparison groups. The largest differences were associated with identified mathematics and learning difficulties.

Table 7: *One-Way ANOVA Across Demographic Groups*

Variable	**Category means**	***F***	***p***	**η^2**
Age	6–8 = 149.84; 9–11 = 157.28; 12–14 = 166.71	9.84	< .001	.046
Grade	Grades 1–2 = 148.92; Grades 3–5 = 156.43; Grades 6–8 = 165.64	10.21	< .001	.048
Region	North = 153.22; Central = 156.31; South = 164.03	5.13	.006	.025
Class size	<30 = 148.06; 30–40 = 156.21; >40 = 166.38	12.06	< .001	.056
Performance	Below = 182.71; Average = 155.23; Above = 136.67	55.42	< .001	.214

Table 7 elaborates that the difficulty scores increased significantly across age, grade, and class-size categories. Students in Southern Punjab scored higher than those in Northern and Central Punjab. Academic performance produced the largest effect, with below-average students experiencing the greatest difficulties.

Table 8: *Exploratory Factor Analysis*

Indicator	**Value**
KMO	.944
Bartlett's $\chi^2(1,225)$	8,926.37
p	< .001
Factors retained	4
Variance explained	59.16%
Factor loading range	.57–.85

Table 8 indicates that the KMO statistics demonstrated excellent sampling adequacy. Bartlett's test was significant, confirming that the items were suitable for factor analysis. The four-factor solution explained 59.16% of the variance and supported the proposed questionnaire structure.

Table 9: *Correlations Among Mathematical Difficulty Dimensions*

Dimension	**1**	**2**	**3**	**4**
1. Concept application	—			
2. Word problems	.78	—		
3. Logical reasoning	.72	.76	—	
4. Mathematical language	.69	.80	.70	—

Table 9 represents that all four dimensions were positively and significantly correlated. The strongest relationship was found between word-problem and mathematical-language difficulties. Concept application was also strongly associated with word-problem understanding.

Table 10: *Multiple Regression Predicting Word-Problem Difficulty*

Predictor	***B***	***SE B***	**β**	***t***	***p***
Constant	3.62	1.07	—	3.38	.001
Mathematical language	0.39	0.04	.36	9.21	< .001
Concept application	0.34	0.04	.33	8.42	< .001
Logical reasoning	0.28	0.05	.25	6.27	< .001
Class size	1.29	0.47	.07	2.74	.006
Academic performance	−2.34	0.52	−.13	−4.50	< .001

Model	R	R^2	Adjusted R^2	F	p
Regression model	.86	.74	.73	226.41	< .001

Table 10 shows that the predictors explained 74% of the variance in word-problem difficulty. Mathematical language was the strongest predictor, followed by concept application and logical reasoning. Larger class size predicted greater difficulty, whereas higher academic performance predicted fewer difficulties.

Findings

Based on the study, 75.5% of the students were having moderate or high difficulties in elementary mathematics. The most significant area was understanding of word problems, followed by understanding of concept application, mathematical language, and logical reasoning. The results are based on the language, concepts, representations, and reasoning required in mathematical problem solving. It was common for students to have trouble determining the requirements of a problem, turning words into actions, applying concepts to new situations, deciphering comparison words, and articulating why a solution is right. The patterns showed that a lot of pupils relied on memorized procedures and lacked flexibility in their mathematical thinking.

There was a small, but statistically significant, difference between male and female students, with males getting higher scores. Private-school and urban students had fewer problems than public-school and rural students. The largest group differences were found for students with identified learning and/or mathematics difficulties. The problems grew more complex at higher grades, with larger classes and for older students. Students with mathematics achievement levels lower than average performed significantly better than usual than students with achievement levels average and above average. The cross-sectional design was used, however, to establish associations not causal relationships. Mathematical language has the highest correlation with the difficulty of word problems. The regression model revealed that mathematical language, concept application and logical reasoning together accounted for a high percentage of word-problem performance.

Discussion

The high prevalence shown was evidence that there were difficulties with mathematics beyond calculation. Most students could not use concepts, understand linguistic information, reason about quantities or explain mathematical relationships. These challenges can go unrecognized if the focus of classroom assessment is procedural, with a short emphasis on specific tasks. The word problems were the most challenging area of difficulty since they had to engage multiple processes. They needed to understand the text, create a representation, recognize relationships, choose a strategy, perform accurate calculations and assess the outcomes. Any weakness in one of these steps might make solutions fail (Anobile et al., 2022; Wang et al., 2024).

Mathematical language was the strongest predictor of word-problem difficulty. Students who misunderstood vocabulary, relational expressions, symbols, or syntactic structures were less able to determine how quantities were connected. The finding supported meta-analytic evidence linking mathematics vocabulary with mathematics achievement. Concept application was also a strong predictor. Students who depended on memorized procedures were less able to solve unfamiliar or contextualized problems. Multiple representations, manipulatives, diagrams, and explicit connections among concepts can help students develop flexible rather than isolated knowledge (Lariviere et al., 2025; Boamah et al., 2025).

Logical reasoning significantly predicted word-problem performance because students needed to determine whether a selected operation was appropriate, sequence multiple steps, and evaluate the reasonableness of an answer. Reasoning-focused teaching should therefore accompany computational instruction. The higher scores among students with identified mathematics and learning difficulties were expected. Such students may experience persistent weaknesses in number sense, working memory, language, spatial representation, attention, or strategy use. They often benefit from explicit instruction, worked examples, visual models, cumulative review, and guided problem-solving. The higher scores in public, rural, and large classrooms may have reflected reduced opportunities for individualized feedback, mathematical discussion, manipulatives, and diagnostic assessment. These results should not be interpreted as evidence of inherent student weakness but as possible indicators of contextual inequalities (Lariviere et al., 2025; Luo et al., 2026).

Conclusion

The study found that there are significant problems when it comes to applying mathematical concepts, understanding word problems, using logical reasoning, and interpreting mathematical language at the elementary level. Most of the samples (76%) had moderate or high difficulty, with word problem comprehension being the most serious area. The results revealed that mathematical achievement was not solely due to calculation. Mathematical language, conceptual knowledge, and logical reasoning were strongly associated with students' ability to understand and solve word problems. Students who could calculate but could not interpret relationships remained at risk of poor performance. Students with identified mathematics or learning difficulties, below-average achievement, and those studying in larger public or rural classrooms appeared particularly vulnerable. Early screening and differentiated instruction were therefore necessary.

Recommendations

Following recommendations are made based on research findings:

1. Schools should assess students separately in computation, concept application, vocabulary, reasoning, and word-problem comprehension. Results should guide targeted interventions, particularly in rural and large public schools.

2. Teachers should use concrete materials, diagrams, models, and equations while directly teaching mathematical vocabulary. Schema-based instruction and step-by-step problem-solving should replace reliance on keywords.

3. Students should explain, justify, compare, and evaluate solutions through open-ended questions and error analysis. Future studies should use direct assessments, observations, interviews, and intervention-based designs.

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