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Decoding Mathematics: Pupils' Performance and Teachers' Pedagogical Challenges in L1 and L2 Word Problem Integration in Tumauini South District, Isabela for the School Year 2025–2026

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Index Terms:

Mother Tongue-Based Multilingual Education (MTB-MLE), first language (L1), second language (L2), mathematical word problems, pupils' performance, language of instruction

Abstract. Language is important when learning mathematics, especially with word problems. Understanding the language used in these problems is key to solving them correctly. This study examined how well Grade 3 students solved math word problems in their first language (L1) and second language (L2) and explored the challenges teachers face when using both languages in their teaching. The research involved 60 students and four teachers from Lapogan Elementary School in Tumauini South District, Isabela, but only 55 student responses were analyzed because some data were incomplete. A 15-item test created by the researchers was administered in both L1 (Ilocano) and L2 (English), along with interviews and analysis of students' academic performance. The data were analyzed using the mean, standard deviation, Z-test, and F-test. The results showed that students did better in L1 ($M = 11.16$, $SD = 2.51$) than in L2 ($M = 9.85$, $SD = 2.61$), with a significant difference ($p < 0.05$). Similarly, their academic performance in the second grading period (L1) was slightly higher ($M = 82.67$, $SD = 6.08$) than in the third grading period (L2) ($M = 81.93$, $SD = 6.60$), with significant differences noted. These findings suggest that the language used in teaching greatly affects students' understanding and problem-solving skills. Teachers also mentioned challenges such as limited teaching materials, vocabulary issues, and insufficient training in multilingual teaching methods. The study concludes that using L1 helps improve mathematical understanding and leads to better learning outcomes, while moving to L2 requires structured teaching support.

Introduction

Mathematics often has a reputation for being one of the toughest subjects in schools, mainly because it deals with abstract ideas and requires a lot of language skills. Recent studies highlight how important language is when it comes to understanding math concepts. This is especially true for word problems, where tricky language can be more of a hurdle than math itself (King & Powell, 2023). Many students find math challenging not because they cannot handle numbers but because they have trouble figuring out what the problems are asking. This issue is exacerbated if they have a limited vocabulary or struggle with sentence structure (Phaladi et al., 2024). To tackle this, schools around the world are increasingly using students' first language (L1) to teach math, which helps with understanding and cognitive growth (Hardy & Clemens, 2024). Research shows that teaching in a student's mother tongue boosts literacy, enhances critical thinking, and improves overall academic performance, especially in early math learning (Ardianto et al., 2024; Cahill & Bostic, 2025).

In the Philippines, the Department of Education (DepEd) has made the Mother Tongue-Based Multilingual Education (MTB-MLE) policy a key part of the K–12 curriculum. This policy focuses on using students' first language from kindergarten to Grade 3 to boost understanding, engagement, and learning outcomes. Research on how MTB-MLE is being implemented, like those studies conducted in Pampanga, shows that teachers have a positive view of it, and students are doing well in both their mother tongue and Mathematics. However, there are ongoing challenges with teaching materials and teacher readiness (Tungul and Lapinid, 2024). On a national level, projects such as the Lingua Franca Project and the Lubuagan First Language Program have shown that when students learn to read and write in their first language, they can transition more smoothly to learning in a second language (L2). However, keeping MTB-MLE faces hurdles such as changing policy

priorities, inconsistent program support, and pushback from stakeholders (Metila et al., 2025). Teachers' beliefs and attitudes also play a significant role in how the policy is applied in classrooms, with some teachers adjusting or even resisting it due to perceived teaching challenges (Velasco, 2024). Looking at a local example, in Tumauini South District, Isabela, students often struggle with mathematical word problems when taught in English (L2). On the other hand, using Ilocano (L1) seems to help students understand and solve problems better. Teachers have pointed out several issues that make it hard to implement effectively, such as the lack of localized teaching materials, insufficient equivalent math terms in the mother tongue, and insufficient training in multilingual teaching methods (Tungul & Lapinid, 2024). These challenges underscore the need to explore how language affects math understanding and the importance of developing teaching strategies that help students transition from L1 to L2 math. Despite the expanding body of literature on MTB-MLE, existing research emphasizes general literacy and language acquisition, with limited focus on mathematics, particularly in the domain of word problem solving. Furthermore, most studies examine the use of L1 and L2 independently, with few offering direct comparative analyses within mathematical contexts. There is also a notable deficiency in localized research investigating the impact of L1–L2 integration on students' performance in specific settings such as the Tumauini South District. Additionally, few studies have concurrently explored both students' academic performance and the pedagogical challenges encountered by educators in implementing multilingual instruction. Consequently, there remains a significant gap in providing context-based, evidence-driven recommendations for enhancing the transition from L1 to L2 in mathematics instruction.

Research Questions

This study aimed to examine pupils' performance and teachers' pedagogical challenges in integrating L1 and L2 in mathematical word problems. Specifically, it sought to answer the following questions.

1. What is the level of pupils' performance in solving mathematical word problems using their first language (L1) and second language (L2)?
2. What is the level of pupils' academic performance during the second grading period (using L1) and third grading period (using L2)?
3. Is there a significant difference in pupils' performance in
   3.1 Solving word problems using L1 and L2?
   3.2 Academic performance during the second and third grading periods?
4. What pedagogical challenges do teachers encounter when integrating L1 and L2 in teaching mathematical word problems?

Integrated Conceptual and Theoretical Mapping

In this study, we explored how the language used for instruction, whether a student's first language (L1) or second language (L2), impacts their ability to solve math word problems. We build on Vygotsky's sociocultural theory and Cummins' linguistic interdependence theory, which suggest that learning is deeply connected to language and that skills acquired in L1 can aid in learning L2. Our framework highlights important elements such as MTB-MLE, the language of instruction, teaching strategies, and learning materials. These components influence how lessons are taught using L1 and L2 for word problem solving. When students learn in their first language, they tend to grasp concepts more easily, which boosts their thinking and problem-solving skills. However, switching to L2 can pose challenges owing to language barriers, making it difficult for students to understand the problems. The framework also emphasizes the role of cognitive development in learning. A better grasp of concepts leads to enhanced problem-solving skills, which, in turn, affects students' performance, including their math scores and grades. Teachers, on the other hand, might encounter hurdles such as a lack of resources, limited L1 vocabulary, and insufficient training, which can impact their teaching. Overall, the framework suggests that effective use of L1 and provision of proper support when transitioning to L2 can enhance students' learning outcomes and help teachers implement more effective teaching strategies.

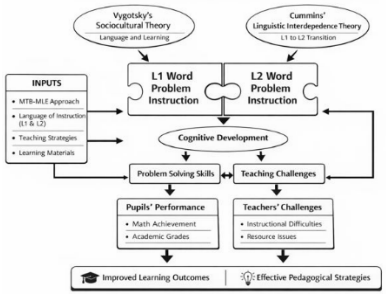

Figure 1. Integrated Conceptual and Theoretical Framework on L1 and L2 Word Problem Instruction and Pupils' Performance

Methodology

Research Design

This study employed a quantitative descriptive-comparative research design to examine the performance of Grade 3 pupils in solving mathematical word problems using their first language (L1) and second language (L2), as well as to identify the pedagogical challenges encountered by teachers in implementing Mother Tongue-Based Multilingual Education (MTB-MLE). The descriptive component was used to determine the level of pupils' performance and academic achievement, while the comparative aspect analyzed the significant differences between L1 and L2 as media of instruction. This design was appropriate because it allowed the researcher to describe existing conditions and compare outcomes without manipulating variables.

Participants and Sampling Technique

The study participants consisted of 60 Grade 3 pupils and four teachers from Lapogan Elementary School, Tumauini South District, Isabela. A purposive sampling technique was used to select respondents who were directly involved in the teaching and learning processes of Mathematics using L1 and L2. The inclusion criteria for pupils were those officially enrolled in Grade 3 during the School Year 2025–2026, while teacher respondents were those currently teaching mathematics at the same level. Respondents who did not meet the inclusion criteria were excluded from the study.

Research Instrument

The primary instrument used in this study was a researcher-made 15-item word problem-solving test administered in both L1 (Ilocano) and L2 (English). The test was designed to assess pupils' comprehension and problem-solving skills across two language conditions in the study. Additionally, unstructured interviews were conducted to gather qualitative data regarding the challenges encountered by teachers, and documentary analysis was used to obtain pupils' grades during the second and third grading periods. The instrument underwent content validation by subject experts to ensure clarity, relevance, and alignment with the study's objectives. However, further reliability testing is recommended to strengthen this instrument.

Data Gathering Procedure

Prior to data collection, permission was obtained from the Schools Division Superintendent and the school principal. The researcher administered the test through a face-to-face approach during scheduled mathematics classes. The pupils were given sufficient time to complete the test under the supervision of the researcher. Interviews with teachers were conducted informally to validate their responses and clarify issues related to the implementation of the MTB-MLE. Documentary data, specifically pupils' grades, were obtained from official school records for the analysis.

Data Analysis Procedure

The collected data were analyzed using the appropriate statistical tools. Frequency, percentage distribution, and mean were used to describe the students' performance levels in word problem solving and academic achievement. To determine significant differences between L1 and L2 performance and between grading periods, Z-test- and F-tests were employed. These statistical methods allowed the researcher to identify patterns, relationships, and differences among the variables being investigated.

Ethical Considerations

Ethical standards were strictly followed throughout the study. Permission was obtained from the relevant school authorities prior to data collection. Participants were informed about the purpose of the study, and informed consent was obtained from both teachers and guardians of the pupils. Participation was voluntary, and the respondents were assured that their identities would remain confidential. All data collected were used solely for research purposes and handled with utmost confidentiality and respect.

Results and Discussion

Distribution of Respondents

Grade Level	Teachers	Pupils
Grade 3 – A	1	15
Grade 3 – B	1	15
Grade 4 – A	1	15
Grade 4 – B	1	15
Total	**4**	**60**

Table 1 Distribution of Respondents

Table 1 provides an overview of the participants in the study: four teachers and 60 students from different grades at Lapogan Elementary School. The students were evenly spread across four sections, which helped ensure that our sample was well balanced. This balance is important because it reduces any bias that might arise from having groups of different sizes. By including both teachers and students, we can thoroughly explore how well students perform and the teaching challenges faced when using L1 and L2 in teaching math word problems.

Performance of Pupils in Word Problem Solving Using L1 and L2

Variable	Mean	Standard Deviation	Interpretation
L1 (Ilocano)	11.16	2.51	Very Satisfactory
L2 (English)	9.85	2.61	Very Satisfactory

Table 2a Performance of Pupils in Word Problem Solving Using L1 and L2

A statistical summary of the pupils' performance in solving word problems using their first language (L1, Ilocano) and second language (L2, English) is presented in Table 2a. The pupils achieved a mean score of 11.16 with a standard deviation of 2.51 when solving word problems in Ilocano (L1), whereas their performance in English (L2) resulted in a slightly lower mean of 9.85 and a standard deviation of 2.61. Both mean scores fall within the "Very Satisfactory" interpretation category, indicating that the pupils performed well in word problem solving, irrespective of the language used. The higher average score in L1 suggests that pupils may exhibit better comprehension and problem-solving efficacy when working in their native language, potentially due to greater linguistic familiarity and cognitive ease. The close standard deviations in both languages indicate comparable variability in pupil performance across L1 and L2 settings. These findings are consistent with research emphasizing the influence of language on mathematical problem-solving. For instance, studies have reported that language load in mathematics items can impact performance, particularly in multilingual or minority language contexts, where comprehension in L2 may hinder the accurate assessment of mathematical ability (Veloo et al., 2024). Furthermore, the use of native language in test accommodations has been shown to improve pupils' outcomes in word problem tasks.

Performance of Pupils During Second and Third Grading Periods

Variable	Mean	Standard Deviation	Interpretation
L1 (2nd Grading)	82.67	6.08	Satisfactory
L2 (3rd Grading)	81.93	6.60	Satisfactory

Table 2b Performance of Pupils During Second and Third Grading Periods

The performance of students during the second and third grading periods, assessed using their first language (L1) and second language (L2) respectively, yielded satisfactory outcomes. In the second grading period, utilizing L1, students achieved a mean score of 82.67, with a standard deviation of 6.08. In the third grading period, using L2, the mean was slightly lower at 81.93, with a standard deviation of 6.60. These statistics indicate consistent performance across grading periods and languages, with minor variations in scores. The close mean values suggest that students maintain a stable level of achievement in word problem solving, irrespective of whether they are interacting with their first or second language during these periods. This stability aligns with research emphasizing the role of language proficiency and instructional support in mathematics performance, particularly for bilingual or emerging bilingual learners. For instance, studies have shown that language comprehension, vocabulary knowledge, and targeted interventions significantly influence word-problem performance among students with varied language backgrounds and mathematics difficulties(King & Powell,

2023; Lariviere et al., 2025; Orosco & Reed, 2024). Furthermore, instructional strategies that incorporate language comprehension directly into math instruction have resulted in improved word-problem-solving outcomes, demonstrating the critical intersection of language and mathematics skills(Fuchs et al., 2021). Hence, the satisfactory performance across both grading periods reflects the effectiveness of either language of instruction, combined with appropriate pedagogical support, in facilitating consistent student achievement in problem-solving.

Test of Significant Difference in Word Problem Solving (L1 vs L2)

Variable	Mean	SD	Test Value	p-value	Decision
L1	11.16	2.51			
L2	9.85	2.61	2.52	<0.05	Reject H_0

Table 3a Test of Significant Difference in Word Problem Solving (L1 vs L2)

Table 3a illustrates the test of significant differences in pupils' performance in solving mathematical word problems using their first language (L1) and second language (L2). The results demonstrated that the pupils exhibited superior performance in L1 (M = 11.16, SD = 2.51) compared to L2 (M = 9.85, SD = 2.61). The computed test value of 2.52, with a p-value less than 0.05, led to the rejection of the null hypothesis, thereby confirming a statistically significant difference between the two conditions. This finding suggests that the language of instruction significantly influences pupils' ability to comprehend and solve mathematical word problems. The enhanced performance in L1 can be attributed to learners' familiarity with vocabulary and sentence structures, which reduces cognitive load and enhances understanding. This result corroborates previous studies that emphasize the critical role of language proficiency in mathematical problem-solving, particularly among bilingual learners (King & Powell, 2023). Similarly, difficulties in interpreting the linguistic components of word problems have been identified as major barriers to mathematical performance (Phaladi et al., 2024). Furthermore, integrating language comprehension into mathematics instruction has been shown to significantly improve learners' problem-solving abilities (Fuchs et al., 2021). Thus, the findings underscore the importance of utilizing learners' first language as a support mechanism in developing mathematical understanding.

Test of Significant Difference in Academic Performance (2nd vs 3rd Grading)

Variables Compared	Computed F	Critical F (0.05)	Decision	Interpretation
2nd Grading (L1) vs 3rd Grading (L2) Performance	27.00	3.94	Reject H_0	Significant

Table 3b Test of Significant Difference in Academic Performance (2nd vs 3rd Grading)

Table 3b illustrates the analysis of significant differences in the students' academic performance between the second grading period (L1) and the third grading period (L2). The calculated F value of 27.00 surpasses the critical value of 3.94 at the 0.05 level of significance, resulting in the rejection of the null hypothesis. This finding indicates a statistically significant difference in students' academic performance across the two grading periods. Although the mean scores appear similar, the statistical results suggest that even minor differences in the language of instruction can substantially impact academic outcomes. The transition from L1 to L2 may introduce additional linguistic and cognitive challenges that affect pupils' ability to fully demonstrate their understanding of mathematical concepts. This finding aligns with studies emphasizing language proficiency as a strong predictor of performance in mathematical word problems (Lariviere et al., 2025). Additionally, learners who encounter language-related challenges benefit from targeted instructional interventions that support both language and mathematical skills (Orosco & Reed, 2024). Furthermore, language has been shown to significantly influences mathematical problem-solving outcomes among multilingual learners (Cahill & Bostic, 2025). Therefore, the results underscore the necessity of structured support, such as scaffolding strategies and vocabulary development, to facilitate a smoother transition from L1 to L2 and to sustain pupils' academic performance.

Conclusion and Recommendations

The findings of this study indicate that the language of instruction significantly impacts students' performance in solving mathematical word problems. Students demonstrated improved performance when problems were presented in their first language (L1) compared to their second language (L2), underscoring the essential role of language comprehension in learning mathematics. Although students maintained a generally satisfactory level of academic performance across grading periods, the statistically significant differences suggest that the transition from L1 to L2 introduces additional cognitive and linguistic challenges that can affect the learning outcomes. These results confirm that mathematical proficiency is not solely reliant on numerical ability but is closely associated with language proficiency and comprehension.

The implications of this study emphasize the importance of enhancing the implementation of Mother Tongue-Based Multilingual Education (MTB-MLE) in early mathematics instruction. The use of L1 should be maintained as a foundational tool to support understanding, particularly in word problem solving, while structured and gradual transition strategies to L2 must be carefully designed and implemented in the future. Educational stakeholders, including curriculum developers and school administrators, should prioritize the development of localized instructional materials and provide continuous professional development to teachers to enhance their competence in multilingual pedagogy. Additionally, integrating language support strategies, such as vocabulary development, scaffolding techniques, and contextualized instruction, can help bridge the gap between L1 and L2 learning. Ultimately, improving the alignment between the language of instruction and cognitive development can lead to more effective teaching practices and better learning outcomes in mathematics education.

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Competing Interests Statement

The authors declare that they have no competing financial interests or personal relationships that could have influenced the work reported in this article.

Data Availability Statement

Data sharing is not applicable to this article, as no new data were created or analyzed in this study; all data used were obtained from previously published sources, as cited in the reference list.

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Appendices

Appendix upon request