

Socio-Demographic Influences on Mathematical Word Problem Solving in the Philippine Context: A Narrative Literature Review

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ABSTRACT

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This narrative literature review examines how socio-demographic factors influence Filipino students' ability to solve mathematical word problems. Drawing on international and local studies, the review synthesizes evidence on the roles of age, sex/gender, and family environment in shaping mathematical literacy. Findings indicate that developmental readiness affects working memory and reading fluency, gender differences are largely influenced by socio-cultural expectations

and confidence, and family environment—particularly socio-economic status and parental involvement—is the strongest predictor of performance. By integrating correlational, quasi-experimental, and intervention studies, the review proposes a causal model that situates these factors as key determinants of word problem-solving ability. The study highlights the need for early academic support, gender-



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sensitive instruction, and strengthened home numeracy practices. These findings provide practical guidance for teachers and policymakers in designing inclusive, evidence-based interventions to improve students' mathematical literacy.

INTRODUCTION

The ability to solve mathematical word problems is a fundamental skill that connects abstract mathematical concepts to real-life situations. However, this skill remains a major challenge for many Filipino learners. International assessments consistently show weak performance in mathematics, particularly in problem-solving tasks. In the Programme for International Student Assessment (PISA) 2018, the Philippines ranked lowest among 79 participating countries, with an average mathematics score of 353 compared to the OECD average of 489 (Organisation for Economic Co-operation and Development [OECD], 2019). This result highlights persistent difficulties in mathematical literacy at the national level.

Local assessment data reflect similar concerns. Results from the National Achievement Test (NAT) indicate that most Filipino students perform below the mastery level in mathematics, with average proficiency rates ranging from 35% to 40% (Department of Education [DepEd], 2019). These findings suggest that weaknesses in problem-solving, especially in word problems that require comprehension and reasoning, are deeply rooted in the Philippine educational system.

Previous research has largely focused on cognitive and linguistic factors affecting mathematical performance. Difficulties in solving mathematical word problems are often linked to students' inability to translate verbal information into mathematical representations and to integrate reading comprehension with arithmetic processes (Edwards, et al., 2009; Pongsakdi et al., 2020; Vilenius-Tuohimaa et al., 2008). While these variables are important, growing evidence suggests that socio-demographic factors also play a critical role. Recent analyses of PISA 2022 data show that students from higher socio-economic backgrounds outperform their disadvantaged peers by nearly 50 points (DepEd, 2023). Similarly, relative age effects and variations in home learning environments have been linked to differences in academic achievement (Carey et al., 2016; Mengistie, 2020).

Gender-related patterns further illustrate the influence of social context. Although global trends often show slight male advantages in mathematics, Philippine data reveal minimal gender gaps, suggesting that socio-cultural expectations and classroom practices may be more influential than biological

factors (OECD, 2019). These findings point to the importance of examining how social and environmental conditions shape students' learning experiences.

Despite these insights, existing studies in the Philippine context remain fragmented and often focus on isolated variables. There is limited synthesis explaining how age, sex/gender, and family environment interact to influence mathematical word problem solving. This gap weakens the development of evidence-based interventions and policies. Therefore, a comprehensive review of socio-demographic influences is necessary to clarify their causal pathways and practical implications.

This narrative literature review addresses this gap by synthesizing international and local research on socio-demographic factors affecting mathematical word problem solving among Filipino learners. By identifying how these variables operate as upstream determinants of performance, the study aims to provide a stronger empirical basis for educational reforms, early interventions, and equity-oriented policies.

OBJECTIVES OF THE STUDY

This study aimed to examine how socio-demographic factors influence Filipino students' ability to solve mathematical word problems. Specifically, it sought to analyze the effects of age and developmental timing on cognitive skills such as working memory and reading comprehension that are essential for problem-solving. It also aims to examine how sex and gender differences in mathematical performance are shaped by socio-cultural expectations, classroom practices, and students' confidence levels. Furthermore, the study investigated the impact of family environment, including socio-economic status, parental education, and home numeracy practices, on students' mathematical literacy. By synthesizing international and local research, this review intended to identify gaps and causal pathways in existing literature. Ultimately, the study aimed to propose evidence-based educational interventions and policy recommendations that address identified disadvantages through early academic support, equitable resource distribution, and gender-sensitive pedagogy.

METHODOLOGY

This narrative literature review synthesized evidence from 25 empirical studies and policy reports related to mathematics education, with a particular focus on the Philippine context. The studies included cross-sectional, longitudinal, quasi-experimental, and intervention designs. To be included, studies had to examine

socio-demographic factors—age, sex/gender, or family environment—and their impact on mathematical word problem solving.

To ensure a robust and reliable synthesis, triangulation was applied. This means that findings from multiple types of studies were compared and integrated, rather than relying on a single source. For example, correlational studies were examined alongside longitudinal and intervention studies to identify patterns that were consistently observed across different methods. While correlational studies show relationships between variables, they do not prove causation. In contrast, longitudinal and quasi-experimental designs provide stronger evidence of causal effects, such as how family environment or age influences problem-solving performance (Carey et al., 2016; Wang et al., 2016).

The review followed a clear step-by-step process: (1) *Literature search*. Scholarly databases and policy reports were screened for relevance. (2) *Screening and selection*. Studies were selected based on inclusion criteria, emphasizing methodological rigor and relevance to socio-demographic influences. (3) *Data extraction*. Key findings on age, gender, and family factors were extracted. (4) *Synthesis*. Findings were organized by socio-demographic factor and triangulated to build a cohesive understanding of causal and correlational evidence. (5) *Contextualization*. International evidence was compared with Philippine data from the Department of Education (DepEd, 2019, 2023) to ensure local relevance.

This approach allowed the review to move beyond simply describing associations, providing a clear picture of how socio-demographic factors contribute to students' mathematical word problem performance.

RESULTS AND DISCUSSION

This review comprehensively examined the socio-demographic factors—age, gender, and family environment—that influence Filipino students' ability to solve mathematical word problems. Age and developmental timing remain critical determinants, as older students within the same grade generally exhibit stronger working memory, reading fluency, and metacognitive skills, which are essential for tackling multi-step word problems (Carey et al., 2016). Word problem solving requires the coordination of text comprehension and arithmetic skills, and weaknesses in either domain significantly hinder performance (Pongsakdi et al., 2020). Empirical evidence further demonstrates a strong association between reading comprehension and success in mathematical word problems, suggesting that language processing is a foundational component of problem solving (Vilenius-Tuohimaa et al., 2008). Students' frequent failure in standardized assessments has been attributed to difficulties in interpreting problem language

rather than purely computational weaknesses (Edwards et al., 2009). Relative age effects are particularly pronounced in the Philippines, where overcrowded classrooms and limited individualized instruction exacerbate developmental disparities (DepEd, 2024). Addressing these gaps requires flexible pacing and differentiated instruction to align with students' cognitive readiness.

Gender differences in mathematical problem solving are largely shaped by socio-cultural expectations rather than innate ability. Philippine studies show mixed results, with some indicating girls slightly outperform boys in mathematics, while others reveal negligible differences (OECD, 2019; Mengistie, 2020). Teacher biases, confidence levels, and differential encouragement significantly influence performance, highlighting the importance of gender-sensitive pedagogy and targeted interventions to reduce disparities (Hannula et al., 2004; Pajares & Graham, 1999).

Family and home environments emerge as the most influential socio-demographic factor. Socio-economic status (SES) affects access to resources, early childhood education, and home learning materials, all of which contribute to mathematical literacy (DepEd, 2023). Parental education and engagement enhance home numeracy practices, including mathematical games and problem-solving discussions, which positively impact students' ability to navigate word problems (Mengistie, 2020; Wang et al., 2016). In contexts where resources are scarce, these home supports become crucial causal mechanisms for academic success.

To consolidate these findings, Table 1 summarizes the socio-demographic factors, their causal pathways, and the implications for Philippine learners. This table highlights both individual-level and systemic interventions necessary to improve mathematical word problem performance.

Table 1

Socio-Demographic Factors and Their Causal Pathways in Philippine Mathematical Word Problem Solving

Factor	Causal Pathway	Philippine Evidence	Educational Implication
Age/ Developmental Timing	Working memory, reading fluency, metacognition	DepEd, 2024	Differentiated instruction; flexible pacing
Gender	Socio-cultural expectations, confidence, teacher bias	OECD, 2019; Yonson, 2017	Gender-sensitive pedagogy; confidence-building interventions
Family Environment	SES, parental education, home numeracy practices	DepEd, 2023; Mengistie, 2020	Parental engagement programs; resource allocation

In conclusion, socio-demographic variables function as upstream determinants of mathematical word problem performance in the Philippines. Age, gender, and family environment interact to shape foundational cognitive and affective resources, which in turn influence achievement. Interventions must therefore address both systemic inequities—such as resource distribution and classroom structure—and individual supports, including parental engagement and gender-sensitive instruction, to enhance mathematical literacy across diverse student populations (Carey et al., 2016; Wang et al., 2016; Rittle-Johnson et al., 2001).

CONCLUSION

Socio-demographic factors—age, sex/gender, and family environment—significantly shape Filipino students' ability to solve mathematical word problems. Among these, interventions targeting early childhood numeracy support, strengthened parental engagement, and equitable allocation of educational resources emerge as the most critical strategies for improving mathematical literacy (DepEd, 2023; OECD, 2019; Mengistie, 2020). Tailoring instruction to students' developmental readiness, promoting gender-sensitive pedagogy, and fostering home numeracy practices can mitigate performance gaps caused by socio-economic and cultural disparities (Carey et al., 2016; Hannula et al., 2004; Wang et al., 2016). Strengthening students' reading comprehension and linguistic interpretation skills is equally essential, as research consistently shows that mathematical word problem difficulty often stems from challenges in language processing and problem representation (Edwards et al., 2009; Pongsakdi et al., 2020; Vilenius-Tuohimaa et al., 2008).

Given the persistent underperformance of Filipino learners in international and national assessments, these reforms are not optional but urgent. Coordinated action across families, schools, and policy frameworks is essential to ensure that students acquire the mathematical skills necessary to succeed both academically and in real-world problem solving (Rittle-Johnson et al., 2001; Verschaffel et al., 2000).

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