Research in Social Sciences
Volume 8, Issue 3, pp. 80-87
2025

Pathways to Enhanced Math Literacy among Elementary School Children

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ABSTRACT: *This study examined the factors influencing the mathematical literacy of early-grade. Utilizing a descriptive-correlational research design, the study assessed 93 pupils from Grades 1 to 3 using the Early Grade Mathematics Assessment (EGMA), which measured competencies in number identification, quantity discrimination, pattern recognition, and arithmetic operations. Supplementary data were gathered through questionnaires assessing parental and home environment, technology-related factors, school-related conditions, and social-emotional aspects. Results indicated that learners generally achieved "Satisfactory" performance across all mathematical indicators. While most contextual variables did not show significant correlations with math achievement, a notable negative relationship was found between both home and social-emotional factors and word problem-solving skills. Additionally, school-related factors were significantly linked to learners' pattern recognition abilities. The findings underscore the importance of holistic interventions that address both cognitive and non-cognitive factors to enhance mathematical literacy, informing future educational policies and school-based support programs.*

Key words: *Early Childhood Education, early grade mathematics assessment, mathematical literacy, parental involvement in education.*

1. Introduction

Mathematical literacy is a foundational skill that empowers individuals to comprehend, evaluate, and apply mathematical concepts in real-world contexts. It extends beyond basic arithmetic to include interpreting data, recognizing patterns, and using logical reasoning to solve complex problems and make informed decisions (OECD, 2021). This competency is vital to students' overall academic growth, as it underpins success in more advanced mathematical studies and is especially critical in STEM-related disciplines, which are drivers of technological innovation and economic development in the 21st century (Kim & Cho, 2024). Moreover, strong mathematical proficiency contributes to economic stability by equipping individuals with the skills necessary to adapt to evolving workplace technologies, solve data-driven challenges, and thrive in knowledge-based economies (Torres & Fernandez, 2025; Clarke & Watson, 2024; Suson, 2019).

Understanding the factors that influence mathematical literacy during the early years of education is essential, as early interventions have been shown to significantly impact long-term learning outcomes. Early-grade mathematics forms the building blocks of future academic success, and addressing gaps during these formative years can prevent learning deficits from compounding over time (Wallace & Green, 2024; Suson,

Research in Social Sciences
Vol. 8, No. 3, pp. 80-87
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DOI: *10.53935/26415305.v8i3.397*
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2020; Patel et al., 2023). International large-scale assessments such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) have consistently highlighted global disparities in mathematical achievement. For example, in the 2019 TIMSS, the Philippines scored only 297, significantly below the international average of 500 (IEA, 2019). Similarly, in the 2018 PISA, the country ranked 79th out of 100 nations in mathematics, underscoring the urgent need for systemic educational reform (OECD, 2020).

One widely adopted diagnostic tool used to assess foundational math skills is the Early Grade Mathematics Assessment (EGMA). EGMA evaluates critical numeracy domains such as number identification, quantity discrimination, pattern recognition, and basic arithmetic operations. Studies have demonstrated that the implementation of EGMA can guide data-informed instruction and significantly improve student performance (Hansen & Liu, 2023; Suson, 2024; Gomez & Bradley, 2024; Singson, 2024). Enhanced mathematical literacy is closely tied to national economic performance, a connection emphasized by the OECD (2021), which advocates for math skills as essential for navigating the demands of a technology-driven global society.

In response to the urgent need for improved mathematics instruction, the Philippine Department of Education (DepEd) has introduced various reforms aimed at strengthening early-grade math competencies. Initiatives such as the K–12 Basic Education Program and the newly launched Matatag Curriculum emphasize foundational learning, critical thinking, and problem-solving in mathematics and science (DepEd, 2023). Despite these reforms, many Filipino students continue to face challenges in mastering basic mathematical skills, which adversely affects their academic success and future employability. The objective was to assess the mathematical literacy of early-grade learners using the EGMA and to identify key factors influencing their performance. The findings aim to contribute to the global discourse on enhancing mathematical literacy by offering contextually grounded and evidence-based recommendations that can inform educational planning both locally and nationally. Addressing the root causes of poor math performance is essential to nurturing a generation of numerate learners who are equipped to actively participate in their communities and contribute meaningfully to the global economy (Wallace & Green, 2024; Morrow & Jenkins, 2025).

2. Literature Review

Mathematical literacy in early education is recognized as a cornerstone for students' academic progression and future workforce readiness. It encompasses more than the ability to perform basic arithmetic; it also includes understanding patterns, interpreting quantitative data, and applying logic and reasoning to real-world problems (OECD, 2021). Numerous studies have underscored the importance of developing these skills during the early grades, as foundational competencies acquired in primary school are predictive of future performance in advanced mathematics and STEM-related disciplines (Kim & Cho, 2024; Hansen & Liu, 2023). Socioeconomic status (SES) has emerged as one of the most influential predictors of mathematical literacy. According to Wallace and Green (2024), children from low-SES families often have less access to learning materials and educational support, which directly impacts their mathematical development. Similarly, Torres and Fernandez (2025) found that parental education and household income are significantly correlated with children's early math achievements, reinforcing the need for targeted interventions to bridge the achievement gap.

In response to these disparities, many educational systems have adopted diagnostic tools such as the Early Grade Mathematics Assessment (EGMA) to evaluate and support students' numeracy development. The EGMA has been widely recognized for its ability to identify specific areas of weakness and inform evidence-based instructional strategies (Gomez & Bradley, 2024; Hansen & Liu, 2023). Research in developing countries, including Kenya and Uganda, has demonstrated that when EGMA data are used to guide classroom interventions, significant gains in mathematical performance can be achieved (Patel et al., 2023). However, access to effective teaching and learning tools also hinges on digital equity. Morrow and Jenkins (2025) argue that technological integration in math instruction holds great promise but caution that without adequate infrastructure and teacher training, digital initiatives may exacerbate rather than mitigate educational inequality. Supporting this, Singh and Matthews (2023) emphasize that while technology can enhance student engagement and performance, its impact depends heavily on how it is implemented. Furthermore, Clarke and Watson (2024) highlight the importance of continuous teacher professional development in ensuring that instructional technologies are used effectively to support mathematical learning. Collectively, these studies

DOI: *10.53935/26415305.v8i3.397*
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suggest that improving mathematical literacy requires a multifaceted approach one that considers socioeconomic disparities, assessment-driven instruction, and the strategic use of educational technology.

3. Methodology

This study adopted a descriptive-correlational research design to examine the mathematical literacy of pupils at Borromeo Brothers Elementary School using the Early Grade Mathematics Assessment (EGMA). A total of 93 pupils from Grades 1 to 3 were chosen through convenience sampling based on their availability and willingness to participate. The EGMA toolkit served as the main instrument for evaluating mathematical proficiency, covering areas such as number identification, quantity discrimination, pattern recognition, and basic arithmetic operations. To ensure inclusivity, the assessments were administered through both oral and written formats, accommodating varying literacy levels among the pupils. In addition to the EGMA, questionnaires were distributed to pupils and their parents to collect important demographic and contextual data, including educational attainment, household income, and home learning conditions. This provided deeper insight into the factors affecting mathematical literacy. Data analysis included the use of descriptive statistics to profile student competencies and correlational analysis to determine key influencing variables.

4. Results and Discussion

Table 1. Parental and Home Environment.

Indicators	**Mean**	**VD**
My parents regularly help me with my homework.	2.31	D
I feel emotionally supported by my family.	2.56	A
I have access to books, internet, and other learning materials at home.	2.18	D
My family expects me to perform well in school.	2.29	D
My home environment provides a quiet space for studying.	2.01	D
Grand Mean	2.27	D

Table 1 presents the perceptions regarding the parental and home environment factors that may influence their academic performance, particularly in mathematics. The data reveals generally low mean scores across the indicators, with a Grand Mean of 2.27, interpreted as "Disagree." This suggests that students generally do not perceive their home environment as supportive of their learning needs. Specifically, students reported limited parental assistance with homework (mean = 2.31), minimal access to educational resources such as books and internet (mean = 2.18), and low academic expectations from their families (mean = 2.29). Additionally, the provision of a quiet study space at home received one of the lowest ratings (mean = 2.01), indicating a lack of conducive learning conditions. The only indicator that reached an "Agree" rating was emotional support from family (mean = 2.56), suggesting that while emotional encouragement may be present, practical and academic support remains insufficient. Overall, the data highlights significant gaps in the home environment that could hinder the development of students' mathematical literacy.

Table 2. Technology-Related Factors.

Indicators	**Mean**	**VD**
I have reliable access to computers/tablets for schoolwork.	1.89	D
Using technology improves my learning experience.	3.24	SA
I spend a lot of time on social media or video games.	2.68	A
Technology often distracts me from studying.	3.27	SA
I easily adapt to using new educational software or platforms.	2.21	D
Grand Mean	2.66	A

Table 2 illustrates students' responses regarding technology-related factors and their potential influence on learning, particularly in mathematics. The overall Grand Mean of 2.66 falls under the category of "Agree," indicating a moderately favorable perception of technology in education. Notably, students strongly agreed that

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technology enhances their learning experience (mean = 3.24) and acknowledged that it often serves as a distraction from studying (mean = 3.27), highlighting a dual role of technology as both beneficial and potentially disruptive. On the other hand, access to technological devices remains a concern, with a mean score of 1.89 ("Disagree"), suggesting that many students lack reliable access to computers or tablets for schoolwork—a critical issue in today's digital learning environment. Additionally, adaptability to educational software scored low (mean = 2.21), pointing to possible difficulties in navigating digital learning tools. While some students agreed that they spend time on social media or video games (mean = 2.68), the data overall reflects a need for better access to technology and guided use to maximize its benefits for learning and minimize distractions.

Table 3. School-Related Factors

Indicators	Mean	VD
My teachers are supportive and help me succeed.	3.4	SA
My school provides adequate resources (e.g., books, labs, facilities).	2.76	D
I feel safe at school.	3.21	A
My classmates are supportive and help me with schoolwork	2.84	A
I participate in extra-curricular activities provided by my school.	2.54	A
Grand Mean	2.95	A

Table 3 presents the students' perceptions of school-related factors that may influence their academic success, especially in mathematics. The Grand Mean of 2.95 falls under the "Agree" category, indicating generally positive but varied experiences within the school environment. Among the indicators, the highest-rated was the perception that teachers are supportive and help students succeed (mean = 3.4), categorized as "Strongly Agree." This reflects a strong belief in teacher encouragement as a key academic support. Students also reported feeling safe at school (mean = 3.21) and receiving help from classmates (mean = 2.84), both under "Agree," suggesting a generally supportive and secure learning atmosphere. However, the availability of school resources like books, labs, and facilities received a lower mean score of 2.76 ("Disagree"), pointing to possible inadequacies in instructional materials. Participation in extracurricular activities was also moderate (mean = 2.54), indicating either limited opportunities or engagement.

Table 4. Social-Emotional Factors.

Indicators	Mean	VD
I am confident in my academic abilities.	2.42	D
I have positive relationships with my classmates.	3.02	A
I can manage my emotions well when faced with challenges.	2.59	A
I feel supported by my friends.	2.96	A
I am able to manage stress effectively.	2.53	A
Grand Mean	2.70	A

Table 4 outlines the social-emotional factors that may influence students' academic engagement and learning outcomes. The overall Grand Mean of 2.70 falls under the category of "Agree," suggesting that students generally perceive their social-emotional environment as moderately supportive. Among the indicators, students reported the most agreement with having positive relationships with classmates (mean = 3.02) and feeling supported by friends (mean = 2.96), reflecting strong peer connections that can enhance emotional well-being and collaborative learning. Additionally, students agreed they can manage their emotions in challenging situations (mean = 2.59) and handle stress effectively (mean = 2.53), indicating a fair level of emotional regulation, although there is room for improvement. The lowest-rated indicator was academic confidence (mean = 2.42), which falls under "Disagree" and highlights a concern regarding self-belief in their academic capabilities. Overall, while students benefit from positive peer relationships, interventions may be needed to strengthen their academic confidence and emotional resilience to support holistic development.

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Table 5. Learners' Performance.

Indicators	Mean	VD
Number Identification	80	Satisfactory
Quantity Discrimination	80	Satisfactory
Missing Number (Patterns)	80	Satisfactory
Addition And Subtraction Level 1	81	Satisfactory
Addition And Subtraction Level 1	80	Satisfactory
Word Problem- Solving Skill	81	Satisfactory

Table 5 presents the learners' performance in key mathematical competencies as assessed using the Early Grade Mathematics Assessment (EGMA) at Lawaan III Elementary School. Across all indicators—Number Identification, Quantity Discrimination, Missing Number (Patterns), Addition and Subtraction Level 1, and Word Problem-Solving Skills—the students consistently achieved mean scores ranging from 80 to 81, all falling within the "Satisfactory" range. These results suggest that students have acquired a foundational understanding of essential math skills. Specifically, performance in Addition and Subtraction Level 1 and Word Problem-Solving Skills was slightly higher (mean = 81), indicating that students are able to apply basic arithmetic operations in both direct computation and contextual problem-solving. Meanwhile, consistent scores of 80 in the remaining areas reflect a stable, though not exceptional, level of proficiency. The uniformity of the results points to the effectiveness of existing instruction but also highlights the opportunity for targeted interventions to elevate performance from satisfactory to higher achievement levels.

Table 6. Significant Relationship Between the Parental and Home Environment to Learners' Performance.

Constructs	r-value	t-value	P value	Remarks	Decision
Number Identification	-0.019	-0.186	0.853	Not Significant	Do not reject
Quantity Discrimination	0.049	0.482	0.631	Not Significant	Do not reject
Missing Number	0.097	0.962	0.338	Not Significant	Do not reject
Addition_Level_1	-0.05	-0.496	0.621	Not Significant	Do not reject
Subtraction Level 1	0.125	1.244	0.216	Not Significant	Do not reject
Word Problem	-0.222	-2.25	0.027	Significant	Do not reject

Table 6 presents the correlation between parental and home environment factors and learners' performance across various mathematical tasks. The results show that most mathematical performance indicators, including Number Identification (r = -0.019, p = 0.853), Quantity Discrimination (r = 0.049, p = 0.631), Missing Number (r = 0.097, p = 0.338), Addition Level 1 (r = -0.05, p = 0.621), and Subtraction Level 1 (r = 0.125, p = 0.216), did not yield statistically significant relationships with parental and home environment variables. This indicates that, for these competencies, variations in home support and conditions did not meaningfully influence students' outcomes. However, a statistically significant negative correlation was found between the parental and home environment and performance in Word Problem Solving (r = -0.222, p = 0.027). Although the correlation is weak, the significance suggests that certain aspects of the home environment may adversely affect students' ability to comprehend and solve word problems. This finding highlights the potential impact of non-academic factors at home, such as lack of support, low exposure to reading materials, or stressful environments, which may hinder students' understanding of context-based mathematical questions.

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Table 7. Significant Relationship Between the Technology Factors to Learners' Performance.

Constructs	r-value	t-value	P value	Remarks	Decision
Number Identification	0.074	0.739	0.462	Not Significant	Do not reject
Quantity Discrimination	0.096	0.954	0.343	Not Significant	Do not reject
Missing Number	0.168	1.691	0.094	Not Significant	Do not reject
Addition_Level_1	0.071	0.703	0.484	Not Significant	Do not reject
Subtraction Level 1	0.117	1.166	0.247	Not Significant	Do not reject
Word Problem	-0.165	-1.658	0.101	Not Significant	Do not reject

Table 7 presents the analysis of the relationship between technology-related factors and learners' performance in various mathematical tasks at Lawaan III Elementary School. The findings indicate that none of the assessed relationships reached statistical significance, as all P values exceeded the 0.05 threshold. For instance, the correlation between technology factors and Number Identification (r = 0.074, p = 0.462), Quantity Discrimination (r = 0.096, p = 0.343), and Addition Level 1 (r = 0.071, p = 0.484) were weak and not statistically meaningful. Similarly, Subtraction Level 1 (r = 0.117, p = 0.247) and Missing Number (r = 0.168, p = 0.094) showed weak to moderate positive correlations but still failed to reach significance. Interestingly, Word Problem performance showed a weak negative correlation with technology factors (r = -0.165, p = 0.101), suggesting a potential inverse relationship, although not statistically significant. This could imply that technology use, particularly when unsupervised or unfocused, might distract rather than support learning in complex, context-based tasks like word problems. Overall, these results suggest that the current use and access to technology among students may not have a substantial or direct influence on their mathematical achievement, possibly due to limited access, low digital literacy, or ineffective integration of technology into instruction.

Table 8. Significant Relationship Between the School Factor to Learners' Performance.

Constructs	r-value	t-value	P value	Remarks	Decision
Number Identification	-0.047	-0.467	0.641	Not Significant	Do not reject
Quantity Discrimination	0.109	1.082	0.282	Not Significant	Do not reject
Missing Number	0.225	2.284	0.025	Significant	Do not reject
Addition_Level_1	-0.029	-0.283	0.777	Not Significant	Do not reject
Subtraction Level 1	-0.021	-0.212	0.833	Not Significant	Do not reject
Word Problem	-0.112	-1.117	0.267	Not Significant	Do not reject

Table 8 examines the relationship between school-related factors such as teacher support, resource availability, and school safety and learners' performance in various mathematical tasks. The results show that most of the correlations are not statistically significant. For example, Number Identification (r = -0.047, p = 0.641), Quantity Discrimination (r = 0.109, p = 0.282), Addition Level 1 (r = -0.029, p = 0.777), Subtraction Level 1 (r = -0.021, p = 0.833), and Word Problem (r = -0.112, p = 0.267) all show weak correlations with P values well above the 0.05 threshold, indicating no significant relationship between these skills and the measured school-related factors. However, Missing Number (Patterns) stands out with a moderate positive correlation (r = 0.225) and a statistically significant p value of 0.025. This suggests that school factors such as the presence of supportive teachers, a safe learning environment, and access to instructional resources may positively influence students' ability to identify and complete numerical patterns. This finding highlights the importance of school-based support structures in fostering cognitive skills related to logical thinking and pattern recognition. While other mathematical tasks do not appear to be significantly influenced by school-related variables, this result underscores the potential of strengthening school environments to enhance specific areas of mathematical learning.

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Table 9. Significant Relationship Between the Social-Emotional Factors to Learners' Performance.

Constructs	r-value	t-value	P value	Remarks	Decision
Number Identification	0.046	0.458	0.648	Not Significant	Do not reject
Quantity Discrimination	-0.154	-1.547	0.125	Not Significant	Do not reject
Missing Number	-0.035	-0.348	0.728	Not Significant	Do not reject
Addition_Level_1	0.047	0.461	0.646	Not Significant	Do not reject
Subtraction Level 1	0.064	0.634	0.527	Not Significant	Do not reject
Word Problem	-0.202	-2.038	0.044	Significant	Do not reject

Table 9 presents the correlation between social-emotional factors such as confidence, emotional regulation, stress management, and peer support and learners' performance in various mathematical tasks. For most of the mathematical skills assessed, the results indicate no statistically significant relationship. Weak correlations were observed in Number Identification (r = 0.046, *p* = 0.648), Quantity Discrimination (r = -0.154, *p* = 0.125), Missing Number (r = -0.035, *p* = 0.728), Addition Level 1 (r = 0.047, *p* = 0.646), and Subtraction Level 1 (r = 0.064, *p* = 0.527), all of which had P values greater than 0.05. This indicates that social-emotional characteristics, in general, do not significantly affect these specific areas of mathematical performance within this context. However, a statistically significant negative correlation was found between social-emotional factors and Word Problem-Solving (r = -0.202, *p* = 0.044). This suggests that students who reported lower levels of social-emotional well-being—such as low academic confidence, difficulty managing stress, or limited peer support—tended to perform worse in word problem-solving tasks. Given the cognitive and emotional demands of solving context-based math problems, this finding emphasizes the importance of fostering emotional resilience and self-efficacy in students. It points to the need for holistic educational approaches that integrate socio-emotional learning (SEL) into the curriculum to support students in both academic and personal development.

5. Discussion

The findings of this study shed light on the complex, multifactorial nature of mathematical literacy among early-grade learners. Despite widespread recognition of the importance of home, technology, school, and social-emotional environments, only a few factors showed statistically significant relationships with student performance, particularly in solving word problems and identifying patterns. The significant negative correlation between parental/home environment and word problem-solving performance suggests that children lacking academic support at home, such as access to learning materials or quiet study spaces, may struggle more with cognitively demanding tasks (Torres & Fernandez, 2025; Johnson & Lee, 2022). Word problems require not only mathematical reasoning but also reading comprehension and focus skills that can be hampered by chaotic or resource-limited home environments. This aligns with previous research indicating that low socioeconomic status and limited parental involvement are strongly associated with lower achievement in applied mathematics (Patel, Green, & Wallace, 2023; Wallace & Green, 2024). It highlights the need for community-based interventions that support home-based learning, particularly in under-resourced households.

Moreover, the school environment showed a significant relationship with learners' ability to recognize patterns, suggesting that structured, well-supported educational settings can foster higher-order thinking skills in mathematics (Gomez & Bradley, 2024; Hansen & Liu, 2023). However, most school, technology, and social-emotional variables did not significantly affect other areas of mathematical performance. Interestingly, social-emotional factors particularly confidence and peer support were significantly and negatively correlated with word problem-solving ability. This aligns with the literature that identifies academic confidence, emotional regulation, and resilience as important predictors of learning outcomes in subjects that require critical thinking and problem-solving (Clarke & Watson, 2024; Kim & Cho, 2024). The absence of significant results across other skill areas could reflect the limitations of current practices in integrating social-emotional learning and educational technology into early mathematics instruction. Researchers like Morrow and Jenkins (2025) and Singh and Matthews (2023) caution that technology alone is not a solution; its success depends on meaningful integration and teacher preparedness. Therefore, these findings suggest a call to action for more holistic, targeted interventions balancing home and school support, emotional well-being, and responsible technology use to enhance the mathematical literacy of early learners.

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6. Conclusion

This study explored the multifaceted factors influencing mathematical literacy among early-grade learners using the Early Grade Mathematics Assessment (EGMA). While learners demonstrated consistent "Satisfactory" performance across core mathematical skills, the findings revealed that most contextual variables such as parental/home support, technology access, school conditions, and social-emotional factors did not significantly correlate with mathematical achievement, except in specific areas. Notably, a significant negative relationship was found between the home environment and word problem-solving skills, and between social-emotional factors and performance in the same domain, underscoring the impact of non-academic challenges on higher-order thinking. Additionally, school-related factors showed a significant positive influence on students' ability to recognize patterns. These findings highlight the need for targeted interventions that go beyond classroom instruction by strengthening home learning conditions, enhancing emotional support systems, and strategically integrating school resources. Ultimately, a holistic and inclusive approach is necessary to foster meaningful and sustained improvements in students' mathematical literacy.

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Vol. 8, No. 3, pp. 80-87
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