

Original Article

Early-Grade Foundational Numeracy Skills: A Pretest-Posttest Analysis Among Grades 1 to 3 Pupils

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Abstract. The study aimed to assess pupils' early-grade foundational numeracy skills in Grades 1 to 3. The researcher employed a quasi-experimental design, specifically a one-group pretest-posttest design. The participants included 11 Grade 1 pupils, 17 Grade 2 pupils, and 23 Grade 3 pupils. The researcher used the validated Numeracy Assessment Tool (NuMAT) and analyzed the results using percentages, standard deviations, means, a t-test for dependent data, and Pearson's *r*. The pretest results revealed that the foundational numeracy skills of Grades 1 to 3 pupils were generally classified as non-numerate in terms of speed. Additionally, none of the pupils demonstrated comprehension in solving mathematical problems. However, the post-test results showed notable improvements. The speed of the pupils was classified as slow for Grade 1, non-numerate for Grade 2, and average for Grade 3. While Grade 1 and Grade 3 pupils were generally categorized as low in comprehension, Grade 2 pupils continued to show no comprehension when solving math problems. Nonetheless, approximately twelve percent of Grade 2 pupils achieved ratings above the non-numerate level. The analysis revealed a statistically significant improvement in both speed and comprehension from the pretest to the post-test across Grades 1 to 3. The higher post-test ratings indicate the effectiveness of the intervention. Moreover, the effect size was categorized as very large, further underscoring the program's substantial impact on learners' foundational numeracy skills.

Keywords: *Early grade; Foundational numeracy skills; Numeracy assessment; Numerical comprehension; Speed.*

Numeracy skills are crucial for navigating contemporary society, forming the foundation for understanding and engaging with various subjects and everyday tasks (Lerkkanen et al., 2022; Graham et al., 2020). Despite their importance, many education systems worldwide report low numeracy proficiency among learners, affecting their ability to recognize numbers, perform basic operations, and solve real-life problems (Uwezo Uganda, 2021). Standardized testing remains a prevalent method for assessing these skills, yet it often fails to address deeper issues of equity and instructional effectiveness (Bahena et al., 2024). The significance of numeracy extends beyond the classroom, influencing problem-solving abilities, career prospects, financial literacy, and overall academic success (Ranta et al., 2022). However, inadequate teaching methodologies and a lack of developmentally appropriate practices further hinder students' understanding and application of numeracy concepts (MoES, 2018). As education systems evolve, a comprehensive examination of assessment methodologies and policies is essential to enhance numeracy skills and ensure equitable educational outcomes (Alam & Mohanty, 2023).

Numeracy skills in the Philippines also face significant challenges, as evidenced by recent PISA results highlighting widespread deficiencies (Layug et al., 2022). Despite various interventions, including individualized instruction, students continue to struggle with basic arithmetic, particularly among marginalized communities (Briñosa et al., 2024). Average numeracy proficiency across all grade levels is alarmingly low, with the highest scores observed in Grade 4 and the lowest in Grade 3 (Maquiling, 2024). Specifically, the 'Visualizing and Modeling' skill shows the highest average scores, whereas 'Applying and Connecting' is notably challenging for learners (Maquiling, 2024). Early-grade students, from Grades 1 to 3, display particularly low numeracy levels, indicating a need for major support (Briñosa et al., 2024). This trend continues in higher grades, suggesting the need for support to enhance numeracy skills effectively (Maquiling, 2024).

While various research efforts in the Philippines have focused on enhancing learners' numeracy skills through targeted interventions, most studies have focused on learners in higher grade levels, such as Grades 3 to 5. For example, Coronacion (2024) and Talento (2024) investigated the effectiveness of programs aimed at Grades 5 and 3, respectively, while Celemin (2024) and Belleza (2022) developed interventions and materials for Grades 3 to 5. However, there is an apparent gap in research specifically targeting the foundational numeracy skills in the earlier grades, particularly Grades 1 to 3. These early stages are crucial for learners' cognitive and numeracy development. This statement aligns with Perez (2023), emphasizing that early childhood years, from birth to age eight, comprise the most important period for numeracy development. The current study seeks to address this gap by focusing on interventions to improve foundational numeracy skills among pupils in Grades 1-3.

As an instructional leader and Math enthusiast, the researcher is dedicated to providing quality education during these formative years. This study aims to make a meaningful contribution toward helping primary learners attain at least the minimum proficiency level in mathematics, in alignment with SDG 4.1.1. The results from pretests and posttests would guide the creation of a tailored intervention program to meet learners' needs and enhance Mathematics instruction under his supervision.

Methodology

Research Design

The research utilized the quasi-experimental design, specifically the one-group pretest-posttest design. Using this design, the researcher did not randomly assign participants to treatment and control groups. Instead, the researcher used existing groups to assess the intervention's effects. The study is also correlational, as the pupils' posttest numeracy performance was correlated with their math achievement.

Results and Discussion

Pupils' Foundational Numeracy Skills During the Pretest

Table 1 presents the data on the foundational numeracy skills of Grades 1 to 3 pupils during the pretest. The data show that the pupils are generally classified as non-numerates, with overall foundational numeracy ratings of 9.49, 5.11, and 9.50 for Grades 1, 2, and 3, respectively. Specifically, these pupils are categorized as non-numerates in terms of speed and numerical comprehension.

These findings indicate that the pupils lack the foundational numeracy skills needed at the beginning of the school year, making them likely to struggle with higher-level Math concepts. This aligns with other research conducted in the Philippines. For instance, Maquiling (2024) reported alarmingly low average numeracy levels among Grades 1 to 3 pupils, while Coronacion (2024) found that nearly half of Grades 2 to 6 pupils were classified as non-numerates. Similarly, Santiago and Mustacisa (2024) highlighted that between 2020-2021, 2021-2022, and 2022-2023, 31% to 35% of Grade 3 pupils were identified as non-numerates out of 287, 268, and 274 pupils, respectively. This consistent trend underscores the persistent challenges in addressing pupils' foundational numeracy skills. The findings also align with international studies. Amelia et al. (2024) reported that two-thirds of learners in Indonesia fall short in numeracy skills. Additionally, Susanto and Mahmudi (2024) posited that numeracy skills among Indonesian learners, from elementary to senior high school, remain below the minimum competency standards.

Table 1. Pupils' Foundational Numeracy Skills During the Pretest

Rating	Verbal Description	Grade 1 (n=13)		Grade 2 (n=17)		Grade 3 (n=23)	
		f	%	f	%	f	%
Speed							
35 - 40	Fast (F)	---	---	---	---	---	---
29 - 34	Average (A)	1	7.69	---	---	2	8.70
22 - 28	Slow (S)	---	---	---	---	5	21.74
< 22	Non-Numerates (NN)	12	92.31	17	100	16	69.57
Total		13	100	17	100	23	100
Mean		7.62 (NN)		7.59 (NN)		17.30 (NN)	
SD		8.14		4.11		8.05	
Numerical Comprehension							
51 - 60	High (H)	---	---	---	---	---	---
41 - 50	Average (A)	---	---	---	---	---	---
31 - 40	Low (L)	---	---	---	---	---	---
< 30	Non-Numerates (NN)	13	100	17	100	23	100
Total		13	100	17	100	23	100
Mean		4.15 (NN)		6.41 (NN)		3.74 (NN)	
SD		1.56		1.28		2.00	
Overall Foundational Numeracy Skills							
90 - 100	Advanced (A)	---	---	---	---	---	---
79 - 89	Intermediate (I)	---	---	---	---	---	---
68 - 78	Beginning (B)	---	---	---	---	---	---
< 68	Non-Numerates (NN)	13	100	17	100	23	100
Total		13	100	17	100	23	100
Mean		11.77 (NN)		14.00 (NN)		20.91 (NN)	
SD		9.49		5.11		9.50	

The results of this study suggest that pupils lack the foundational numeracy skills necessary for their grade levels and struggle significantly with Math. Addressing this gap is crucial to prevent learners from developing a negative attitude toward the subject. Nelson and McMaster (2019) recognize that early struggles with numeracy can lead to ongoing difficulties and poor academic performance later in life. Moreover, Maquiling (2024) argues that these low numeracy levels indicate an urgent need for major support, as the early years are critical for building a strong foundation in numeracy.

Pupils' Foundational Numeracy Skills During the Posttest

Table 2 presents the posttest results, which assessed pupils' foundational numeracy skills three months after the implementation of the CPRI program. The data indicate that, overall, the three groups of pupils remain in the non-numerates category with mean ratings of 64.00, 44.47, and 59.57 for Grades 1, 2, and 3, respectively. However, when examining the speed assessment component, Grade 1 and Grade 3 pupils demonstrated improvement, with classifications of slow and average as reflected in their ratings of 22.08 and 29.00, respectively. In contrast, Grade 2 pupils continue to be categorized as non-numerate in this area, with a rating of 15.53. In terms of numerical comprehension, Grade 1 and Grade 3 pupils achieved a low classification of 40.92 and 31.00, respectively, while Grade 2 pupils are classified as non-numerates, with a rating of 28.94. This result is similarly evident in Cabalang's (2024) study, which found that Grade 2 pupils struggle to solve mathematical problems and analyze patterns in numeracy tasks. Persistent challenges remain in areas such as number recognition, place value, sequencing, and the four fundamental operations applied in problem-solving.

Looking closely at the data, nearly 50% (6 out of 10) of Grade 1 pupils, approximately 12% (2 out of 17) of Grade 2 pupils, and about 22% (5 out of 23) of Grade 3 pupils are performing above the non-numerate classification. While this indicates some progress among pupils, the majority still struggle with foundational numeracy skills. These alarming findings highlight the urgent need for focused interventions to address pupils' deficiencies in foundational numeracy skills. The findings align with those of Briñosa et al. (2024), who reported that despite implementing various interventions, such as individualized instruction, learners continue to struggle with basic

arithmetic. This suggests that, beyond addressing foundational gaps, additional factors contributing to learners' difficulties warrant exploration. A stronger, more comprehensive support system may be necessary to help learners develop the numeracy skills required for their grade level.

Table 2. Pupils' Foundational Numeracy Skills During the Posttest

Rating	Verbal Description	Grade 1		Grade 2		Grade 3	
		f	%	f	%	f	%
Speed							
35 – 40	Fast (F)	2	15.38	---	---	4	17.39
29 – 34	Average (A)	1	7.69	---	---	9	39.13
22 – 28	Slow (S)	4	30.77	2	11.76	6	26.09
< 22	Non-Numerates (NN)	6	46.15	15	88.24	4	17.39
Total		13	100	17	100	23	100
Mean		22.08 (S)		15.53 (NN)		29.00 (A)	
SD		9.28		4.90		7.09	
Numerical Comprehension							
51 – 60	High (H)	2	15.38	1	5.88	---	---
41 – 50	Average (A)	6	46.15	1	5.88	1	4.35
31 – 40	Low (L)	2	15.38	4	23.53	12	52.17
< 30	Non-Numerates (NN)	3	23.08	11	64.71	10	43.48
Total		13	100	17	100	23	100
Mean		40.92 (L)		28.94 (NN)		31.00 (L)	
SD		10.79		11.68		7.16	
Overall Foundational Numeracy Skills							
90 – 100	Advanced (A)	1	7.69	---	---	---	---
79 – 89	Intermediate (I)	2	15.38	---	---	1	4.35
68 – 78	Beginning (B)	3	23.08	2	11.76	4	17.39
< 68	Non-Numerates (N)	7	53.85	15	88.24	18	78.26
Total		13	100	17	100	23	100
Mean		64.00 (NN)		44.47 (NN)		59.57 (NN)	
SD		18.16		15.37		11.41	

Difference Between the Pretest and Posttest Foundational Numeracy Skills of the Grades 1 to 3 Pupils

Table 3 presents data on differences in pupils' foundational numeracy skills between the pretest and posttest. Using a t-test for dependent data, the results indicate a statistically significant improvement (all $p < .001$) in both speed and comprehension skills across Grades 1 to 3. Similarly, pupils' overall foundational numeracy skills show significant differences, with higher posttest ratings. Additionally, the effect size is very large across all areas and year levels, supporting the conclusion that the CPRI program is effective to some extent.

While Table 2 indicates that some learners continue to struggle, the notable progress achieved within three months underscores the program's positive impact. It is important to note that the intervention is designed to last for 10 months, and the current assessment reflects outcomes from only the first quarter. These findings emphasize the value of interventions in improving pupils' foundational numeracy skills. Similar outcomes were observed in Talento's (2024) study, which developed contextualized learning recovery materials for Grade 3 pupils. These materials proved effective in providing teachers with tools for remediation and enhancement activities designed to meet learners' needs. Likewise, Coronacion (2024) demonstrated the success of the Math-Yaga program, a 10-month initiative that significantly enhanced learners' numeracy skills. Moreover, Gonzales (2024) noted that Project Math-GALING successfully improved the numeracy skills of Grade 1- 6 learners, achieving a 0% rate of non-numerates.

Table 3. *Difference in the Pretest and Posttest Foundational Numeracy Skills of the Grades 1 to 3 Pupils*

Variables	Grade 1			Grade 2			Grade 3		
	\bar{x}	t	p	\bar{x}	t	p	\bar{x}	t	p
Speed									
Pretest	7.62	8.84	<.001	7.59	8.47	<.001	17.30	8.27	<.001
Posttest	22.08			15.53			29.00		
Effect Size	2.45 (Very Large)			2.05 (Very Large)			1.73 (Very Large)		
Remark	Significant			Significant			Significant		
Numerical Comprehension									
Pretest	4.15	14.43	<.001	6.41	8.54	<.001	3.74	21.01	<.001
Posttest	40.92			28.94			31		
Effect Size	4.00 (Very Large)			2.07 (Very Large)			4.38 (Very Large)		
Remark	Significant			Significant			Significant		
Overall Foundational Numeracy Skills									
Pretest	11.77	14.72	<.001	14.00	10.41	<.001	20.91	24.88	<.001
Posttest	64.00			44.47			59.57		
Effect Size	4.08 (Very Large)			2.52 (Very Large)			5.19 (Very Large)		
Remark	Significant			Significant			Significant		

t-test for dependent data at 0.05 level of significance.

Classification	Cohen's d Effect Size
Ignored	0.00 < d ≤ 0.19
Small Effect	0.19 < d ≤ 0.49
Medium Effect	0.49 < d ≤ 0.79
Large Effect	0.79 < d ≤ 1.29
Very Large Effect	d > 1.29

Conclusion

The findings indicate that while the intervention led to measurable improvements in pupils' foundational numeracy skills, these gains were insufficient to elevate most pupils beyond the non-numerate classification. The persistence of speed and comprehension challenges among Grade 2 pupils indicates that, although the program had a positive impact, it may require further enhancements in intensity, duration, or instructional approaches to more effectively address deeper learning gaps. Additionally, Grade 2 pupils may face unique challenges or developmental needs that the intervention did not adequately address, and teachers may have overlooked them. Notably, the pupils' very satisfactory academic achievement, despite their foundational skill limitations, may point to strengths in other areas, such as their effort, classroom activities, or the quality of teacher support.

Contributions of Authors

Aljun B. Selorio: conceptualization of the study, research design, data collection, data analysis, and drafting of the manuscript

Dr. Ma Chona Z. Futalan: supervision of the research, validation of methodology, interpretation of results, and critical review and revision of the manuscript for intellectual content

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Conflict of Interests

This study has no conflict of interest of any sort.

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