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THE EFFECTIVENESS OF PLAY-BASED AND VEDIC APPROACH IN KINDERGARTEN EARLY NUMERACY SKILLS

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ABSTRACT

Early numeracy is a vital foundation for lifelong learning, yet many kindergartners struggle with counting, recognizing numbers, and performing simple addition. This study compared two instructional approaches—Play-Based Learning and Vedic Mathematics—in fostering early numeracy skills. Play-based learning emphasized games, storytelling, and hands-on activities, while the Vedic approach employed finger counting, rhythmic patterns, and visualization techniques. Seventy kindergarten pupils (ages 5–6) from a public school in Misamis Oriental, Philippines, were purposively sampled and divided into two groups. Pre-tests and post-tests measured four skills: counting and matching objects, numeral recognition (1–15), number patterns, and single-digit addition without regrouping. Data were analyzed using descriptive statistics and Repeated Measures MANOVA (RM-MANOVA) at the 0.05 level of significance. Anchored in Piaget's Cognitive Development Theory, Vygotsky's Sociocultural Theory, and Cognitive Load Theory, the study found that both approaches significantly improved pupils' numeracy skills. The play-based group demonstrated stronger conceptual understanding, confidence, and enjoyment, while the Vedic group showed greater speed and accuracy in problem-solving. Neither method was fully better than the other, their complementary strengths suggest potential synergy when integrated. This research addresses two gaps: the limited adaptation of Vedic Mathematics for kindergartners in Southeast Asia and the insufficiently examined cultural responsiveness of play-based frameworks. By profiling learners in a diverse public-school setting, the study provides evidence-based insights for teachers, curriculum developers, and policymakers. In conclusion, combining play-based and Vedic approaches may offer a balanced pathway to inclusive, engaging, and effective early numeracy instruction, supporting Sustainable Development Goal 4 on quality education.

Keywords: *Early Numeracy, Play-Based Learning, Vedic Mathematics, Kindergarten, RM-MANOVA, Quality Education*

INTRODUCTION

Early numeracy is a fundamental part of early childhood education and plays a crucial role in shaping children's future mathematical learning and overall academic success, as it involves the ability to understand, interpret, and apply numerical concepts in different contexts. As an essential life skill, numeracy enables individuals to make sense of the world since numbers are embedded in everyday activities and decision-making, and developing strong skills early lays a solid foundation for lifelong learning and problem-solving. Research has shown that baseline numeracy levels at school entry positively correlate with later mathematics achievement (Devlin et al., 2022). Yet, despite the emphasis on early numeracy in kindergarten, many learners still struggle with recognizing numbers, counting objects accurately, and performing simple operations, often because traditional teacher-centered instruction limits opportunities for active exploration. While play-based learning and alternative strategies such as Vedic mathematics have shown promise in enhancing mathematical understanding, classroom-based evidence remains limited, highlighting the need for engaging and developmentally appropriate interventions that can strengthen young learners' foundational numeracy skills.

Early numeracy difficulties or challenges in young children are complex and diverse that is why it requires a thorough evaluation and focused intervention in order to address the gap. Aunio (2020) asserts that fundamental numerical competencies, including counting, number comparison, and basic arithmetic, evolve rapidly between the ages of 5 and 8; however, the acquisition rate varies among children. This variability makes it hard to tell the difference between normal developmental delays and real learning problems. Mathematical skills are essential not only for academic performance but also for children's future educational success, as they support clear thinking, problem-solving, and everyday routines (Aunio et al., 2021). Since math is present everywhere—at home, in school, on the street, and even in stores—early numeracy becomes a practical life skill. Some studies view early numeracy as a single construct, while others see it as made up of multiple components (Dierkx et al., 2025). Because of its importance in, teachers must carefully choose teaching methods that are both fun and effective, ensuring pupils learn numbers in ways that match their interests. For children to truly grasp mathematical ideas, the approach must be thoughtfully designed to engage them while supporting their developmental needs.

One way to get the interest of the pupils is through play-based approach, where pupils learn by playing games, doing active activities, and using their imaginations. Children are naturally curious and active, and through playing it is how they discover and learn about the world around them. There are recent studies that indicate this method helps the children in recognizing numbers, counting, and even identifying patterns while

engaging with mathematics (Louw and Claassens, 2025). It also boosts their confidence and makes them more interested in learning. Since the children already know how to play, that is why it is very important to think about an consider play-based approach when setting up a kindergarten.

On the other hand, Vedic approach is another way to get the interest or enhance the numeracy skills of the children. Vedic comes from an old Indian math and it helps pupils learn how to think quickly, figure things out, and find patterns in numbers. Hence, Vedic approach can be considered as a mental math way. According to studies conducted by (Sharma et al., 2024), Vedic approach helps learn math better and feel less scared of numbers. These give a quick way to solve problems in addition, subtraction, multiplication, division, and even more difficult operations like algebra and square roots. It is a method that comes from the Vedas, which are ancient Indian religious texts, and they have been brought back to life and changed to fit modern education. Through this, it can be a great way to encourage the children in enhancing their numeracy skills and making their cognitive function better.

As Sasan et al. (2024) note, both play-based and Vedic approaches show promising impacts in improving numeracy skills, yet each carries unique strengths and deficiencies, particularly in their responsiveness to diverse developmental and cultural needs in inclusive early childhood settings. Similarly, Ancog et al. (2024) found that play-based methods greatly enhance number recognition and counting skills, though teachers and parents expressed concern about the lack of structured guidance for adapting these methods to different environments. Vedic mathematics, meanwhile, is less commonly used in early childhood education because it is abstract and relies on shortcuts, even though it is praised for efficiency and elegance; many learners still find it difficult. Since these approaches rely on recognizing patterns and performing mental math, they are not often adjusted to meet the developmental needs of young children. Mukunda (2020) warns that introducing such methods too early may cause children to skip over the basic concepts necessary for mathematical reasoning, a concern echoed in contemporary studies such as Ancog et al. (2024), which stress the importance of age-appropriate numeracy approaches that prioritize comprehension over speed.

In this study, it examined the contributions of each approach to early numeracy by identifying their respective. The study sought to provide practical, culturally sensitive insights for enjoyable and effective math instruction by comparing and contextualizing both, thereby enabling teachers to develop learning experiences that are both significant and inclusive for pupils in early childhood settings.

This research also supports in the Sustainable Development Goal number 4, which is Quality Education. This goal stresses that everyone should have access to quality education that is fair and inclusive. SDG Target 4.2 specifically says that all girls and boys should have access to high-quality early childhood development and pre-primary education so that they are ready for the primary school. This study supports efforts to improve early learning outcomes and promote equity in education by looking into culturally relevant and developmentally appropriate teaching methods. Where the

children must learn the basics so that they can build a strong base for later in life.

Therefore, this study aimed to determine the efficacy of play-based and Vedic approaches in fostering early numeracy skills in kindergarten pupils. Even though the results are promising, there are still some gaps. First, there is insufficient research regarding the adaptation of Vedic approach for kindergartners, especially in Southeast Asia. Second, culturally responsive play-based frameworks are insufficiently examined. Hence, the goal of this study was to give teachers, curriculum developers, and policymakers useful information on how to improve early childhood math instruction in ways that are fun, welcoming, and effective for the children's holistic development.

Research Questions

This study assessed the early numeracy skills of kindergarten pupils through the implementation of both Play-Based and Vedic approaches in mathematics instruction.

Specifically, the study sought to answer the following questions:

1. What is the level of numeracy skills of the two groups before and after the intervention?
2. Is there a significant difference between the pretest and posttest scores of the two groups?
3. Which intervention is more effective in improving the kindergarten numeracy skills?

METHODOLOGY

The participants of this study consisted of seventy (70) kindergarten pupils aged 6 years old, enrolled in one of the public schools in Misamis Oriental, Philippines. The study utilized a purposive sampling with intact groups approach, in which all kindergarten learners from the two selected classes were included as participants. One class was exposed to the Vedic approach, while the other class received instruction through the play-based approach.

The morning session class received the play-based intervention, while the afternoon session class was exposed to the Vedic mathematics approach. The participants were selected based on specific inclusion criteria, focusing on children within the designated age range who were enrolled in the 2025–2026 academic year. Kindergartners with diagnosed learning disabilities, those who transferred mid-year, or those enrolled in private or special education programs were excluded to maintain sample consistency.

In order to measure the early numeracy skills of the participants, a teacher-made assessment tool was developed based on the Kindergarten Curriculum Guide (DepEd, 2020). The instrument included multiple-choice that assessed the numeracy skills of the pupils in single-digit addition, and the following subskills were targeted throughout the

intervention: counting and matching objects, numeral recognition (1 to 15), and number patterns. Visual aids and manipulatives were incorporated to ensure developmental appropriateness.

The early numeracy assessment tool was designed to test kindergartners' basic skills in adding single digits. The test consisted of four parts, each with five multiple-choice questions that measured important subskills. Part I involved counting objects and matching them with numerals. Part II focused on reading and writing numerals (1–15) in relation to sets. Part III assessed recognition of number patterns or sequences. Lastly, Part IV measured single-digit addition without regrouping. The questionnaire served both diagnostic and instructional functions, providing insights into pupils' conceptual comprehension and their preparedness for formal addition capabilities.

The research instrument was evaluated for content validity by experts in early childhood education and curriculum development. Once the experts' comments had been obtained, they were incorporated into the research instruments. Afterward, the instrument was tested on 20 kindergartners who were not part of the intervention. The reliability was assessed using Cronbach's alpha, with a coefficient of at least .70 considered acceptable.

The result of reliability test showed that the instrument was reliable for measuring the children's numeracy skills. The scores for the four parts ranged from .722 to .826, which are all above the minimum level of .70. For Counting and Matching Objects, the value was .787, which is acceptable. Reading and Writing Numerals had .722, also acceptable. Recognizing Number Patterns reached .826, rated good, while Single-Digit Addition had .817, also good. These results mean that the questions worked well together, no changes were needed, and the instrument was reliable for assessing the numeracy skills of kindergartners. Fatimah et al. (2024) stated that the acceptability value is an important part of evaluating early numeracy assessment tools. This ensured that the tools were not only valid and reliable, but also useful and culturally appropriate for both educators and learners.

To guide the researcher in organizing and interpreting the data, the scoring procedure was straightforward: each correct response earned one point, while incorrect or blank answers received zero. The total scores were computed for both pre-test and post-test phases and were categorized into proficiency levels:

Score Range	Interpretation
8.01 – 10.00	Outstanding
6.01 – 8.00	Very Good
4.01 – 6.00	Good
2.01 – 4.00	Fair
0.00 – 2.00	Poor

To get the overall numeracy skills, the scoring range were as follows:

Score Range	Interpretation
32.01 – 40.00	Outstanding

24.01 – 32.00	Very Good
16.01 – 24.00	Good
8.01 – 16.00	Fair
0.00 – 8.00	Poor

RESULTS AND DISCUSSION

Research Question 1: What is the level of numeracy skills of the two groups before and after the intervention?

Table 1
Participants' Level of Numeracy Skills Before and After the Play-based and Vedic Approach Interventions

Numeracy Skills	Play-based Approach				Vedic Approach			
	Pretest		Posttest		Pretest		Posttest	
	Mean	Int.	Mean	Int.	Mean	Int.	Mean	Int.
Counting and Matching Objects	5.29	G	9.23	O	5.31	G	9.09	O
Numeral Recognition	4.43	G	9.17	O	4.54	G	9.14	O
Number Pattern	3.26	F	9.20	O	3.91	F	9.03	O
Single Digit Addition	3.86	F	9.11	O	3.94	F	9.06	O
Total	16.83	G	36.71	O	17.71	G	36.31	O

Note. Int = Interpretation, O = Outstanding, VG = Very Good, G = Good, F = Fair, P = Poor

Table 1 presents the participants' numeracy skills before and after the interventions. It demonstrates substantial improvement under both the Play-Based and Vedic Approaches. In the Play-Based Approach, the mean score increased from 16.83 (Good) in the pretest to 36.71 (Outstanding) in the posttest which implies that engaging learners in play-based activities effectively facilitated the development of their numeracy skills.

The significance of the Play-Based Approach in developing numeracy skills has been consistently highlighted. Ugalde (2024) emphasized that play-based learning fosters creativity, curiosity, and problem-solving, which directly contribute to children's mathematical development, including number recognition and computation. Ancog (2024) reported that play-based activities provided effective contexts for boosting numeracy skills, particularly in counting and symbol recognition, as children engaged in interactive tasks that reinforced mathematical concepts. Merano (2025) further demonstrated that integrating play-based pedagogy into early childhood curricula enhanced foundational literacy and numeracy, showing that playful engagement supports both cognitive and social growth.

Meanwhile, the Vedic Approach showed an increase from 17.71 (Good) to 36.31 (Outstanding) which demonstrates that the Vedic approach facilitated substantial

improvement in the learners' numeracy skills as well. Kumra (2023) highlighted that Vedic Mathematics improved basic numeracy competencies by reducing cognitive load and enabling children to solve problems with greater accuracy. Agrawal (2025) emphasized that Vedic Mathematics enhances mental math skills and logical reasoning, which are essential for mastering foundational numeracy tasks such as counting, matching, and addition. Patel (2021) further demonstrated that the systematic nature of Vedic Mathematics supports learners in developing fluency across multiple numeracy domains, including number recognition and sequencing.

These results indicate that both approaches can be effectively enhanced the learners' cumulative numeracy competencies across the assessed skills, including counting and matching, recognizing numerals, number patterns, and single-digit addition. Frequency distributions further show that in the posttest, the majority of students reached the Outstanding level, with 97.14% in both approaches, while none remained in the lowest performance range, suggesting that all learners benefitted from the interventions. The findings imply that engaging, play-based activities and structured, systematic instruction are both effective in developing foundational numeracy skills, supporting young learners in achieving mastery while promoting confidence and readiness for further mathematical learning.

Moreover, the kindergartners' numeracy skills before and after the intervention showed substantial improvement under both the Play-Based and Vedic Approaches. The Play-Based Approach helped children by making mathematics joyful and meaningful. The games and playful activities encouraged active participation, reduced anxiety, and allowed learners to connect mathematical ideas with real experiences. This atmosphere supported holistic development, as children not only improved their computation skills but also built confidence and readiness for more advanced learning. The large increase in scores and the high percentage of students reaching the outstanding level confirm the effectiveness of this approach.

The Vedic Approach also produced strong results by giving learners systematic techniques and mental strategies. The structured methods helped children visualize number relationships and solve problems with speed and accuracy. This approach reduced reliance on finger-counting and built confidence in mental computation. The consistency of improvement across all learners shows that the Vedic Approach provided a solid foundation for early numeracy, preparing children for more complex mathematical concepts.

The improvement in scores was caused by the way both approaches addressed different aspects of learning. Play-Based strategies promoted motivation and enjoyment, while Vedic techniques strengthened accuracy and logical thinking. Together, they created a supportive environment where all children benefitted. The absence of low scores in the posttest and the high percentage of learners at the outstanding level demonstrate that both interventions were effective in developing foundational numeracy skills.

Research Question 2: Is there a significant difference between the early numeracy skills' pretest and posttest scores of the two groups?

Ho_1: *There is no significant difference between the early numeracy skills' pretest and posttest scores of the two groups.*

Table 2
Repeated Measures Multivariate Analysis of Variance (RM-MANOVA) Between Pretest and Posttest Early Numeracy Skills Scores among Students Exposed in Play-based Approach

Early Numeracy Skills	Pretest			Posttest			t(34)	p
	M	Int	SD	M	Int	SD		
Counting and Matching Objects	5.29	G	2.18	9.23	O	0.81	11.036*	<.001
Numeral Recognition	4.43	G	1.91	9.17	O	0.95	14.098*	<.001
Number Patterns	3.26	F	2.45	9.20	O	0.87	13.521*	<.001
Single Digit Addition	3.86	F	2.72	9.11	O	0.87	10.064*	<.001
Multivariate Analysis								
Wilks' Λ = 0.073	F(4,31) = 98.447**			p < .001			Partial η^2 = 0.927	

*Note. M = mean, Int = Interpretation SD = standard deviation, Partial η^2 = effect size. Effect size interpretation: 0.01 to 0.05 is small, 0.06 to 0.13 is medium, above or equal 0.14 is large, Legend: 8.01 – 10.00 O = Outstanding, 6.01 – 8.00 VG = Very Good, 4.01 – 6.00 G = Good, 2.01 – 4.00 F = Fair, 0.00 – 2.00 P = Poor. *Significant at 0.01 two-tailed alpha level.*

Table 2 shows the Repeated Measures Multivariate Analysis of Variance (RM-MANOVA) between pretest and posttest Early Numeracy Skills scores among students exposed to the play-based approach. The multivariate analysis indicates a statistically significant overall difference between the pretest and posttest Early Numeracy Skills scores. Since the p-value is less than the 0.05 level of significance, the first null hypothesis is rejected. This indicates that there is a significant difference between the pretest and posttest early numeracy skills scores of the kindergartners exposed to the play-based approach, meaning the play-based approach is effective in improving the early numeracy skills.

The results show Wilks' Λ = 0.073, F(4,31) = 98.447, p < .001, with a large effect size (partial η^2 = 0.927). This finding indicates that the play-based approach is effective in improving the students' overall Early Numeracy Skills. Examination of the individual subcomponents also shows significant improvements from pretest to posttest. Counting and Matching Objects increased from a mean score of 5.29 (Good) at pretest to 9.23 (Outstanding) at posttest, t(34) = 11.036, p < .001. Numeral Recognition improved from 4.43 (Good) to 9.17 (Outstanding), t(34) = 14.098, p < .001. Number Patterns increased from 3.26 (Fair) to 9.20 (Outstanding), t(34) = 13.521, p < .001. Single Digit Addition improved from 3.86 (Fair) to 9.11 (Outstanding), t(34) = 10.064, p < .001. The descriptive statistics indicate that students initially demonstrated Good to Fair levels of early numeracy skills during the pretest.

After the intervention, the posttest scores for all four subcomponents reached the Outstanding level. The consistent increase across all components indicates that the play-based approach supported improvements in object counting and matching, numeral recognition, number pattern identification, and basic addition skills. Overall, the results indicate that the play-based approach significantly enhanced students' Early Numeracy Skills. The large multivariate effect size suggests that the intervention had a strong influence on the development of foundational numeracy competencies among the students.

The effectiveness of play-based learning in enhancing numeracy skills has been well-documented in recent scholarship. Ugalde (2024) emphasized that play-based pedagogy fosters creativity, curiosity, and problem-solving, which directly contribute to children's mathematical development, including counting, numeral recognition, and basic operations. Merano (2025) highlighted that integrating play-based strategies into early childhood curricula significantly improved foundational literacy and numeracy, showing that playful engagement supports both cognitive and social growth. These findings align with the present study, where kindergartners exposed to the Play-Based Approach showed statistically significant improvements across all components of early numeracy skills, with large effect sizes confirming the strength of the intervention.

The results showed that the Play-Based Approach produced a significant improvement in the kindergartners' early numeracy skills. The playful activities created a learning environment where children were motivated to participate and explore mathematical ideas without fear. The games and interactive tasks allowed them to practice counting, recognizing numerals, identifying patterns, and performing single-digit addition in ways that felt natural and enjoyable. This approach encouraged focus, cooperation, and confidence, which explains the consistent increase across in all components. It was noticed that children who were hesitant during the pretest became more active and willing to try during the intervention. The playful context reduced anxiety and made mathematics feel like part of their everyday experiences. As a result, learners moved from Fair or Good levels in the pretest to Outstanding level in the posttest. The large effect size confirms that the Play-Based Approach had a strong influence on their overall development of numeracy skills.

Table 3
Repeated Measures Multivariate Analysis of Variance (RM-MANOVA) Between Pretest and Posttest Early Numeracy Skills Scores among Students Exposed in Vedic Approach

Early Numeracy Skills	Pretest			Posttest			t(34)	p
	M	Int	SD	M	Int	SD		
Counting and Matching Objects	5.31	G	2.04	9.09	O	0.89	10.216*	<.001
Numeral Recognition	4.54	G	1.74	9.14	O	0.85	14.583*	<.001
Number Patterns	3.91	F	2.24	9.03	O	0.79	12.883*	<.001

Single Digit Addition	3.94	F	2.33	9.06	O	0.91	12.616*	<.001
Multivariate Analysis								
Wilks' Λ = 0.100	F(4,31) = 69.520*		p < .001		Partial η^2 = 0.900			

*Note. M = mean, Int = Interpretation SD = standard deviation, Partial η^2 = effect size. Effect size interpretation: 0.01 to 0.05 is small, 0.06 to 0.13 is medium, above or equal 0.14 is large, Legend: 8.01 – 10.00 O = Outstanding, 6.01 – 8.00 VG = Very Good, 4.01 – 6.00 G = Good, 2.01 – 4.00 F = Fair, 0.00 – 2.00 P = Poor. *Significant at 0.05 two-tailed alpha level.*

Table 3 shows the Repeated Measures Multivariate Analysis of Variance (RM-MANOVA) between pretest and posttest Early Numeracy Skills scores among students exposed to the Vedic approach. Since the p-value is less than the 0.05 level of significance, the first null hypothesis is rejected. This indicates that there is a significant difference between the pretest and posttest early numeracy skills scores of the kindergartners exposed to the Vedic approach.

The multivariate analysis indicates a statistically significant difference between the pretest and posttest Early Numeracy Skills scores. The results show Wilks' Λ = 0.100, F(4,31) = 69.520, p < .001, with a large effect size (partial η² = 0.900). This finding indicates that the Vedic approach produced a substantial improvement in students' overall Early Numeracy Skills. Examination of the individual subcomponents also shows significant improvements from pretest to posttest. Counting and Matching Objects increased from a mean score of 5.31 (Good) at pretest to 9.09 (Outstanding) at posttest, t(34) = 10.216, p < .001. Numeral Recognition improved from 4.54 (Good) to 9.14 (Outstanding), t(34) = 14.583, p < .001. Number Patterns increased from 3.91 (Fair) to 9.03 (Outstanding), t(34) = 12.883, p < .001. Single Digit Addition improved from 3.94 (Fair) to 9.06 (Outstanding), t(34) = 12.616, p < .001.

The descriptive statistics indicate that students initially demonstrated Good to Fair levels of early numeracy skills during the pretest. After exposure to the Vedic approach, the posttest scores for all four subcomponents reached the Outstanding level. The consistent increase across the components indicates improvements in counting and object matching, numeral recognition, number pattern identification, and single digit addition skills. Overall, the results indicate that the Vedic approach significantly enhanced students' Early Numeracy Skills. The large multivariate effect size suggests that the intervention had a strong influence on the development of foundational numeracy competencies among the students.

The results showed that the Vedic Approach produced a significant improvement in the kindergartners' early numeracy skills. The structured methods of Vedic mathematics gave children clear steps and mental strategies that reduced confusion and built confidence. Kindergartners who were hesitant at the start became more accurate and consistent when guided by systematic rules. This explains why all four components: counting and matching, numeral recognition, number patterns, and single-digit addition improved from Fair or Good levels in the pretest to Outstanding levels in the posttest.

The kindergartners responded well to the emphasis on patterns and logical steps.

The Vedic techniques helped them visualize number relationships and solve problems mentally, which reduced reliance on finger-counting. The large effect size confirms that the Vedic Approach had a strong influence on their overall numeracy development. The improvement was caused by the way the Vedic Approach provided structure and clarity. By breaking down mathematical tasks into simple, logical steps, children were able to master skills more efficiently. The consistent gains across all components show that this approach was effective in building a strong foundation for early numeracy, preparing learners for more complex mathematical concepts.

Research Question 3: Which intervention is more effective in improving the kindergartners' numeracy skills?

Ho^2: *None of the intervention is more effective in improving the kindergartners' numeracy skills.*

Table 4
Multivariate Analysis of Covariance (MANCOVA) Summary Table for Posttest Scores with Pretest Scores as Covariates

Writing Skills	Play-based Approach			Vedic Approach			F(1,64)	p
	M	Int	SD	M	Int	SD		
Counting and Matching Objects	9.23	O	0.81	9.09	O	0.89	0.753	0.389
Numeral Recognition	9.17	O	0.95	9.14	O	0.85	0.000	0.996
Number Patterns	9.20	O	0.87	9.03	O	0.79	0.742	0.392
Single Digit Addition	9.11	O	0.87	9.06	O	0.91	0.116	0.734
Multivariate Analysis								
Wilks' Λ = 0.979	F(4,61) = 0.321			p = 0.863			Partial η^2 = 0.021	

*Note. M = mean, Int = Interpretation SD = standard deviation, Partial η^2 = effect size. Effect size interpretation: 0.01 to 0.05 is small, 0.06 to 0.13 is medium, above or equal 0.14 is large, Legend: 8.01 – 10.00 O = Outstanding, 6.01 – 8.00 VG = Very Good, 4.01 – 6.00 G = Good, 2.01 – 4.00 F = Fair, 0.00 – 2.00 P = Poor. *Significant at 0.05 two-tailed alpha level.*

Table 4 shows the Multivariate Analysis of Covariance (MANCOVA) results comparing the posttest Early Numeracy Skills scores of students exposed to the Play-based Approach and the Vedic Approach, while controlling for the pretest scores as covariates. The multivariate test indicates no statistically significant difference in the overall posttest Early Numeracy Skills between the two instructional approaches after adjusting for the pretest scores. Since the multivariate analysis revealed no statistically significant difference in the posttest early numeracy skills of the kindergartners exposed to the Play-Based Approach and the Vedic Approach after controlling for the pretest scores, the second null hypothesis cannot be rejected. This indicates that neither instructional approach is statistically more effective than the other in improving the kindergartners' numeracy skills.

The results show Wilks' Λ = 0.979, F(4,61) = 0.321, p = 0.863, with a small effect

size (partial $\eta^2 = 0.021$). This result indicates that the two approaches produced comparable levels of early numeracy performance when the initial skill levels were statistically controlled. Examination of the individual subcomponents also indicates no significant differences between the groups. For Counting and Matching Objects, students in the Play-based Approach obtained a mean of 9.23 (Outstanding) while those in the Vedic Approach obtained a mean of 9.09 (Outstanding), $F(1,64) = 0.753$, $p = 0.389$. For Numeral Recognition, the Play-based group obtained a mean of 9.17 (Outstanding) and the Vedic group obtained a mean of 9.14 (Outstanding), $F(1,64) = 0.000$, $p = 0.996$. For Number Patterns, the Play-based group obtained a mean of 9.20 (Outstanding) while the Vedic group obtained a mean of 9.03 (Outstanding), $F(1,64) = 0.742$, $p = 0.392$. For Single Digit Addition, the Play-based group obtained a mean of 9.11 (Outstanding) and the Vedic group obtained a mean of 9.06 (Outstanding), $F(1,64) = 0.116$, $p = 0.734$.

The descriptive statistics indicate that both instructional approaches produced Outstanding levels of Early Numeracy Skills in the posttest across all four subcomponents. The absence of significant differences suggests that both approaches were similarly effective in developing counting skills, numeral recognition, pattern identification, and single digit addition abilities among the students. Overall, the results indicate that when the pretest scores were controlled, the Play-based Approach and the Vedic Approach produced comparable outcomes in kindergartners' Early Numeracy Skills. The small multivariate effect size further suggests that the difference between the two instructional approaches was minimal. This finding implies that both the Play-Based Approach and the Vedic Approach are comparably effective instructional strategies in enhancing the early numeracy skills of kindergartners. Although both groups showed improvement in their numeracy performance, the difference in the level of improvement between the two approaches was not statistically significant. This suggests that teachers may adopt either strategy depending on the learning context, instructional objectives, and the needs of the learners.

Recent studies show that both play-based learning and Vedic mathematics can help young children develop early math skills. Play-based learning makes lessons fun and helps kindergartners recognize numbers and practice counting (Sasan et al., 2024). On the other hand, Vedic mathematics improves speed in solving problems and builds a more positive attitude toward math (Yogeshwari, 2025). These findings give strong support for comparing the two approaches in kindergarten interventions.

The results showed that there was no statistically significant difference in the posttest scores of kindergartners exposed to the Play-Based Approach and those exposed to the Vedic Approach after controlling for pretest scores. In the researcher's observation, this finding means that both approaches were comparably effective in improving early numeracy skills. While the Play-Based Approach encouraged motivation and enjoyment, and the Vedic Approach provided structure and accuracy, the overall outcomes showed that learners reached similar levels of mastery regardless of the method used.

During the intervention, the kindergartners responded positively to both strategies. Play-Based activities created a joyful environment where learners actively engaged with

mathematical tasks, while the Vedic Approach gave them systematic tools to solve problems with confidence. The fact that no significant difference was found in the posttest results suggests that each approach addressed different learner needs but ultimately led to comparable improvements. The absence of statistical difference does not reduce the value of either approach. Instead, it highlights that both methods can be used effectively to support early numeracy development. Teachers may choose either strategy depending on classroom context, learner preferences, or instructional goals, knowing that both can lead to strong outcomes. The findings confirm that diverse pedagogical approaches can equally foster mastery, confidence, and readiness for more advanced mathematical learning.

The result indicating that neither intervention is significantly more effective than the other suggests that both instructional strategies are capable of improving early numeracy skills. This finding is consistent with Ancog et al. (2024), who reported that play-based learning enhances kindergarten learners' numeracy skills through engaging and meaningful mathematical activities. Likewise, Kumra and Garg (2023) found that Vedic mathematics strategies significantly improve students' mathematical performance by simplifying numerical operations and strengthening computational skills. These findings support the present study's conclusion that both approaches can serve as effective pedagogical strategies for developing early numeracy among kindergartners.

Conclusions

1. Both groups have improved their performance in numeracy skills indicating that the intervention in terms of using play-based and Vedic were effective in improving the kindergartners' early numeracy skills.
2. There was a significant difference between the pretest and posttest scores of the two groups in early numeracy skills after the implementation of the Play-Based and Vedic approaches respectively. The significant difference between the pretest and posttest scores of the two groups suggests that both the Play-Based and Vedic approaches were effective in enhancing the kindergartners' early numeracy skills**.**
3. Neither of the intervention is comparably effective in improving the kindergartners' numeracy skills which implies that the Play-Based Approach and the Vedic Approach contributed similarly to the improvement of the kindergartners' numeracy skills. Neither approach outperformed the other, indicating that both approaches are comparably effective in improving early numeracy skills.

Recommendations

Based on the findings and conclusions drawn from the study, the following are hereby recommended.

1. Kindergarten Teachers, may explore Play-Based strategies as the foundation of mathematics instruction, while gradually integrating simplified Vedic techniques to strengthen computational fluency. This balanced approach ensures that children not only understand mathematical concepts but also develop confidence in solving

problems quickly and accurately.

2. School Administrators specifically those supervising the ECCD programs that they may provide training, resources, and professional development opportunities that equip teachers with the skills to implement these approaches effectively. Consistent support from school leaders will ensure that teachers can adapt their practices to meet the needs of young learners in inclusive classrooms.
3. Parents and Guardians, may facilitate playful math activities at home such as games, storytelling, and manipulatives, while introducing simple Vedic-inspired counting techniques to build confidence and fluency.
4. For Future Researchers, may explore the long-term effects of combining Play-Based and Vedic approaches, particularly in multicultural and inclusive settings.

Compliance with Ethical Standards

The intervention commenced upon the researcher's acquisition of ethical clearance from the Research Ethics Committee of Lourdes College. Following this, formal approval was sought from the principal of the selected school. When the permit was granted, informed consent was obtained from the parents or legal guardians of the participating pupils. The consent form clearly outlined the study's objectives, procedures, potential benefits and risks, and the measures in place to ensure confidentiality and data protection. It emphasized that participation was entirely voluntary and that participants could withdraw at any time without any consequences. In accordance with the Belmont Report's ethical principles, the study upheld Respect for Persons by securing both parental consent and child assent. The researcher explained the study to the pupils using age-appropriate language, ensuring they understood that participation was optional and that they could decline or withdraw at any point. Beneficence was observed by ensuring that all activities were developmentally appropriate, engaging, and conducted in safe, familiar classroom settings, with no foreseeable harm to the participants. Justice was maintained by selecting participants fairly and ensuring that the benefits and burdens of the research were equitably distributed. All collected data were treated with strict confidentiality and used solely for educational and research purposes, with participants' identities anonymized in all documentation and reporting.

In line with the ethical standards of research and the provisions of the Data Privacy Act of 2012 (Republic Act 10173), there was no conflict of interest in the conduct of the study. The investigation was carried out solely for academic purposes, without any financial, institutional, or personal affiliations that could have influenced its outcomes. To ensure privacy and confidentiality, all participants were assigned code numbers to replace identifying information, thereby preventing the disclosure of names or personal details in any research instruments, datasets, or reports. Access to raw data was strictly limited to the researcher and authorized academic advisers, with no third-party involvement unless prior consent was obtained. Data were securely stored, with hard copies kept in a locked cabinet accessible only to the researcher and electronic files protected by passwords and encryption. In compliance with institutional requirements, all physical documents were shredded and electronic files permanently deleted after the retention period, ensuring that no residual data could be retrieved or misused.

During the conduct of the study, possible risks included minor discomfort or fatigue among pupils during testing and intervention activities, as well as potential anxiety when confronted with unfamiliar mathematical tasks. There was also a minimal risk of breach of confidentiality if data were not properly safeguarded. To mitigate these risks, the researcher ensured that activities were age-appropriate, engaging, and conducted within reasonable timeframes to avoid undue stress. Breaks were provided when necessary, and pupils were reassured that participation was voluntary and that their performance would not affect their academic standing. Strict adherence to coding, access control, secure storage, and proper disposal procedures further minimized risks related to data privacy.

Despite the possible risk, it directly benefits the participants to enhanced opportunities to strengthen their early numeracy skills through engaging play-based activities and structured Vedic techniques. Pupils gained improved confidence in counting, number recognition, and single-digit addition, which were foundational skills for future mathematics learning. Teachers also benefited from evidence-based insights into effective instructional approaches, while parents observed improved mathematical readiness in their children. The study contributed to the broader goal of improving early childhood education practices in public schools. By examining culturally responsive and developmentally appropriate teaching strategies, the research supported the Department of Education's Early Childhood Care and Development (ECCD) programs and aligned with Sustainable Development Goal 4 on Quality Education. The findings provided school administrators, curriculum developers, and policymakers with practical recommendations for enhancing numeracy instruction in diverse kindergarten settings, thereby promoting equity, inclusivity, and long-term educational success within the community.

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