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Integrating educational games to enhance numeracy proficiency in kindergarten pupils

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ABSTRACT

This study explored how educational games improved kindergarteners' numeracy skills in 2025–2026 as a foundation for an intervention plan. The study examined teacher and student characteristics, teachers' use of educational games, learners' numeracy skills in key areas, and the association between profile factors and numeracy performance. Four teachers and 100 kindergarteners participated in descriptive-correlational research. Frequency, percentage, weighted mean, standard deviation, and chi-square test of significance were used to examine structured questionnaire and evaluation instrument data. The data showed that all teachers were female, had bachelor's degrees, intermediate teaching experience, and had educational technology training. Students were mostly five to six years old, balanced in gender, and from low-income families. Educational games were used in numeracy instruction "Always." Kindergarten students performed "Expert" in foundational skills and number sense, but poorly in applied numeracy, time, and measurement. Most profile variables—age, gender, family size, birth order, and income—did not correlate with numeracy ability, according to statistical analysis. Students' numeracy development is heavily influenced by parents' education. Educational games are helpful for teaching early numeracy, according to the study. Higher-order and application-oriented skills must be improved. A systematic intervention approach was developed to maximize educational games, improve teacher proficiency, and build home-school cooperation for holistic numeracy development.

Keywords: Early childhood education, educational games, numeracy skills, descriptive-correlation, intervention plan, City of Naga, Cebu, Philippines.

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INTRODUCTION

The global educational landscape increasingly emphasizes the development of foundational academic competencies, particularly in early childhood where cognitive growth is most rapid (Ünal & Kaya, 2024). Among these competencies, numeracy plays a crucial role as it serves as a strong predictor of future academic success, extending beyond mathematics to areas such as reading and problem-solving (Maghfirah et al., 2025; Elfiky, 2021). However, deficiencies in early numeracy skills remain a widespread concern across multiple countries, including the United Kingdom, Turkey, Canada, Northern Ireland, and Malaysia, where young

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learners experience difficulties in number recognition, counting, and numerical reasoning (Singh et al., 2021; Yuniria et al., 2025). These persistent challenges highlight the need for effective and engaging instructional strategies to strengthen early mathematical foundations (Ali et al., 2022).

In response to these global concerns, educational games and digital gamebased learning have emerged as promising approaches for improving numeracy skills among young learners (Afrianti & Maryatun, 2025). These strategies align with the characteristics of Generation Alpha, who are highly receptive to digital and interactive forms of learning (Asqia et al., 2025). Research indicates that gamebased learning enhances motivation, engagement, and problem-solving abilities while supporting cognitive, social, and emotional development (Maryana et al., 2024; Kim & Kim, 2024; Alotaibi, 2024). Moreover, educational games help make abstract mathematical concepts more accessible, thereby improving mathematical cognition and performance (Al-Hassan et al., 2025; Wardat et al., 2022; Buray & Alferez, 2025). The effectiveness of these approaches is further influenced by the home learning environment, which interacts with formal instruction in shaping early numeracy development (Gottardo & Restiglian, 2022). This integration of formal and informal learning contexts highlights the potential of educational games as flexible and innovative instructional tools (Balala et al., 2021).

Despite these promising developments, significant gaps remain in the literature regarding the effectiveness of educational games in improving specific numeracy outcomes. While several studies report positive impacts, empirical evidence remains limited and inconsistent, particularly across diverse educational settings (Abdullahi & Abdulkareem, 2023; Ahmed et al., 2021; Grimes et al., 2021). Variations in pedagogical design, software architecture, and implementation strategies may influence the extent to which educational games contribute to learning outcomes (Lim, 2021; Grimes et al., 2021). Furthermore, there is limited understanding of how educators perceive and utilize these tools, as well as how teacher competence and training affect successful integration in classroom instruction (Hoareau, 2021; Alvarez & Galman, 2025). These gaps underscore the need for more context-specific and methodologically robust investigations into digital game-based learning for early numeracy (Mondragon et al., 2023; Yuniria et al., 2025).

In the Philippines, the issue of low mathematics performance remains a pressing concern. National and international assessments, such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), consistently reveal that Filipino learners perform below expected proficiency levels in mathematics (Capinding & Salazar, 2023; Lasala, 2023; Copioso & Lapada, 2024). A substantial proportion of students demonstrate only basic mathematical skills, with minimal improvement across assessment cycles (Garcia et al., 2024; Vergara & Balquedra, 2024). Despite increasing integration of technology in education, these challenges persist, indicating that innovative strategies such as game-based learning have not yet fully achieved their intended impact (Godoy, 2022; Sulpico et al., 2025). Nevertheless, the widespread popularity of mobile gaming among Filipino youth—estimated at approximately 40 million users—presents a strategic opportunity to leverage digital games for educational purposes (Marie et al., 2021). Initiatives such as gamified tutoring and peer-assisted learning programs have shown potential in improving engagement and self-efficacy in mathematics, particularly in resource-limited contexts (Esteban & Cajandig, 2025; ED et al., 2025). However, the effectiveness of these approaches in improving numeracy outcomes remains underexplored (Abenes et al., 2023; Anggraeni et al., 2024; Chavez, 2024).

At the local level, kindergarten learners often exhibit difficulties in mastering foundational numeracy skills, such as number recognition, cardinality, and basic operations, which are essential for future mathematical learning (Darnon & Fayol, 2021). These challenges

necessitate the implementation of targeted, developmentally appropriate, and engaging instructional interventions. Educational games, when effectively designed and implemented, have the potential to address these learning gaps by providing interactive and meaningful learning experiences aligned with learners' cognitive developmental stages (Wang, 2025; Muhtarom et al., 2022).

In light of these concerns, this study aims to examine the utilization and impact of educational games on the numeracy skills of kindergarten pupils. Specifically, it seeks to determine how digital game-based learning influences early mathematical competencies and how teachers perceive its effectiveness as an instructional tool (Bang & Siebert-Evenstone, 2024). By analyzing both learner outcomes and teacher perspectives, this study intends to contribute to the growing body of empirical evidence on game-based learning and provide insights for the development of targeted intervention strategies and best practices in early childhood education (Buray & Alferez, 2025; Đan et al., 2024).

The ongoing difficulties in early numeracy development underscore the necessity for new and engaging instructional methods to effectively assist young learners. Educational games present a viable solution to these difficulties by integrating interactivity, motivation, and significant learning experiences. Their efficacy, however, is contingent upon meticulous design, appropriate execution, and instructors' preparedness to incorporate them into teaching. This study aims to determine the utilization of educational games in improving numeracy skills among kindergarten learners during the school year 2025–2026 as a basis for the development of an intervention plan. Specifically, it seeks to assess how gamebased learning influences learners' foundational mathematical competencies and to examine teachers' perceptions of its effectiveness as an instructional strategy. The expected output of this study is a structured and context-responsive intervention plan designed to enhance numeracy instruction through the strategic use of educational games.

Statement of the problem

This study aimed to determine the utilization of educational games in improving numeracy skills among kindergarten learners at Langtad Elementary School, City of Naga, Cebu, during the school year 2025–2026 as a basis for an intervention plan. Specifically, this study seeks to answer the following questions:

1. What is the profile of the teacher-respondents in terms of age and sex at birth, highest educational attainment, years of teaching experience, and EdTech trainings attended, and what is the profile of the kindergarten learners in terms of age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income?
2. What is the extent of the teachers' utilization of educational games in teaching numeracy skills among kindergarten pupils?
3. What is the level of numeracy skills of kindergarten learners in terms of foundational skills, patterns, time, and measurement, number sense and operations, and applied numeracy?
4. Is there a significant relationship between the identified profile and the numeracy skills of the learners?
5. Based on the findings of the study, what intervention plan may be proposed to enhance the use of educational games in improving numeracy skills among kindergarten pupils?

METHODOLOGY

This research utilized a descriptive-correlational design with a quantitative methodology. This design was considered suitable as it corresponded with the primary aims of the study, which were to elucidate the existing practices in the application of educational games for teaching numeracy and to ascertain whether a significant correlation existed between the use of these games and the numeracy skills of kindergarten students.

The descriptive component of the design systematically provided and analyzed the current state of the important variables included in the investigation. The profile of the teacher-respondents was delineated in terms of age, sex assigned at birth, highest educational qualification, years of teaching experience, and attended EdTech training sessions. This assessed the degree of integration of educational games in teaching numeracy skills, the mathematical competencies of kindergarten students, and the obstacles faced by educators in executing educational games in the classroom.

The correlational feature of the design was employed to investigate the association between the use of educational games (independent variable) and the numeracy skills of kindergarten students (dependent variable). This ascertained whether a substantial correlation existed between the two variables without any manipulation, rendering it appropriate for naturally occurring classroom environments.

This research methodology integrated descriptive and correlational methodologies to deliver a thorough review of existing instructional techniques and their potential impact on learner outcomes. The study's results provided an empirical foundation for creating an intervention strategy designed to enhance the use of educational games to improve numeracy abilities in kindergarten students.

Based on the data presented, the respondents of the study consisted of a total of one hundred four (104) participants. Of this number, four (4) were kindergarten teachers, representing 3.85% of the total respondents, while one hundred (100) were kindergarten pupils, accounting for 96.15% of the total population.

Teacher-Respondents. Due to the manageable and finite size of the population, this study employed total enumeration or universal sampling. The four (4) kindergarten teachers, representing 3.85% of the total respondents, were included in the study. This non-probability sampling technique was deemed appropriate because it ensured the participation of all teachers in the kindergarten department, thereby providing a comprehensive and accurate representation of the extent of educational game utilization and the challenges encountered in teaching numeracy skills at the school level.

Pupil-Respondents. For the pupil performance data, the study included all one hundred (100) kindergarten pupils enrolled during the School Year 2025–2026, representing 96.15% of the total respondents. The pupils' 3rd Quarter and 4th Quarter Mathematics average grades were utilized to assess their level of improvement in numeracy skills. The grades of pupils under each teacher were consolidated to determine the overall improvement in numeracy performance. Since the study aimed to evaluate the relationship between teachers' utilization of educational games and pupils' numeracy development, the entire population of kindergarten pupils was included in the assessment.

The participants of this study were the kindergarten teachers of the school who served as the teacher-respondents. The data on pupils' performance were taken from the average grades of the kindergarten classes they handle. Langtad Elementary School also offers a positive learning environment that supports both teaching and learning, especially in helping young pupils develop basic skills such as numeracy.

The primary instrument that was utilized in this study was a structured questionnaire adapted from the study of Padillo et al. (2024) titled "Play-based learning approach and

numeracy skills in modular learning of kindergarten pupils." The instrument was modified to align with the specific objectives of the current study, particularly in assessing the utilization of educational games in a face-to-face classroom setting and its relationship to the improvement of numeracy skills among kindergarten pupils. The questionnaire was divided into four (4) parts, each designed to gather specific data corresponding to the research questions of the study.

Part I focused on the Demographic Profile of the Respondents. This section sought to gather essential information about the teacher-respondents, including their age, sex at birth, highest educational attainment, years of teaching experience, and relevant training on educational technology or educational games they had attended. This part utilized a checklist format where respondents ticked the box corresponding to their answer.Part II pertained to the Utilization of Educational Games in Teaching Numeracy Skills. This section listed ten (10) specific types of educational games commonly used in kindergarten settings, such as role-playing activities, shape hunting games, block building, board games, hopscotch, mathematics mobile applications, card matching games, puzzle assembly, dice rolling games, and songs with dance activities. Respondents rated the extent to which they utilized each game using a five-point Likert scale, where: 5 – Always, 4 – Often, 3 – Sometimes, 2 – Rarely, and 1 – Never.

Part III aimed to determine the Effectiveness of Educational Games in Improving Numeracy Skills. In this part, teachers were asked to provide the average numeracy performance of their kindergarten pupils by indicating the 3rd Quarter Mathematics Average Grade and the 4th Quarter Mathematics Average Grade. This data was used to measure the level of improvement in pupils' numeracy skills.

Part IV covered the Learner's Profile Questionnaire for Parents. This section was researcher-made and obtained information regarding learners' age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income. The data gathered from this section were used to describe the learner-respondents and determine whether the identified learner profile variables were significantly related to the numeracy skills of the learners. Like Part I, this section used a checklist format for convenience.

The process of collecting data for this study was carried out in three stages: the Preliminary Stage, Data Gathering Stage, and Post–Data Gathering Stage. Each stage was systematically implemented to ensure the accuracy, reliability, and ethical integrity of the research process.

Preliminary Stage. In this initial phase, the researcher first secured permission to conduct the study by drafting a transmittal letter addressed to the Schools Division Superintendent of the Department of Education, Division of Naga City, requesting approval to conduct research. Upon approval from the division office, the researcher then sought permission from the school principal to administer the questionnaire to the kindergarten teachers.

Data Gathering Stage. Following the approval and validation of the instrument, the researcher personally distributed the questionnaires to the kindergarten teacher-respondents. Before administration, the researcher explained the purpose and significance of the study, provided clear instructions on how to accomplish each part of the questionnaire, and assured the respondents of the confidentiality of their responses. The teachers were given ample time to accomplish the questionnaire, particularly Part III, which required them to retrieve and encode the 3rd and 4th quarter mathematics average grades of their respective pupils. To ensure a high retrieval rate, the researcher set a specific date for collection and maintained communication with the respondents for follow-ups if necessary.

Post–Data Gathering Stage. Once all distributed questionnaires had been retrieved, the researcher manually checked, sorted, and encoded the gathered data. The responses were

tabulated and organized in a master sheet using a spreadsheet program such as Microsoft Excel to facilitate analysis. The encoded data were then subjected to the appropriate statistical treatments. Upon completion of the statistical analysis, the results were interpreted and analyzed in relation to the specific research questions posed in the study. The findings derived from this stage served as the basis for developing the proposed intervention plan aimed at enhancing the use of educational games in improving numeracy skills among kindergarten pupils.

RESULTS AND DISCUSSION

This chapter presents the findings of a study examining the demographic profile of teacher-respondents, kindergarten learner-respondents, and parents of selected learners, as well as the extent of teachers' use of educational games in teaching numeracy skills and the level of numeracy skills demonstrated by kindergarten learners at Langtad Elementary School, Naga City, Cebu during the school year 2025–2026. The study involved 4 teacher-respondents and 100 kindergarten learner-respondents, utilizing a survey questionnaire and a numeracy assessment instrument as the primary data collection tools. Descriptive statistics including frequencies, percentages, weighted means, and standard deviations were employed to analyze the profile variables and the levels of the main study variables, while chi-square tests of significance were used to determine whether the learners' profile variables were significantly associated with their numeracy skills. All results are discussed in direct relation to the objectives of the study, and the interpretations presented throughout this chapter are grounded entirely in the data gathered from the respondents.

Teacher-respondents' age and sex at birth

The age and sex at birth of the teacher-respondents were examined to determine the demographic composition of the kindergarten teachers involved in numeracy instruction. All 4 teacher-respondents were female, accounting for 100.00% of the sample, with no male participants included. In terms of age distribution, the predominant group was the 31–35 age bracket, comprising 50.00% of the total respondents, followed by the 41–45 and 46–50 age groups, each accounting for 25.00%. Notably, no respondents fell within the 36–40 age category, which represented a complete absence of representation in this demographic range.

The findings indicated that the teaching workforce in this sample was exclusively female and predominantly concentrated in the early to mid-career stage. The absence of male teachers in this study reflected a persistent gender imbalance characteristic of the kindergarten teaching profession, consistent with broader patterns observed in the education sector where women were often overrepresented, particularly in pre-primary and primary education settings (Venketsamy, 2023). Specifically, some studies revealed that women constituted over 80% of the teaching population in primary education (Almanea et al., 2024). The complete absence of respondents in the 36–40 age group suggested a possible generational gap or attrition during this career stage, which could affect the transfer of pedagogical knowledge and mentoring opportunities within the school. The demographic profile of the teacher-respondents implied that intervention strategies designed to enhance the use of educational games for teaching numeracy should be tailored to a predominantly female, early-to-mid-career teaching force, accounting for the specific professional development needs and career stage characteristics of this population.

Teachers' highest educational attainment

The highest educational attainment of the teacher-respondents was examined to determine their academic preparation and professional qualification in handling kindergarten numeracy instruction. The data showed that all 4 respondents, representing 100.00% of the sample, possessed a bachelor's degree. No respondent had undertaken or completed postgraduate study of any kind, including master's or doctoral degrees.

The findings suggested a consistent but limited level of educational achievement among the teachers, indicating that while they fulfilled the basic qualifications for teaching, there was restricted involvement in advanced professional or academic growth within this cohort. The absence of any postgraduate degree holders pointed to a potential ceiling in professional development, where teachers remained at the minimum educational requirement without pursuing further academic credentials. This pattern reflected either individual barriers to continuing education or systemic factors within the school or division that did not actively encourage or facilitate advanced degree completion. This educational stagnation often correlates with challenges in professional development, frequently exacerbated by systemic issues within workplace culture that limit opportunities for advanced training and academic engagement (Khairiah et al., 2024). Indeed, the inability to pursue further education, coupled with limited training opportunities and rigid requirements, often impedes career advancement for seasoned educators (Precellas & Bauyot, 2025), and this phenomenon can lead to feelings of professional stagnation and disillusionment, ultimately impacting teacher retention rates and overall job satisfaction (Guira & Doctolero, 2023; Smith & Husband, 2024). The educational profile of the teacher-respondents implied that intervention strategies and professional development programs should be designed with the assumption that teachers possessed foundational pedagogical knowledge but may lacked specialized training in advanced instructional methodologies, including the integration of educational games for numeracy instruction. School administrators might need to establish incentive structures, such as tuition reimbursement, study leave, or salary increases, to motivate teachers to pursue postgraduate studies, while the proposed intervention plan should incorporate capacity-building components that directly addressed the gap between undergraduate preparation and the specialized skills required for effective game-based numeracy instruction.

Teachers' years of teaching experience

The years of teaching experience of the teacher-respondents were examined to determine their length of service and classroom exposure in handling kindergarten learners, given that teaching experience may influence classroom management skills, instructional decision-making, and the ability to facilitate educational games in teaching numeracy. The findings indicated that the largest segment of respondents belonged to the 9–10 years category, comprising 50.00% of the sample. Those with 11 years and above and those with 5–6 years of experience each accounted for 25.00%. Significantly, no respondents were represented in the 7–8 years category, indicating a complete absence in this experience range.

The findings indicated that the majority of teachers in the sample possessed substantial teaching experience predominantly within the upper mid-level range, signifying a reasonably seasoned group of educators. The absence of respondents in the 7–8 years category suggested a possible disruption in teacher retention or hiring patterns during that specific career stage, creating a gap in the experience continuum. Despite this gap, the overall distribution reflected a workforce that had moved well beyond the early years of teaching, with half of the

respondents having nearly a decade of classroom experience and a quarter having over eleven years. This demographic characteristic suggested a collective pedagogical expertise associated with a mature phase of teaching where educators had consolidated their skills (Xia, 2024), and this concentration of experienced professionals suggested a robust foundation for implementing sophisticated pedagogical approaches and potentially mentoring less experienced colleagues (Marmoah et al., 2024). The experience profile of the teacher-respondents implied that the proposed intervention plan for enhancing the use of educational games in teaching numeracy could leverage this collective pedagogical expertise, particularly that of teachers in the 9–10 and 11 and above years categories who likely possessed established classroom management skills and instructional routines conducive to integrating game-based learning strategies. However, the absence of teachers in the 7–8-year range also suggested a potential loss of mid-career professionals who might have served as bridges between newer and veteran educators, making it necessary for professional development activities to examine school-level factors that may have contributed to attrition at this career stage in order to improve future retention.

Teachers' attendance to EdTech trainings

The teachers' attendance to EdTech trainings was examined to determine their exposure to professional development activities related to educational technology, given that such training may influence teachers' readiness, confidence, and competence in integrating technology-assisted and game-based strategies in teaching numeracy. The data showed that all 4 respondents, representing 100.00% of the sample, had attended EdTech-related trainings, while none reported non-attendance, yielding a 0.00% non-attendance rate.

The findings signified substantial and uniform exposure to educational technology among teachers, implying that the school or division prioritized technology-related capacity building and ensured that every teacher had received at least some foundational training in educational technology. The complete participation rate also reflected either a strong culture of professional development compliance or the consistent availability and accessibility of EdTech training opportunities for all kindergarten teachers in the sample. However, the mere fact of training attendance did not guarantee effective classroom integration, as ongoing learning experiences rather than isolated training sessions were instrumental in cultivating pedagogical proficiency and adaptability for integrating technology effectively into diverse educational practices (Napitupulu et al., 2024; Tondeur et al., 2013). This perspective highlighted the necessity of continuous professional development to address both the evolving technological landscape and the nuanced pedagogical requirements for effective digital tool integration (Mekheimer, 2025). The universal participation in EdTech training among teacher-respondents implied that the proposed intervention plan for enhancing the use of educational games in teaching numeracy could build upon an existing foundation of technological awareness, allowing the intervention to focus on specialized applications of educational games specifically targeting numeracy development rather than beginning with basic digital literacy instruction. Furthermore, any identified challenges in implementing educational games were likely not attributable to a complete lack of EdTech exposure but rather to other factors such as resource availability, curriculum alignment, or the depth of training received.

Profile of kindergarten learner-respondents

This section presents the profile of the 100 kindergarten learner-respondents who participated in the study. Their characteristics were described in terms of age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly family

income. These demographic variables were examined to determine their potential influence on the numeracy skills of kindergarten pupils, and understanding the learners' profile provided a contextual foundation for analyzing the relationship between learner characteristics and numeracy performance.

Age of the learners

Age was examined to determine the developmental stage of the learners included in the study, given that numeracy skills among kindergarten learners are closely related to their level of cognitive, social, and developmental readiness. The distribution showed that 5-year-old learners comprised the largest proportion at 52.00%, followed by 6-year-olds at 45.00%. A minor fraction of learners were 7 years old, accounting for 2.00%, and 4 years old, accounting for 1.00%.

The results indicated that the age range was concentrated at ages 5 and 6, representing 97.00% of the total sample combined, which suggested a generally homogeneous developmental baseline appropriate for instructional planning at the kindergarten level. The predominance of 5-year-olds as the largest group reflected the typical entry age for kindergarten programs. However, the presence of age deviations, including learners as young as 4 years old and as old as 7 years old, demonstrated that teachers faced a classroom environment with some degree of developmental variability. This difference between mental and physical age could be particularly problematic in school systems that segregated students by age, as it could cause students who developed at different rates to experience divergent learning outcomes and greater academic stress (Havugiyaremye, 2026; Stager, 2019). The age distribution of learners implied that the proposed intervention plan for enhancing numeracy skills through educational games must be designed with developmental flexibility in mind, incorporating differentiation strategies within the same game-based activities, such as varying complexity levels, providing additional scaffolding for the 1.00% of 4-year-old learners, or offering extension challenges for the 2.00% of 7-year-old learners, to ensure that neither the youngest nor the oldest learners were excluded from meaningful participation.

Gender of the learners

Gender was examined as one of the profile variables considered in determining whether learner characteristics were significantly related to numeracy skills. The data indicated that females comprised 55.00% of the total sample, while males accounted for 45.00%, reflecting a relatively balanced distribution across both genders.

This nearly equal representation implied that the classroom population included both genders in comparable proportions, allowing teachers to create both group and individual tasks that supported social learning without significant gender bias. Teaching methods and activities should therefore continue to be fair and gender-inclusive, ensuring that both male and female students were equally involved and supported. This approach was consistent with the broader literature, which emphasized that gender-inclusive teaching methods were essential for creating fair and empowering learning environments for all students (Pandey, 2025), strategies that encompassed methods designed to eliminate gender stereotypes, promote equal opportunities, and ensure the full participation of all learners (Chalco, 2021), while actively incorporating awareness of gender identities into lesson design and delivery (Dogra, 2020). The balanced gender distribution provided an opportunity to intentionally design collaborative game structures where male and female learners worked together, promoting positive peer

interactions and challenging any gender-based stereotypes about mathematical ability, while the proposed intervention plan for enhancing numeracy skills through educational games should incorporate themes, characters, and participation structures that appealed equally to both genders and included specific guidance on equitable participation strategies and gender-neutral game modifications.

Parents' highest educational attainment

Parents' highest educational attainment was examined as a descriptor of the educational background of learners' families, with data collected separately for mothers and fathers. For mothers, the largest proportion were high school graduates at 43.00%, followed by those with college level education at 23.00%, college graduates at 17.00%, those with high school level at 8.00%, elementary graduates at 7.00%, and those with elementary level education at 2.00%. None of the mothers reported no formal education, accounting for 0.00%. For fathers, high school graduates also comprised the largest group at 54.00%, followed by college level at 15.00%, college graduate at 12.00%, elementary graduate at 8.00%, elementary level at 5.00%, high school level at 5.00%, and 1.00% reported no formal education.

The results showed that most learners came from families where both parents had at least a high school education, suggesting that some basic academic support might be available at home. Mothers generally exhibited slightly higher educational attainment than fathers across most categories, particularly in college level at 23.00% compared to 15.00%, and college graduate at 17.00% compared to 12.00%. The low percentage of college graduates among both parents indicated that most households lacked direct experience of completing a four-year degree program, which could limit the level of academic scaffolding available for numeracy development at home. To fully understand this phenomenon, it is important to consider the existing research on the complex effects of parental educational attainment on student academic outcomes and the effectiveness of different school-based interventions aimed at closing educational gaps (Cláudia & Paun, 2024; Tan et al., 2019). The parental educational profile implied that the proposed intervention plan for enhancing numeracy skills through educational games could not assume high levels of parental academic capacity to support game-based learning at home. Any take-home components of the intervention would need to include clear, simple instructions that did not require advanced literacy or mathematical knowledge, and communication about the intervention might be more effectively directed through mothers given their slightly higher educational attainment, while parent orientation sessions demonstrating how to play educational games with children should emphasize practical modeling over written instruction.

Number of siblings of the learners

The number of siblings of the kindergarten learners was examined to describe the family composition of respondents, given that the number of siblings may influence learners' home experiences, opportunities for interaction, and availability of support for learning activities. The distribution indicated that 41.00% of learners came from households with 3–4 siblings, closely followed by those with 1–2 siblings at 40.00%. Only children comprised 10.00% of the sample, while 9.00% came from families with 5 or more siblings.

The results suggested that the majority of learners, representing 81.00% when the 3–4 and 1–2 sibling groups were combined, came from families with a moderate to large number of children, indicating that the typical learner in this sample grew up in a household where parental attention and resources were likely shared among several offspring. Many studies had shown that family size was negatively related to educational outcomes, particularly academic

success (Hertwig et al., 2002), and this relationship was often explained through resource dilution theory, which held that as the number of siblings grew, parental resources including time, attention, and money became more evenly distributed, potentially having a significant effect on each child's ability to learn and perform academically (Downey, 1995; Lu & Treiman, 2008; Radl et al., 2017; Sheppard & Monden, 2020). The sibling distribution implied that the proposed intervention plan for enhancing numeracy skills through educational games needed to account for home learning environments characterized by shared parental resources, favoring educational games that could be played cooperatively among siblings with minimal adult supervision, using durable materials that could be used by multiple children sequentially, and providing alternative support mechanisms for the 9.00% of learners from very large families of five or more siblings who might face the greatest resource constraints.

Birth order of the learners

The birth order of the kindergarten learners was examined to describe their position in the family, given that birth order may reflect differences in home experiences, sibling interaction, parental attention, and the type of support learners received within the family. The distribution revealed that the largest proportion of learners were the youngest child at 31.00%, followed closely by second-born children at 30.00%. Only children accounted for 19.00%, eldest children comprised 14.00%, and middle children represented the smallest group at 6.00%.

The predominance of youngest and second-born children in the sample, representing 61.00% combined, indicated that most learners were not the firstborn in their families and thus may have experienced different parenting dynamics compared to their older siblings. A significant body of research had been conducted on how birth order affected different aspects of a child's development, especially in educational settings (Hotz & Pantano, 2013), with studies showing that children born later tended to receive less parental involvement in their cognitive development and performed less well in school than their older peers (Booth et al., 2008; Lehmann et al., 2016), while differences in school performance across birth order groups could be attributed to factors such as declining intellectual age in the family, limited resources, parental decisions, and changes in reproductive quality with age (Esposito et al., 2020). The small percentage of middle children at 6.00% reflected either family size patterns or a sampling characteristic, while the 19.00% of only children likely experienced exclusive parental attention without sibling competition, making them more accustomed to adult-directed learning activities. The birth order distribution implied that the proposed intervention plan for enhancing numeracy skills through educational games should incorporate flexible implementation guides for parents recognizing birth-order-related differences, such as suggesting varying levels of parental scaffolding for youngest versus eldest children, and that teachers should be aware that the 6.00% of middle children and 14.00% of eldest children might exhibit different learning behaviors or peer interaction styles influenced by their birth order dynamics at home.

Combined monthly income

The combined monthly income of the learners' families was examined to determine the economic background of the kindergarten learner-respondents, given that family income may influence the availability of learning materials, educational toys, digital devices, internet access, and other resources that support children's numeracy development at home. The distribution showed that the largest proportion of learners came from households earning

₱10,000 and below, representing 45.00%, followed by those earning ₱10,001–₱15,000 at 23.00% and ₱15,001–₱20,000 at 16.00%. Only 4.00% of families earned ₱20,001–₱25,000, while 6.00% each fell within the ₱25,001–₱30,000 and above ₱30,000 income categories.

The findings indicated that 68.00% of all families, representing the combined total of those earning ₱10,000 and below and those earning ₱10,001–₱15,000, lived on a monthly income of ₱15,000 or below, confirming that the learner population was predominantly drawn from low-income socioeconomic backgrounds where financial resources for educational materials and enrichment activities were severely limited. It had long been recognized that a student's socioeconomic position was strongly linked to academic performance (Agasisti et al., 2021), and this widespread challenge often manifested as significant achievement gaps caused by differences in parental employment, educational attainment, and access to home learning tools (Ikeda, 2022), frequently resulting in a less stimulating home environment that slowed cognitive development and limited access to essential school supplies such as books, which were known to have a considerable effect on academic outcomes (Thomson, 2018). The household income distribution implied that the proposed intervention plan for enhancing numeracy skills through educational games could not assume access to expensive resources such as tablet computers, smartphones with internet connectivity, or commercially produced games, and instead needed to be designed using low-cost or no-cost materials that were readily available or could be produced by teachers using simple supplies, with classroom-based game implementation maximized given that home access to technology and learning materials would likely be inconsistent or nonexistent for the majority of learners.

Extent of teachers' use of educational games in teaching numeracy skills

The extent of teachers' use of educational games in teaching numeracy skills among kindergarten pupils was assessed across 10 game-based instructional indicators. The results revealed a very high level of utilization, with an aggregate mean of 4.83 and an aggregate standard deviation of 0.15, both interpreted as "Always" on a scale where 4.21 to 5.00 corresponded to Always, 3.41 to 4.20 to Often, 2.61 to 3.40 to Sometimes, 1.81 to 2.60 to Rarely, and 1.00 to 1.80 to Never. Among the indicators, block building activities to demonstrate addition and subtraction concepts, board games that encourage number sequencing and turn-taking, hopscotch games that use number lines and physical counting, mathematics mobile applications for number recognition and counting, card matching games involving number pairs, odd and even numbers, puzzle assembly activities focusing on patterns and shapes, dice rolling games that involve counting and simple probability, and songs and dance activities that incorporate rhythm and number counting each obtained a perfect weighted mean of 5.00 with a standard deviation of 0.00, indicating complete consensus and uniform use among all teacher-respondents. Shape hunting games that involved identifying and matching shapes obtained a weighted mean of 4.50 and a standard deviation of 0.58, still interpreted as Always, while role-playing activities such as store play for counting money or objects obtained the lowest weighted mean of 3.75 with a standard deviation of 0.96, interpreted as Often.

The findings indicated that teachers strongly integrated educational games as a primary instructional strategy in teaching numeracy, reflecting a learner-centered and interactive pedagogical approach. The perfect mean scores and zero standard deviations recorded across 8 of the 10 game types indicated complete consensus among all teacher-respondents regarding the consistent use of these specific games, pointing to either a standardized curriculum expectation or a shared pedagogical philosophy within the school. While both digital and non-digital games had been shown to positively impact mathematics learning, non-digital games often demonstrated higher effect sizes, particularly in contexts with limited resources (Mahinay, 2025), and the prevalence of non-digital games in resource-constrained

environments underscored their accessibility and versatility as pedagogical tools, contrasting with the extensive research emphasis on digital game-based learning outcomes (Russo et al., 2024). The slightly lower use of shape hunting games at a weighted mean of 4.50 and role-playing activities at 3.75 suggested that while these strategies were still employed frequently, they were not utilized with the same level of consistency as the other game types, with the higher standard deviation of 0.96 for role-playing suggesting that some teachers faced constraints such as time, classroom management challenges, or lack of materials that limited the implementation of more complex, scenario-based games. The very high level of educational game utilization implied that the proposed intervention plan would be building upon an existing strong foundation of game-based instructional practice, allowing the intervention to focus on optimizing the two less-frequently utilized activities, particularly role-playing, through practical support such as ready-made scenario kits, classroom management strategies specific to dramatic play, and peer mentoring arrangements where more consistent implementers could model their practices for colleagues.

Level of numeracy skills of kindergarten learners

The level of numeracy skills demonstrated by the 100 kindergarten learner-respondents was assessed across four domains: foundational skills, patterns, time, and measurement, number sense and operations, and applied numeracy.

In the domain of foundational skills, the aggregate mean was 3.54 with an aggregate standard deviation of 0.72, both interpreted as Expert on a scale where 3.25 to 4.00 corresponded to Expert, 2.50 to 3.24 to Advanced, 1.75 to 2.49 to Intermediate, and 1.00 to 1.74 to Beginner. Among the specific indicators, identifying basic colors and shapes obtained the highest weighted mean of 3.63 with a standard deviation of 0.68, followed by sorting and classifying objects by color, shape, and size at a weighted mean of 3.58 with a standard deviation of 0.68, comparing objects such as big and small and long and short at a weighted mean of 3.56 with a standard deviation of 0.69, and arranging objects by size or order at a weighted mean of 3.37 with a standard deviation of 0.85, all four of which were individually interpreted as Expert. The findings indicated that learners demonstrated strong and consistent competency in foundational numeracy skills, with the standard deviation of 0.72 reflecting the lowest variability among all four domains, suggesting that performance in this area was the most uniformly developed across the sample.

In the domain of patterns, time, and measurement, the aggregate mean was 3.00 with an aggregate standard deviation of 0.94, interpreted as Advanced. Among the indicators, recognizing and completing patterns obtained the highest weighted mean of 3.26 with a standard deviation of 0.85, interpreted as Expert, while naming days of the week and months obtained a weighted mean of 3.05 with a standard deviation of 0.96, identifying time of day and telling time by the hour obtained a weighted mean of 2.89 with a standard deviation of 0.94, and using simple tools to measure obtained the lowest weighted mean of 2.81 with a standard deviation of 1.01, all three of the latter interpreted as Advanced. The findings indicated a noticeable disparity between recognition-based competencies and applied, hands-on tasks within this domain, with learners performing best on pattern recognition, which involved visual discrimination and logical extension of sequences, while finding tasks requiring practical application, tool manipulation, and abstract temporal reasoning comparatively more challenging. The standard deviation of 0.94 was the highest among all four domains, indicating the least consistent performance across learners in this area. Current literature repeatedly emphasized that a strong grasp of basic numerical skills was essential for

successful mathematical advancement (Powell & Fuchs, 2012), yet a noticeable gap persisted in the successful application of these core skills in practical circumstances, especially regarding measurement and time reasoning (Rediani, 2024), and the proposed intervention should therefore prioritize hands-on, game-based activities that developed applied competencies in time-telling and measurement through games such as measurement scavenger hunts, daily schedule sequencing activities, and clock-reading games.

In the domain of number sense and operations, the aggregate mean was 3.39 with an aggregate standard deviation of 0.82, interpreted as Expert. Among the indicators, counting and recognizing numbers from 0 to 10 obtained the highest weighted mean of 3.60 with a standard deviation of 0.80, followed by matching numbers to objects at a weighted mean of 3.44 with a standard deviation of 0.83, and ordering numbers and identifying position at a weighted mean of 3.39 with a standard deviation of 0.82, all three interpreted as Expert. Solving simple addition and subtraction using objects obtained the lowest weighted mean of 3.11 with a standard deviation of 0.84, interpreted as Advanced, indicating that operational thinking requiring higher cognitive processing and quantity manipulation was still developing. The foundational aspects of number sense encompassing numerical recognition and sequencing were critical precursors to more advanced mathematical understanding, including the decomposition of numbers and the principled understanding of place value (Jordan et al., 2012; Laurillard, 2016), and these early competencies were instrumental for developing arithmetic operation skills and for applying mathematical concepts across domains such as measurement, data analysis, and geometry (Dyson et al., 2015). The difference between the highest and lowest performing indicators in this domain, spanning from 3.60 to 3.11, revealed that learners were more confident in receptive and rote numerical tasks than in constructive, problem-solving tasks, and the proposed intervention should therefore concentrate on educational games involving concrete manipulatives for addition and subtraction operations, such as counting collections, dice games requiring sum calculations, and board games with simple operational challenges.

In the domain of applied numeracy, the aggregate mean was 3.07 with an aggregate standard deviation of 0.89, interpreted as Advanced. Among the indicators, recognizing coins and bills up to ₱20 obtained the highest weighted mean of 3.40 with a standard deviation of 0.85, interpreted as Expert, while grouping objects into equal sets obtained a weighted mean of 3.06 with a standard deviation of 0.87, and identifying simple fractions such as half obtained the lowest weighted mean of 2.76 with a standard deviation of 0.93, both interpreted as Advanced. The findings revealed that learners performed well in practical numeracy tasks involving concrete, familiar objects such as coins and bills likely encountered in daily life, while the Expert-level performance in currency recognition at 3.40 contrasted sharply with the lowest performance in identifying simple fractions at 2.76, a more abstract concept requiring understanding of part-whole relationships. The standard deviation of 0.93 for fractions was the highest among the three indicators, suggesting greater variability in learner understanding of this abstract concept. This finding highlighted a significant educational challenge in converting fundamental mathematical concepts into applicable problem-solving skills (Gula & Lovrić, 2024) and underscored the necessity for educational approaches that transcended rote memorization to cultivate a relational and rational comprehension of mathematical concepts (Iswara et al., 2022; Winarni et al., 2025). The proposed intervention should leverage learners' demonstrated strength in currency recognition as a concrete bridge to fraction instruction, using games that required learners to share coins equally between characters before transitioning to more symbolic representations.

The summary across the four domains revealed a grand mean of 3.25 with a grand standard deviation of 0.84, interpreted as Expert overall. Foundational Skills obtained the highest mean of 3.54 with a standard deviation of 0.72, followed by Number Sense and

Operations at a mean of 3.39 with a standard deviation of 0.82, both interpreted as Expert. Applied Numeracy obtained a mean of 3.07 with a standard deviation of 0.89, and Patterns, Time, and Measurement obtained a mean of 3.00 with a standard deviation of 0.94, both interpreted as Advanced. The findings indicated that kindergarten learners possessed robust fundamental and procedural numeracy skills, but a notable gap existed between these foundational competencies and the more complex, application-based domains where performance was lower and variability was higher. This disparity underscored the critical need for targeted pedagogical interventions that bridged these gaps, fostering a more holistic development of early mathematical cognition (Jordan et al., 2009), with specific focus on strengthening number concepts and their practical application to operational and real-world tasks, since a deficiency in these areas often led to an overreliance on rote memorization and underdeveloped problem-solving abilities (Dyson et al., 2015). The proposed intervention plan should therefore allocate minimal instructional time to foundational and procedural areas where Expert-level performance was already achieved, and instead concentrate substantially on Patterns, Time, and Measurement and Applied Numeracy, designing differentiated game-based activities that addressed the higher variability in these domains through scaffolded support for struggling learners and extension challenges for those who had already mastered the content.

Test of significance of the relationship between the identified profile and the numeracy skills of the learners

The test of significance of the relationship between the identified profile variables and the numeracy skills of the learners was conducted using chi-square analysis to determine whether statistically significant associations existed between learner characteristics and numeracy performance. The results of the chi-square tests revealed that age and numeracy skills yielded a chi-square value of 1.586 with 2 degrees of freedom and a p-value of 0.452, gender and numeracy skills yielded a chi-square value of 2.601 with 2 degrees of freedom and a p-value of 0.272, number of siblings and numeracy skills yielded a chi-square value of 1.676 with 2 degrees of freedom and a p-value of 0.433, birth order and numeracy skills yielded a chi-square value of 2.419 with 6 degrees of freedom and a p-value of 0.877, and combined monthly income and numeracy skills yielded a chi-square value of 0.300 with 2 degrees of freedom and a p-value of 0.861. All five of these associations yielded p-values greater than 0.05, leading to the decision not to reject the null hypothesis and indicating that age, gender, number of siblings, birth order, and combined monthly income did not have a statistically significant relationship with the numeracy skills of kindergarten learners. In contrast, mother's highest educational attainment and numeracy skills yielded a chi-square value of 17.074 with 4 degrees of freedom and a p-value of 0.002, and father's highest educational attainment and numeracy skills yielded a chi-square value of 19.278 with 4 degrees of freedom and a p-value of 0.001, both of which were less than the 0.05 level of significance, leading to the rejection of the null hypothesis and indicating statistically significant relationships.

The findings indicated that while demographic and economic determinants such as age, gender, family size, birth order, and household income exhibited no significant influence on learners' numeracy skills, parental education, specifically that of both mother and father, emerged as the sole profile variable significantly associated with learners' numeracy development. The stronger statistical significance yielded by father's educational attainment at $p = 0.001$ compared to mother's at $p = 0.002$, while both below the 0.05 threshold, suggested that both parents contributed meaningfully to children's numeracy outcomes, with the father's education level yielding a slightly more significant association. The non-significant finding for

combined monthly income at p = 0.861 was particularly noteworthy, as it suggested that parental educational background independently influenced numeracy skills regardless of the family's financial resources, implying that the quality of academic support, learning stimulation, and educational awareness provided by more educated parents might compensate for lower household income levels. The correlation between parental education levels and children's mathematical proficiency had been consistently documented, with research indicating that higher parental educational attainment was associated with more robust early learning environments conducive to skill development (Visser et al., 2019), and a positive correlation had been observed between parental education and children's numeracy skills particularly across both parents (Tumaob & Parazo, 2025), an influence that extended beyond direct instruction to encompass the creation of enriched home learning environments and parental engagement in educational activities (Mutaf-Yıldız et al., 2020). The significant relationship between parental educational attainment and learners' numeracy skills had important implications for the proposed intervention plan for enhancing numeracy skills through educational games, as it indicated that strategies actively engaging parents in their children's numeracy development were essential, particularly targeting families where both parents had lower educational backgrounds, through parent orientation sessions demonstrating how to play educational games at home, simple guides accessible to parents with limited literacy or numeracy, and school-to-home communication systems encouraging involvement from both parents when possible. The non-significant findings for age, gender, number of siblings, birth order, and income implied that the intervention could be implemented uniformly across these demographic subgroups without requiring extensive differentiation, allowing resources to be concentrated on supporting families where parental educational attainment was a limiting factor.

The collective findings of this chapter present a coherent portrait of a kindergarten educational context where teachers were highly experienced, exclusively female, and formally trained to a bachelor's degree level, with universal participation in EdTech training, and where they consistently employed educational games in numeracy instruction at a very high level reflected by an aggregate mean of 4.83. The 100 kindergarten learners, drawn predominantly from low-income, moderately large families with parents whose highest educational attainment was largely at the high school graduate level, demonstrated an overall Expert level of numeracy performance with a grand mean of 3.25, with notably stronger competence in Foundational Skills at a mean of 3.54 and Number Sense and Operations at a mean of 3.39 relative to Patterns, Time, and Measurement at a mean of 3.00 and Applied Numeracy at a mean of 3.07. Chi-square analysis confirmed that among all learner profile variables examined, only mother's educational attainment at chi-square = 17.074, df = 4, p = 0.002, and father's educational attainment at chi-square = 19.278, df = 4, p = 0.001 had statistically significant relationships with numeracy skills, while age at p = 0.452, gender at p = 0.272, number of siblings at p = 0.433, birth order at p = 0.877, and combined monthly income at p = 0.861 did not. These findings collectively establish that the educational level of both parents is the most critical family-level variable shaping kindergarten numeracy outcomes in this context, and that despite the consistently high use of educational games by teachers, specific instructional gaps remain in applied and reasoning-based numeracy domains. Taken together, these results provide a strong empirical foundation for the subsequent chapter, which will present the proposed intervention plan designed to strengthen the less-developed numeracy domains through targeted, accessible, and contextually responsive game-based instructional strategies that account for the demographic realities of the learner population and the instructional capacity of the teaching force.

CONCLUSION

The study concludes that kindergarten teachers have strong and consistent practices in integrating educational games into numeracy instruction, reflecting a learner-centered, play-based pedagogical approach. While learners demonstrate mastery of basic and procedural numeracy skills, a notable gap exists in higher-order and application-oriented competencies such as time-telling, measurement, and fractions, indicating that foundational instruction does not automatically transfer to practical problem-solving contexts. The significant relationship between parental education and learner numeracy outcomes, contrasted with the non-significant findings for income and family structure, implies that the quality of home learning environment and parental engagement matters more than economic resources alone. These findings suggest that professional development programs should shift from introducing game-based learning to optimizing it for complex skill development. Furthermore, intervention plans must actively bridge school and home learning by equipping parents particularly those with lower educational backgrounds with structured, easy-to-implement game-based activities.

Based on the findings, the proposed intervention plan is recommended for implementation to enhance the use of educational games specifically targeting higher-order numeracy skills, accompanied by teacher training and parent engagement components to address the identified gaps in applied numeracy and home learning support.

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