

The use of educational games in improving numeracy skills among kindergarten learners

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ABSTRACT

This study determined the use of educational games in improving numeracy skills among kindergarten learners at Naga Central Elementary School during the school year 2025–2026 as basis for an intervention plan. Specifically, it described the profile of the teacher-respondents and learner-respondents, assessed the extent of teachers' utilization of educational games, determined the level of learners' numeracy skills in foundational skills, patterns, time and measurement, number sense and operations, and applied numeracy, and tested whether the identified learner profile variables were significantly related to numeracy skills. The study used a quantitative descriptive-correlational research design. The respondents were seven (7) kindergarten teachers selected through total enumeration and one hundred (100) kindergarten learners selected through proportionate stratified random sampling. Data were gathered using a structured teacher questionnaire, a parent profile questionnaire, and a numeracy skills assessment checklist. Frequency, percentage, weighted mean, standard deviation, and chi-square test of independence were used in the analysis. Findings showed that teachers always utilized educational games in numeracy instruction, with songs and dance activities obtaining the highest mean and mathematics mobile applications obtaining the lowest mean. The learners demonstrated an overall expert level of numeracy skills, although patterns, time, and measurement obtained the lowest component mean and therefore required further enhancement. The test of significance showed no significant relationship between the identified learner profile variables and numeracy skills. Based on these findings, an Educational Games Intervention Plan was proposed to strengthen existing game-based practices, reinforce patterns, time, and measurement, increase purposeful use of underutilized digital games, and promote home-school support for kindergarten numeracy learning.

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

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INTRODUCTION

The global education sector continues to recognize the importance of developing basic academic skills during early childhood, a period when children's cognitive abilities grow rapidly (Ünal & Kaya, 2024). One of the most important of these skills is numeracy, as it

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contributes significantly to children's later academic achievement, not only in mathematics but also in reading and problem-solving (Elfiky, 2021; Maghfirah et al., 2025). Despite this importance, many young learners in countries such as the United Kingdom, Turkey, Canada, Northern Ireland, and Malaysia still struggle with basic numeracy skills, including recognizing numbers, counting, and understanding numerical concepts (Singh et al., 2021; Yuniria et al., 2025). These continuing difficulties emphasize the need for teaching strategies that are engaging, effective, and appropriate for strengthening children's early mathematical development (Ali et al., 2022).

In addressing these global issues, educational games and digital game-based learning have become useful strategies for enhancing the numeracy skills of young children (Afrianti & Maryatun, 2025). These approaches are also suited to the learning preferences of Generation Alpha, who are more exposed and responsive to digital, interactive, and technology-based learning experiences (Asqia et al., 2025). Studies show that game-based learning can increase learners' motivation, participation, and problem-solving skills while also supporting their cognitive, social, and emotional growth (Alotaibi, 2024; Kim & Kim, 2024; Maryana et al., 2024). In addition, educational games make abstract mathematical ideas easier for young learners to understand, which may lead to better mathematical thinking and performance (Al-Hassan et al., 2025; Buray & Alferez, 2025; Jarrah et al., 2022). The success of these strategies may also be strengthened by the home learning environment, since children's early numeracy development is shaped by both classroom instruction and learning experiences at home (Cheung et al., 2020).

This connection between formal and informal learning settings shows that educational games can serve as flexible, engaging, and innovative tools for teaching numeracy (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).

Considering these concerns, this study focuses on exploring the use and effects of educational games on the numeracy skills of kindergarten learners. It specifically aims to examine how digital game-based learning supports the development of early mathematical competencies and how teachers view its effectiveness as a teaching strategy (Bang & Siebert-Evenstone, 2024). By looking into both learners' performance and teachers' perceptions, the study seeks to add to the existing research on game-based learning. It also aims to provide useful insights for designing appropriate intervention programs and identifying effective practices in early childhood education (Buray & Alferez, 2025; Dan et al., 2024).

The continuing challenges in early numeracy development emphasize the need for innovative and engaging teaching approaches that can effectively support young learners. Educational games offer a meaningful response to these challenges because they combine interaction, motivation, and enjoyable learning experiences. However, their effectiveness depends on careful planning, proper implementation, and teachers' readiness to integrate them into classroom instruction. Thus, this study aims to determine the use of educational games in improving the numeracy skills of kindergarten learners during the school year 2025–2026 as the basis for developing an intervention plan. Specifically, it seeks to assess how game-based learning affects learners' foundational mathematical competencies and to examine teachers' perceptions of its effectiveness as an instructional strategy. The expected output of the study is a structured and context-responsive intervention plan that will help strengthen numeracy instruction through the purposeful use of educational games.

Statement of the problem

This study determined the use of educational games in improving numeracy skills among kindergarten learners at Naga Central Elementary School during the school year 2025–2026 as a basis for an intervention plan.

Specifically, this study sought to answer the following questions:

1. What is the profile of the teacher-respondents and kindergarten learner-respondents in terms of age and sex at birth, highest educational attainment, years of teaching experience, and EdTech trainings attended for teachers; and age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income for kindergarten learners?
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 quantitative descriptive-correlational design. This design was appropriate because the study described the profile of the respondents, the extent of teachers' utilization of educational games, and the level of numeracy skills of kindergarten learners, while also determining whether selected learner profile variables were significantly related to learners' numeracy skills. The descriptive component was used to present the teacher-respondents' profile in terms of age and sex at birth, highest educational attainment, years of teaching experience, and EdTech trainings attended; the learner-respondents' profile in terms of age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income; the extent of teachers' utilization of educational games; and the level of learners' numeracy skills in the four identified domains. The correlational component was used to test the significant relationship between the identified learner profile variables and the numeracy skills of the kindergarten learners. Since the study did not manipulate variables or assign learners to treatment conditions, it did not establish causality; rather, it determined whether significant statistical associations existed among the variables included in the study. The results of the descriptive and correlational analyses served as the empirical basis for developing an intervention plan designed to strengthen existing game-based practices and reinforce numeracy areas that needed further support.

This study was conducted at Naga Central Elementary School, located in Central Poblacion, City of Naga, Cebu. The school is a public educational institution under the jurisdiction of the Department of Education (DepEd), Division of City of Naga. It offers a comprehensive basic education program, including a Special Needs Education (SNED) program, Kindergarten, and complete elementary education from Grade 1 to Grade 6. The respondents of this study were the kindergarten teachers and kindergarten learners of Naga Central Elementary School, City of Naga, during the school year 2025-2026. For the teacher-respondents, the study employed total enumeration sampling. Since the number of kindergarten teachers was limited and manageable, all seven (7) kindergarten teachers were included in the study. This sampling approach was appropriate because it ensured complete participation of all teachers handling kindergarten classes, thereby providing a comprehensive basis for determining the extent of use of educational games in teaching numeracy skills. For the learner-respondents, the study employed proportionate stratified random sampling. From the total population of 253 kindergarten learners, 100 learners were selected as respondents. The number of learners taken from each class was determined proportionately according to class population, after which the specific learner-respondents were selected through simple random sampling.

The primary instruments utilized in this study were a structured questionnaire and a numeracy skills assessment checklist consisting of researcher-made and adapted sections. These instruments were designed to gather data aligned with the Statement of the Problem, particularly the teacher profile, learner profile, teachers' utilization of educational games, and learners' numeracy skills. The utilization and numeracy assessment sections were anchored on DepEd Order No. 47, s. 2016 (Omnibus Policy on Kindergarten Education) and the K to 12 Kindergarten Curriculum Guide (May 2016). The instrument was divided into four (4) parts, each intended to gather data relevant to the research questions. The first part focused on the demographic profile of the teacher-respondents and gathered information on age, sex at birth,

highest educational attainment, years of teaching experience, and EdTech trainings attended; this part was researcher-made and used a checklist format in which respondents checked the category corresponding to their answer. The second part pertained to the use of educational games in teaching numeracy skills and contained ten (10) indicators of educational games and play-based classroom activities used in kindergarten, 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 and dance activities; the teacher-respondents rated each item using a five-point Likert scale of 5 - Always, 4 - Often, 3 - Sometimes, 2 - Rarely, and 1 - Never. The third part was the individual learner's numeracy skills assessment, which was adapted from the K to 12 Kindergarten Curriculum and the Sample Kindergarten Progress Report attached to DepEd's Kindergarten Policy; it assessed numeracy skills in four dimensions, namely foundational skills, patterns, time, and measurement, number sense and operations, and applied numeracy. The indicators reflected kindergarten mathematics competencies such as sorting and classifying objects, arranging and comparing objects, recognizing and completing patterns, telling time by the hour, naming days and months, counting and recognizing numerals, matching numerals to objects, solving simple addition and subtraction using concrete objects, grouping equal sets, identifying equal parts, and recognizing coins and bills. This assessment was observation-based, consistent with DepEd's policy that kindergarten assessment should be performance-based and conducted in play-based settings, and responses were rated using the scale 4 - Always Demonstrated, 3 - Often Demonstrated, 2 - Sometimes Demonstrated, and 1 - Not Yet Demonstrated. The fourth part covered the learner's profile questionnaire for parents, which 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, and like the first part, this section used a checklist format for convenience.

The process of collecting data for this study was carried out in three stages, namely the preliminary stage, the data gathering stage, and the stage following data gathering, each of which was systematically implemented to ensure the accuracy, reliability, and ethical integrity of the research process. In the preliminary stage, the researcher secured permission to conduct the study by preparing and submitting a transmittal letter to the Schools Division Superintendent of the Department of Education, Division of City of Naga. Upon approval from the division office, the researcher sought permission from the school principal of Naga Central Elementary School. The researcher also finalized the research instruments, secured validation if required, prepared informed consent forms, and coordinated with the kindergarten teachers for the schedule of data gathering. During the data gathering stage, after approval and coordination had been secured, the researcher distributed the teacher questionnaires to the seven kindergarten teacher-respondents and the learner profile questionnaires to the parents or guardians of the selected learners. The kindergarten learners' numeracy skills were then assessed using the observation-based checklist with the assistance and coordination of the kindergarten teachers, and the assessment was conducted in a manner appropriate for young learners and aligned with play-based and performance-based assessment practices. Once all questionnaires and assessment checklists had been retrieved, the researcher manually checked, sorted, encoded, and tabulated the data in a master sheet using Microsoft Excel or similar spreadsheet software. The encoded data were then subjected to the appropriate statistical treatments, and the results were analyzed and interpreted based on the specific research

questions, with the findings serving as the basis for developing the proposed Educational Games Intervention Plan.

RESULTS AND DISCUSSION

This chapter presents the results and discussion of the study based on the data gathered from a total of seven (7) kindergarten teacher-respondents and one hundred (100) kindergarten learner-respondents, together with the parents or guardians of the selected learners, from Naga Central Elementary School, City of Naga, Cebu, during the school year 2025-2026. The study employed a quantitative descriptive-correlational research design, with the teacher-respondents selected through total enumeration sampling and the learner-respondents selected through proportionate stratified random sampling. Data were gathered using a structured questionnaire and a numeracy skills assessment checklist consisting of researcher-made and adapted sections, and were analyzed using frequency and percentage distribution, weighted mean, aggregate mean, standard deviation, and the chi-square test of independence. The discussion that follows is grounded entirely in the data gathered through these instruments and procedures, and the results are interpreted and discussed in direct relation to the specific research questions and objectives of the study, namely the profile of the teacher- and learner-respondents, the extent of teachers' use of educational games in teaching numeracy skills, the level of numeracy skills of kindergarten learners, and the significance of the relationship between the identified learner profile variables and their numeracy skills.

Profile of the teacher-respondents

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, as these variables provided a contextual understanding of the teachers who utilized educational games in teaching numeracy skills among kindergarten learners. The data revealed that a total of seven teacher-respondents participated in the study, of whom six teachers (85.71%) were female, while one teacher (14.29%) was male. In terms of age, the largest group was composed of teachers aged 26–30 years, with four respondents (57.14%), followed by teachers aged 31–35 years, with two respondents (28.57%), while only one teacher (14.29%) belonged to the 41–50 age bracket. Overall, the data revealed that the kindergarten teaching force in this study was predominantly female and concentrated in the 26–35 age range. The predominance of female teachers in kindergarten numeracy instruction reflects the broader societal pattern where early childhood education remains a largely female-dominated profession, while the concentration of teachers within the 26–35 age range suggests that most respondents were in an active and productive stage of their teaching career. This demographic profile may be advantageous for implementing educational games, as game-based numeracy instruction often requires high energy, creativity, classroom flexibility, and active interaction with young learners, and the younger age profile may indicate greater openness to innovative and interactive teaching approaches, including play-based activities and technology-supported strategies, which are central to the present study's focus on improving numeracy skills. The profile of the teachers is important because they serve as the direct implementers of the instructional strategy; although age and sex at birth do not determine the effectiveness of educational games by themselves, these variables provide useful background information for understanding the teaching force involved in the study. The findings imply that the successful integration of educational games depends not only on the availability of instructional materials but also on teachers' readiness, competence, and willingness to apply developmentally appropriate and innovative strategies in the classroom; thus, professional development

programs should consider leveraging the apparent energy and openness of younger, predominantly female teaching staff, while also preparing all teachers, regardless of demographic background, to effectively implement game-based numeracy instruction. This interpretation, that teacher readiness and competence are critical for successful game-based instruction, is supported by Hoareau (2021), who emphasized that digital and educational game integration relies heavily on teacher pedagogical beliefs and willingness to innovate, and by Alvarez and Galman (2025), who argued that developmentally appropriate practices in early numeracy require not just materials but active teacher facilitation and reflective adaptation of strategies to learner needs.

The highest educational attainment of the teacher-respondents was likewise examined to determine their academic preparation and professional qualification in handling kindergarten numeracy instruction, since this variable provided important background information on teachers' capacity to apply instructional strategies, including the use of educational games. The data showed that, out of the seven teacher-respondents, three teachers (42.86%) had bachelor's degrees as their highest educational attainment, another three teachers (42.86%) had earned master's units, and one teacher (14.29%) had already completed a master's degree, revealing that the teacher-respondents were equally distributed between those whose highest degree was a bachelor's and those who had pursued graduate studies without completion, while only one teacher had fully completed a master's degree. The findings indicate that all kindergarten teachers possessed at least the required academic preparation to teach at the early childhood level, as a bachelor's degree is typically the minimum qualification, and the presence of teachers with master's units and a completed master's degree suggests that several teacher-respondents were engaged in continuing professional development, which is important because graduate studies may expose teachers to updated teaching approaches, research-based strategies, curriculum development, learner-centered instruction, and technology-supported pedagogy, all of which can enhance classroom practice. The results imply that the teacher-respondents had a developing professional foundation that may support the effective use of educational games in numeracy instruction, as teachers who pursue graduate education may be more prepared to select, adapt, and implement game-based activities appropriate to the developmental level of kindergarten learners; however, since some teachers remained at the bachelor's degree level, continuous professional development may still be needed to further strengthen their competence in designing and facilitating educational games. In relation to the study, teachers' educational attainment is relevant because the successful integration of educational games depends not only on materials but also on teachers' knowledge, instructional decision-making, and readiness to use innovative strategies in early childhood classrooms. This interpretation, that graduate studies enhance teachers' readiness for innovative, research-based strategies, is supported by Hoareau (2021), who found that teachers' pedagogical knowledge and ongoing professional learning are critical determinants of effective educational game implementation, and by Alvarez and Galman (2025), who argued that higher educational attainment and engagement in graduate coursework equip early childhood educators with the theoretical and practical foundations necessary to design developmentally appropriate, game-based numeracy interventions.

The years of teaching experience of the teacher-respondents were examined to determine their length of service and classroom exposure in handling kindergarten learners, a variable relevant because teaching experience may influence teachers' classroom management skills, instructional decision-making, and ability to facilitate educational games in teaching numeracy skills. The data revealed that the majority of the teacher-respondents, composed of five teachers or 71.43 percent, had 5–6 years of teaching experience, while one teacher, or

14.29 percent, had 3–4 years of teaching experience, and another one teacher, or 14.29 percent, had 9–10 years of teaching experience; none of the teacher-respondents belonged to the 7–8 years category, revealing that most of the kindergarten teachers had already gained several years of teaching experience. The findings indicated that the teacher-respondents were not new to the teaching profession and had already acquired sufficient classroom exposure, as having 5–6 years of experience may suggest that most teachers had developed familiarity with learners' behavior, classroom routines, instructional pacing, and appropriate teaching strategies for young children, a level of experience that may be beneficial in implementing educational games because game-based instruction requires proper classroom organization, clear directions, active facilitation, and the ability to connect play activities with numeracy competencies. The results implied that the teacher-respondents had adequate practical experience to select, manage, and facilitate developmentally appropriate educational games for kindergarten learners, and their classroom exposure may help them identify which games are suitable for teaching foundational skills, patterns, number sense, operations, and applied numeracy; however, the presence of teachers with fewer years of experience also suggests the need for continuous mentoring and professional sharing among kindergarten teachers. In relation to the study, teaching experience is important because the effective use of educational games depends not only on the activity itself but also on how teachers guide learners, manage participation, and ensure that play-based activities lead to meaningful numeracy learning. Teachers possess the practical pedagogical knowledge required to integrate game-based strategies effectively within the early childhood curriculum (Peña, 2025), and this depth of professional tenure likely facilitates a more nuanced understanding of how to overcome implementation challenges, such as resource limitations and assessment complexities inherent in play-based instruction (Ugalde et al., 2024). Pedagogical experience also acts as a critical variable in shaping a teacher's predisposition toward game-based strategies, as seasoned educators often develop specialized techniques to manage both technological constraints and student engagement (Kufarimani & Chitanana, 2025; Palha & Matić, 2023), and increased professional service directly correlates with higher proficiency in executing educational games, as years of practice allow educators to refine their instructional delivery and self-efficacy in managing game-based classroom environments (Akçınar & Arak, 2023).

The teachers' attendance to EdTech trainings was examined to determine their exposure to professional development activities related to educational technology, a variable significant because such training may influence teachers' readiness, confidence, and competence in integrating technology-assisted and game-based strategies in teaching numeracy skills. The data revealed that all seven teacher-respondents, or 100.00 percent, reported that they had attended EdTech trainings, while none of the respondents, or 0.00 percent, reported having no attendance to EdTech-related training, indicating that all kindergarten teachers in the study had been exposed to professional learning opportunities focused on the use of educational technology. The findings indicate that the teacher-respondents possessed prior knowledge and training that may support the integration of educational games in classroom instruction, and since educational games may include both traditional play-based activities and digital tools such as mathematics mobile applications, teachers' exposure to EdTech trainings is an important factor in preparing them to use interactive and technology-supported strategies, suggesting that the teachers were not only familiar with conventional classroom games but may also have the basic readiness to explore digital game-based learning in teaching numeracy. The result implies that the kindergarten teachers were in a favorable position to implement educational games as part of numeracy instruction, as their attendance at EdTech trainings may help them select appropriate digital tools, manage technology-assisted activities, and align educational games with kindergarten numeracy competencies; however, training attendance alone does not automatically guarantee effective classroom application, and continuous

professional development, mentoring, and monitoring may still be needed to ensure that EdTech-based games are used purposefully and appropriately. In relation to the study, this finding supports the use of educational games in improving numeracy skills because teacher training and competence are important in the successful integration of technology and innovative instructional strategies in early childhood classrooms. This interpretation, that EdTech training provides foundational readiness for integrating digital tools yet must be supplemented by ongoing support, is supported by Hoareau (2021), who emphasized that effective educational game implementation relies on sustained teacher professional development beyond one-time training sessions, and by Alvarez and Galman (2025), who argued that technology-supported pedagogy in early numeracy requires not only initial exposure but also continuous mentoring and reflective practice to ensure that digital games are developmentally appropriate and instructionally purposeful.

Profile of the kindergarten learner-respondents

The profile of the kindergarten learner-respondents who participated in the study was described in terms of their 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 their numeracy performance, as well as for developing a responsive intervention plan.

Age was examined to determine the developmental stage of the learners included in the study, a variable important because numeracy skills among kindergarten learners are closely related to their level of cognitive, social, and developmental readiness. The data revealed that all 100 kindergarten learner-respondents, or 100.00 percent, were six years old, with no learner belonging to any other age category, indicating that the respondents were homogeneous in terms of age and that all learners were within the same developmental age group during the conduct of the study. The findings indicate that the learner-respondents were developmentally comparable, which is important in assessing their numeracy skills, since differences in numeracy performance could not be attributed to age variation, allowing the researcher to assess the learners' numeracy skills under a more consistent developmental condition; moreover, being six years old is appropriate for kindergarten learners who are expected to develop foundational numeracy skills such as identifying numbers, recognizing shapes, comparing objects, counting, understanding patterns, and performing simple mathematical tasks. The result implies that the use of educational games was developmentally suitable for the learner-respondents, as at six years old children are generally active, curious, and responsive to play-based and interactive learning experiences; therefore, educational games may serve as appropriate instructional tools for improving their numeracy skills because these activities allow learners to understand mathematical concepts through concrete, enjoyable, and meaningful experiences. This finding supports the idea that early childhood is a critical period for developing foundational numeracy skills and other core academic competencies, an interpretation supported by Ünal and Kaya (2024), who found that age-appropriate educational games significantly enhance early mathematical reasoning when aligned with children's developmental stage, and by Elfiky (2021), who argued that the early childhood period, particularly around six years of age, represents a sensitive window for acquiring foundational numeracy through concrete, enjoyable, and meaning-driven activities.

Gender was examined as a profile variable because it provides a demographic description of the learners and was considered in determining whether learner characteristics are significantly related to numeracy skills. The data showed that, out of the 100 kindergarten learner-respondents, 57 learners, or 57.00 percent, were female, while 43 learners, or 43.00 percent, were male, revealing that female learners slightly outnumbered male learners by 14 learners, representing a 14.00 percentage-point difference between the two groups. Although both genders were represented in the study, the sample had a slightly higher proportion of female learners. The findings indicated that the kindergarten learner-respondents were composed of both male and female learners, with females forming the majority, providing a clear description of the respondents who participated in the assessment of numeracy skills; however, the higher number of female learners does not automatically suggest that female learners performed better in numeracy than male learners, but rather only describes the gender composition of the sample. The result implied that the educational games used in teaching numeracy skills should be appropriate, engaging, and inclusive for both male and female kindergarten learners, and since the study focuses on the use of educational games in improving numeracy skills, teachers should ensure that game-based activities are not limited to the interests of one gender but are designed to encourage equal participation, cooperation, and learning among all learners. In relation to the study, gender serves as an important profile variable, but numeracy performance should be understood more in terms of instructional support, learning experiences, and the effective use of educational games rather than gender alone. Consistent with broader trends in early childhood research where sample demographics often reflect varied participation rates, the observed gender distribution aligns with recent studies that utilize demographic profiles to contextualize instructional outcomes without assuming inherent performance disparities based on sex (Krammer & Kelz, 2021; Kelz & Krammer, 2024). Furthermore, scholarly investigations into early numeracy emphasize that while gender serves as a notable covariate in mathematical development, interventions are more critically mediated by the quality of teacher-child interactions and the specific nature of pedagogical support provided in the classroom (Anders et al., 2022; Gürbüz et al., 2020; Siraj et al., 2023). In this regard, contemporary research indicates that play-based learning and structured instructional strategies are essential for fostering cognitive growth regardless of the learner's demographic profile (Onoshakpokaiye & Blessing, 2026).

Parents' highest educational attainment was examined as an important variable in describing the background of the learners, as it provides information on the educational profile of their families. The data showed that the largest proportion of both mothers and fathers were high school graduates, with 69 mothers (69.00%) and 69 fathers (69.00%). Among the mothers, 13 (13.00%) were college graduates, 11 (11.00%) were at the college level, 3 (3.00%) were at the high school level, 2 (2.00%) had master's degrees, and another 2 (2.00%) were at the elementary level. Among the fathers, 12 (12.00%) were at the high school level, 9 (9.00%) were college graduates, 6 (6.00%) were at the college level, 2 (2.00%) were at the elementary level, 1 (1.00%) was an elementary graduate, and 1 (1.00%) had no response, with no father reported to have a master's degree or master's units. The findings indicate that the majority of the kindergarten learners came from families whose parents had completed secondary education, suggesting that most parents possessed basic educational preparation that may help them support their children's early learning needs; however, the smaller percentage of parents who reached or completed college may also imply that some learners may have limited access to more structured academic support at home, particularly in numeracy-related activities, as higher educational attainment among parents is often associated with greater familiarity with school-type learning tasks and instructional strategies. The results imply that while parents may provide basic assistance in learning, the school still plays a major role in strengthening kindergarten learners' numeracy skills, and since the study focuses on the use of educational

games in improving numeracy skills, teachers need to provide classroom-based game activities that can support learners regardless of their parents' educational background; simple home-based educational games may also be encouraged so that parents can participate in their children's numeracy development even without advanced educational preparation. This finding is relevant because the home learning environment and parental capacity to support learning may interact with formal instruction in shaping children's early numeracy development, an interpretation supported by Gottardo and Restiglian (2022), who found that while parents with higher education may provide more structured academic support, schools can compensate by equipping all parents, regardless of educational attainment, with simple, play-based strategies to engage meaningfully in their children's foundational mathematics learning at home.

The number of siblings of the kindergarten learners was examined to describe the family composition of the respondents, a variable relevant because the number of siblings may influence learners' home experiences, opportunities for interaction, and availability of support for learning activities. The data revealed that the largest group of learners, composed of 48 respondents (48.00 percent), had 1–2 siblings, followed by 32 learners (32.00 percent) who had 3–4 siblings, while 16 learners (16.00 percent) had no siblings, and only 4 learners (4.00 percent) had 5 or more siblings, revealing that most of the kindergarten learners belonged to families with a small to moderate number of children. The findings indicate that many learners had siblings at home who may serve as playmates or companions in informal learning activities, as having 1–2 siblings may provide opportunities for sharing, counting, turn-taking, matching, grouping, and other simple numeracy-related experiences during play; on the other hand, learners with no siblings may receive more direct parental attention but may have fewer opportunities for sibling-based interaction, while learners with more siblings may experience more social interaction at home, although parental attention and learning support may also be divided among several children, potentially affecting the quality of one-on-one numeracy guidance. The result implies that the home environment of the learners may offer different levels of support for numeracy development, and since the study focuses on the use of educational games in improving numeracy skills, teachers may consider activities that can be extended at home and played with siblings or family members, such as counting objects, matching number cards, arranging toys by size, or playing store, to help strengthen learners' numeracy skills outside the classroom; teachers may also provide differentiated home activity suggestions based on whether a child has siblings, no siblings, or many siblings, to maximize the unique learning opportunities available in each family structure. This interpretation, that sibling interactions and the home environment play a meaningful role in early numeracy development, is supported by Cheung et al. (2020), who found that informal numeracy activities involving siblings, such as playing board games, counting household objects, and engaging in turn-taking routines, significantly contribute to young children's foundational mathematical skills, and that these home-based interactions interact with formal classroom instruction to shape overall numeracy outcomes in kindergarten learners.

The birth order of the kindergarten learners was examined to describe their position in the family, a variable relevant because birth order may reflect differences in home experiences, sibling interaction, parental attention, and the type of support learners receive within the family. The data revealed that the largest group of learners was composed of youngest children, with 36 respondents (36.00 percent), followed by second-born children, with 27 respondents (27.00 percent); only children comprised 16 learners (16.00 percent), while 12 learners (12.00 percent) were eldest children, and the smallest group was composed of middle children, with 9 respondents (9.00 percent), revealing that a considerable portion of the kindergarten learners were youngest children in their families. The findings indicate that many learners may have

older siblings at home who could assist or interact with them during play and learning activities, as youngest children may benefit from guidance, modeling, and support from older siblings, while second-born and middle children may experience both receiving help from older siblings and interacting with younger ones; eldest children, on the other hand, may be more exposed to responsibility and may sometimes act as helpers in family routines, while only children may receive more focused attention from parents but may have fewer sibling-based learning interactions, which could influence the variety of informal numeracy experiences available at home. The result implies that birth order may provide useful background information in understanding learners' home experiences; however, birth order alone does not determine numeracy performance, and teachers may still need to provide equal opportunities for all learners to participate in educational games, regardless of their family position. Classroom-based game activities are important because they allow learners to practice counting, comparing, sequencing, measuring, and problem-solving with peers, thereby compensating for any variations in home-based sibling interactions; birth order should therefore be interpreted together with the home numeracy environment and the learning support available to each child rather than being treated as an isolated predictor of academic outcomes. This interpretation, that birth order provides useful background context but should not be isolated from the broader home numeracy environment, is supported by Lehmann et al. (2016), who found that sibling configuration and birth order influence early cognitive development primarily through differential parental investment and sibling teaching opportunities, and by Cheung et al. (2020), who argued that classroom-based peer interactions in game-based learning can effectively compensate for variations in home-based sibling support, ensuring equitable numeracy development across different family structures.

The combined monthly income of the learners' families was examined to determine the economic background of the kindergarten learner-respondents, a variable relevant because family income may influence the availability of learning materials, educational toys, digital devices, internet access, and other resources that can support children's numeracy development at home. The data revealed that the largest group of learners, composed of 54 respondents (54.00 percent), came from families with a combined monthly income of ₱10,001–₱15,000, followed by 26 learners (26.00 percent) whose families earned ₱15,001–₱20,000 monthly; meanwhile, 9 learners (9.00 percent) belonged to families earning ₱10,000 and below, 5 learners (5.00 percent) came from families earning ₱25,001–₱30,000, 4 learners (4.00 percent) came from families earning above ₱30,000, and only 2 learners (2.00 percent) belonged to families earning ₱20,001–₱25,000, revealing that most of the kindergarten learners came from families with modest monthly income, with over half falling within the ₱10,001–₱15,000 bracket. The findings indicate that many learners may have limited access to costly educational materials and technology-based learning resources at home; since more than half of the learners came from families earning ₱10,001–₱15,000 monthly, it may be assumed that parents prioritize basic household needs such as food, utilities, and transportation, while educational resources such as paid mobile applications, learning kits, tablets, and commercial educational toys may not always be readily available. However, this does not mean that learners cannot develop strong numeracy skills; rather, it highlights the importance of school-based instruction and low-cost, play-based learning materials that can support numeracy development regardless of family income level. The result implies that educational games used in teaching numeracy skills should be practical, accessible, and affordable, and teachers may use locally available materials such as bottle caps, sticks, stones, cards, blocks, recycled paper, counters, and classroom objects to create meaningful numeracy games that help learners practice counting, sorting, grouping, comparing, measuring, and solving simple problems without requiring expensive resources or technology. In relation to the study, the learners' economic background strengthens the need for educational games that are developmentally appropriate and resource-

sensitive, and teachers should also provide guidance to parents on how to create and use simple homemade games at home, ensuring that numeracy support continues beyond the classroom despite financial constraints. This interpretation, that family income shapes children's access to numeracy-related materials and that low-cost, play-based resources can effectively support early mathematics learning, is supported by Cheung et al. (2020), who found that socioeconomic conditions influence the home numeracy environment primarily through the availability of learning materials and parental time for educational activities, but who also demonstrated that intentionally designed, low-cost, and locally sourced game-based interventions can substantially narrow numeracy gaps between children from lower- and higher-income families when implemented consistently in both school and home settings.

Extent of the teachers' use of educational games in teaching numeracy skills among kindergarten learners

This section presents the extent of the teachers' use of educational games in teaching numeracy skills among kindergarten learners, an assessment that measured how frequently and effectively teachers integrate game-based strategies to develop number recognition, counting, and basic operations, and that provided a clear benchmark of current practices, highlighting areas where educators demonstrate strong implementation and aspects that may require further reinforcement or professional development. The data showed that the extent of teachers' use of educational games in teaching numeracy skills among kindergarten learners obtained an aggregate mean of 4.27 with an aggregate standard deviation of 0.64, verbally described as "Always," indicating a high level of use of educational games among the respondents. Among the indicators, songs and dance activities that incorporate rhythm and number counting obtained the highest weighted mean of 5.00 and were described as "Always." Role-playing activities, block building activities, and card matching games also obtained high weighted means of 4.57 and were likewise described as "Always." On the other hand, mathematics mobile applications for number recognition and counting obtained the lowest weighted mean of 3.00 and were described as "Sometimes." The findings imply that teachers strongly favor concrete, movement-based, and play-oriented activities, while digital or app-based games are used less frequently, and the high extent of teachers' use of educational games supports the view that game-based instruction can strengthen numeracy learning when it is purposefully integrated into classroom activities. Educational games provide interactive and enjoyable learning experiences that help young learners recognize numbers, understand basic mathematical concepts, and participate more actively in numeracy tasks; gamified activities also promote learner engagement, motivation, and participation, which are important in sustaining children's interest in mathematics instruction, and game-based learning is especially effective in early childhood education when the activities are developmentally appropriate, properly facilitated by the teacher, and aligned with specific mathematical learning objectives. The result implies that teachers in this study effectively utilized a variety of non-digital, hands-on educational games to support kindergarten numeracy instruction; however, the lower use of mathematics mobile applications suggests that digital game-based learning remains underutilized, possibly due to limited access to devices, lack of training on educational apps, or teacher preferences for tangible materials. Schools may consider providing professional development on integrating developmentally appropriate mathematics apps alongside traditional games, and since the teachers already demonstrated a strong foundation in using concrete and movement-based games, gradual integration of carefully selected digital tools could further enrich numeracy instruction without replacing the effective play-based strategies

already in place. Teachers should also continue to prioritize low-cost, locally available materials to ensure that game-based numeracy instruction remains accessible and sustainable. This interpretation, that concrete, movement-based, and play-oriented activities are highly effective in early childhood numeracy instruction, is supported by Afrianti and Maryatun (2025), who found that interactive and enjoyable game-based experiences strengthen number recognition and mathematical concept understanding in young learners; by Maryana et al. (2024), who demonstrated that gamified activities boost learner engagement and motivation in mathematics; by Kim and Kim (2024), who emphasized that play-based experiences allow children to explore and apply mathematical ideas meaningfully; and by Alotaibi (2024), who concluded that game-based learning is most effective in early childhood when activities are developmentally appropriate, properly facilitated, and aligned with specific mathematical learning objectives.

Level of numeracy skills of kindergarten learners

The level of numeracy skills demonstrated by kindergarten learners at Naga Central Elementary School, Naga City, Cebu during the school year 2025–2026 was assessed across four key domains, namely foundational skills, patterns, time, and measurement, number sense and operations, and applied numeracy. In terms of foundational skills, the data showed an aggregate mean of 3.76 with an aggregate standard deviation of 0.52, verbally described as "Expert," indicating that the learners consistently demonstrated strong foundational numeracy-related competencies, with all four indicators rated at the expert level. Among the indicators, "Identified basic colors and shapes" obtained the highest weighted mean of 3.83, followed by "Sorted and classified objects" with a weighted mean of 3.80 and "Compared objects" with a weighted mean of 3.76, while the lowest indicator was "Arranged objects by size or order," with a weighted mean of 3.65, though still interpreted as "Expert," suggesting that although sequencing required slightly higher cognitive organization, the learners still demonstrated this skill at a high level. The findings imply that the kindergarten learners had already developed essential pre-mathematical competencies needed for more advanced numeracy learning, as foundational skills such as identifying shapes and colors, sorting, classifying, comparing, and arranging objects are important because they prepare learners for counting, number recognition, patterning, measurement, and simple problem-solving. Early mathematical skill development is strengthened when young learners are exposed to meaningful and contextual learning activities that allow them to explore mathematical ideas through concrete experiences, and the expert-level performance of the learners in foundational skills suggests that they had strong readiness for higher numeracy tasks and that classroom learning experiences, including the use of educational games, may have supported the development of these early mathematical competencies. The result implies that the kindergarten learners possessed a solid foundation upon which more complex numeracy instruction can be built; since learners already demonstrated expertise in identifying, sorting, comparing, and arranging objects, teachers may now focus on progressively introducing more advanced skills such as number operations, simple addition and subtraction, pattern extension, and early measurement concepts. Educational games that build on these foundational skills, such as counting games using sorted objects, comparing quantities through card games, or arranging numbered blocks in sequence, can effectively bridge learners from concrete classification and comparison tasks to symbolic number understanding, and teachers should continue to reinforce foundational skills through play-based activities while systematically scaffolding learners toward higher-order numeracy competencies. This interpretation, that foundational pre-mathematical competencies such as sorting, comparing, and arranging prepare learners for advanced numeracy learning, is supported by Maghfirah et al. (2025), who found that meaningful and contextual learning

activities allowing concrete exploration of mathematical ideas strengthen early mathematical skill development, and by Elfiky (2021), who demonstrated that early development of number competencies and arithmetic readiness supports children's later academic performance and mathematical fluency, particularly when foundational skills are firmly established before progressing to symbolic operations and problem-solving tasks.

In terms of patterns, time, and measurement, the data showed an aggregate mean of 3.24 with an aggregate standard deviation of 0.82, verbally described as "Advanced," indicating that the learners frequently demonstrated the skills under this domain with minimal prompting. Among the indicators, "Recognized and completed patterns" obtained the highest weighted mean of 3.46 and was verbally described as "Expert," and "Named days of the week and months" obtained a weighted mean of 3.34 and was also rated "Expert"; however, "Identified time of day and told time by the hour" obtained a weighted mean of 3.11, while "Used simple tools to measure" obtained the lowest weighted mean of 3.04, both verbally described as "Advanced." The findings imply that patterns, time, and measurement needed further reinforcement through more focused and developmentally appropriate activities, as although learners performed at the "Expert" level in pattern recognition and calendar concepts, their skills in time-telling and measurement were comparatively lower, falling only at the "Advanced" level. Time-telling and measurement skills may require more concrete experiences because these concepts involve sequencing, comparison, estimation, and the use of tools, which are more abstract and less intuitive than pattern completion or rote memorization of days and months; the use of educational games that involve clocks, calendars, measuring tools, pattern blocks, and classroom objects may help strengthen this domain, particularly the lower-rated skills in time-telling and measurement. The result implies that teachers should prioritize the development of targeted, hands-on educational games specifically designed to improve time-telling and measurement skills among kindergarten learners; since learners already demonstrated strong performance in patterns and calendar concepts, instructional time can be reallocated to address the relative weaknesses in using measurement tools and telling time by the hour. Teachers may incorporate daily routines such as checking the classroom clock during transitions, measuring classroom objects using non-standard units like paper clips or blocks, and using sand timers or stopwatches in game-based activities, as these concrete, repetitive, and playful experiences can help bridge the gap between the "Advanced" and "Expert" levels in this domain, while teachers should continue reinforcing patterns and calendar skills through games to maintain the high performance already observed. This interpretation, that intentional, developmentally appropriate interventions support kindergarten learners' mathematical progress, particularly in abstract domains like time and measurement, is supported by Darnon and Fayol (2021), who found that early mathematical interventions are most effective when instruction is systematic and suited to children's developmental level, and by Muhtarom et al. (2022), who demonstrated that educational games help improve numeracy skills by transforming abstract mathematical concepts such as time and measurement into concrete, hands-on, and engaging learning experiences that allow young learners to explore, estimate, compare, and apply these ideas meaningfully in classroom contexts.

In terms of number sense and operations, which are essential components of early mathematical development, the data showed an aggregate mean of 3.69 with an aggregate standard deviation of 0.55, verbally described as "Expert," indicating that the learners consistently demonstrated strong number-related skills. Among the indicators, "Counted and recognized numbers from 0 to 10" obtained the highest weighted mean of 3.82, while "Matched numbers to objects" and "Ordered numbers and identified the position" both obtained weighted means of 3.80, and the lowest indicator was "Solved simple addition and subtraction using

objects," with a weighted mean of 3.34, although still rated "Expert," suggesting that while learners were competent in simple operations, this skill was relatively more challenging than recognizing, matching, and ordering numbers. The findings imply that the learners had developed a strong foundation in number sense and were capable of handling simple operations using concrete materials, as number sense and operations are essential in early mathematics because they support counting, quantity recognition, comparison, sequencing, and problem-solving; the expert-level performance in counting, number recognition, matching, and ordering indicates that learners have mastered the prerequisite skills for more advanced numerical understanding, while the lower score in simple addition and subtraction using objects, though still at the expert level, suggests that operations involving quantitative change or combination may require additional concrete practice and reinforcement compared to static number recognition and matching tasks. The result implies that teachers should continue to strengthen number sense through educational games while providing more targeted support for simple addition and subtraction using objects; since learners already demonstrated expertise in counting, recognizing, matching, and ordering numbers up to 10, instructional activities can now gradually introduce larger number ranges, such as 11–20, and more varied operation tasks. For addition and subtraction, teachers may design games that involve combining groups of objects, taking away items from a set, and using number lines or ten frames within playful contexts, such as "object addition race," "subtraction bowling," or "feed the monster" using counters, which can make operations more concrete and enjoyable, and regular practice with manipulatives during game-based activities can help raise addition and subtraction skills closer to the level of counting and number recognition. This interpretation, that digital and game-based learning supports number sense and operations by making mathematical concepts interactive and accessible, is supported by Buray and Alferez (2025), who found that digital game-based learning contributes to numeracy skills by helping young learners understand mathematical concepts through engaging, hands-on activities, and by Jarrah et al. (2022), who demonstrated that game-based learning makes mathematical ideas more accessible and meaningful, particularly when learners are allowed to actively explore and practice concepts such as counting, matching, ordering, and simple operations within developmentally appropriate, play-based contexts.

In terms of applied numeracy, which reflects learners' ability to use basic mathematical concepts in simple and familiar situations, the data showed an aggregate mean of 3.52 with an aggregate standard deviation of 0.76, verbally described as "Expert," indicating that the learners consistently demonstrated the ability to apply numeracy skills in simple and familiar situations. Among the indicators, "Recognized coins and bills up to ₱20" obtained the highest weighted mean of 3.71, followed by "Grouped objects into equal sets," which obtained a weighted mean of 3.56, while the lowest indicator was "Identified simple fractions, particularly half," with a weighted mean of 3.28; although this was still rated "Expert," it showed that fraction concepts were relatively more difficult compared with recognizing money and grouping objects. The findings imply that the learners had developed strong applied numeracy skills and were able to connect mathematical concepts to practical situations such as recognizing money and grouping objects into equal sets, as applied numeracy is important because it helps young learners use mathematical ideas in real-life contexts, including sharing objects, grouping items, making purchases, and understanding basic economic transactions. The relatively lower performance in identifying simple fractions, particularly half, suggests that fraction concepts may be more abstract for kindergarten learners compared to money recognition and equal grouping, as fractions require understanding of part-whole relationships, equivalence, and division of continuous or discrete quantities, which are cognitively more demanding. The result implies that teachers should reinforce applied numeracy skills through real-world, play-based activities, with particular attention to improving learners' understanding

of simple fractions such as one-half; since learners already demonstrated expertise in recognizing coins and bills up to ₱20, teachers can integrate classroom "pretend play" stores or market activities where learners use play money to buy and sell items, reinforcing both money recognition and simple transactions. For fractions, teachers may design educational games involving sharing snacks, cutting play dough or paper shapes into equal parts, and using fraction puzzles or dominoes that visually represent halves, as these concrete, hands-on experiences can help bridge the gap between money and grouping skills and fraction understanding; additionally, teachers can encourage parents to involve children in simple home activities such as sharing food equally among family members or identifying coins during grocery shopping to strengthen applied numeracy in everyday contexts. This interpretation, that meaningful early numeracy activities support mathematical development and that applied numeracy connects classroom learning to real-life contexts, is supported by Balala et al. (2021), who found that early numeracy activities are positively associated with young learners' mathematical engagement and achievement when experiences are meaningful and contextualized, and by Al-Hassan et al. (2025), who demonstrated that digital and play-based game learning enhances early childhood mathematics by providing interactive, structured experiences that help children apply mathematical concepts such as money recognition, equal grouping, and simple fractions in familiar, practical, and developmentally appropriate situations.

Across the four identified components, the level of numeracy skills of kindergarten learners obtained a grand mean of 3.55 with a grand standard deviation of 0.63, verbally described as "Expert," indicating that the learners generally demonstrated a high level of numeracy skills. Among the four components, foundational skills obtained the highest mean of 3.76, followed by number sense and operations with a mean of 3.69; applied numeracy obtained a mean of 3.52, while patterns, time, and measurement obtained the lowest mean of 3.24 and was verbally described as "Advanced." Although the learners generally performed at an expert level, the results showed that patterns, time, and measurement remained the domain that needed the most reinforcement. The findings imply that the learners had strong overall numeracy development, particularly in foundational skills, number sense, operations, and applied numeracy; however, the lower rating in patterns, time, and measurement, which fell at the "Advanced" level rather than "Expert," suggested the need for more targeted game-based activities in this area. This pattern indicates that while learners are proficient in concrete, perceptually obvious skills such as identifying shapes, counting, and recognizing money, they face greater difficulty with more abstract, sequential, or tool-dependent concepts such as identifying patterns across time, reading clocks, and using measurement instruments, and the disparity between the highest domain, foundational skills at 3.76, and the lowest domain, patterns, time, and measurement at 3.24, represents a notable gap that warrants instructional attention. The result implies that the proposed intervention plan should prioritize the patterns, time, and measurement domain while maintaining the already strong performance in the other three components. Teachers may design and implement a series of targeted educational games specifically focused on completing and extending patterns, telling time by the hour, using non-standard measurement tools, and sequencing daily events; for example, pattern-making games using colored blocks or natural objects, "daily schedule" sequencing activities, classroom clock matching games, and measurement scavenger hunts using paper clips or unifix cubes can address the specific weaknesses identified in this domain. The overall expert rating affirms the potential of educational games as flexible and engaging instructional tools; therefore, the proposed intervention should leverage game-based strategies that have already proven effective in other domains and apply them systematically to patterns, time, and measurement, with pre-

and post-assessments targeting only this domain used to evaluate the effectiveness of the proposed intervention plan. This interpretation, that structured, intentional math games support mathematical development and that reduced cognitive load enhances concept understanding, is supported by DePascale and Ramani (2025), who found that math games in early childhood are most effective when they are structured, intentional, and directly connected to specific learning goals such as pattern completion and measurement concepts, and by Es-Sajjade and Paas (2020), who demonstrated that instructional design minimizing unnecessary cognitive load while supporting meaningful, hands-on learning experiences improves young learners' understanding of abstract mathematical concepts, including time sequencing and spatial measurement, which are often more challenging than foundational counting or shape recognition tasks.

Relationship between the identified profile and the numeracy skills of the learners

The relationship between the identified profile variables and the numeracy skills of the learners was tested to examine whether the learners' gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income were significantly associated with their numeracy skills, and the results served as the basis for determining whether the null hypothesis was accepted or rejected. The chi-square test of independence showed that all profile variables obtained p-values greater than the .05 level of significance. Specifically, gender was not significantly related to numeracy skills, $\chi^2 (2, N = 100) = 5.18, p = .075$. Mother's highest educational attainment was also not significantly related to numeracy skills, $\chi^2 (4, N = 100) = 7.27, p = .122$. Similarly, father's highest educational attainment was not significantly related to numeracy skills, $\chi^2 (4, N = 100) = 3.06, p = .548$. Number of siblings, $\chi^2 (4, N = 100) = 6.80, p = .147$; birth order, $\chi^2 (8, N = 100) = 14.77, p = .064$; and combined monthly income, $\chi^2 (6, N = 100) = 6.78, p = .342$, were likewise not significantly related to numeracy skills. Since all p-values were greater than .05, the null hypothesis was not rejected in all cases. The findings indicate that there was no significant relationship between the identified learner profile variables, namely gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly income, and the numeracy skills of the kindergarten learners, meaning that these demographic and family-related factors were not significantly associated with the learners' numeracy performance in this study. The result implies that the learners' numeracy skills may have been more strongly influenced by classroom instruction, learning activities, and the implementation of educational games than by the selected background variables; in other words, regardless of a learner's gender, family size, birth order, parental education level, or household income, their numeracy performance was relatively consistent, suggesting that the instructional environment played a more powerful role than demographic characteristics. The result implies that teachers and school administrators should focus on improving classroom instruction, teacher competence, and the quality of educational games rather than attributing differences in numeracy performance to learners' demographic backgrounds. Since profile variables were not significantly related to numeracy skills, the study suggests that well-designed, developmentally appropriate, and consistently implemented game-based numeracy instruction can benefit all learners regardless of their gender, family structure, or socioeconomic status, a finding that supports the equitable potential of educational games as an instructional strategy. Schools may therefore invest in teacher training on game-based pedagogy, the development of low-cost and locally available game materials, and the integration of educational games into daily numeracy lessons without concerns that certain learner subgroups are inherently disadvantaged, and the proposed intervention plan for improving numeracy skills through educational games can be implemented across all learner subgroups with the expectation of comparable benefits. This

interpretation, that the effectiveness of educational games depends more on game design, instructional purpose, and implementation quality than on learner demographic characteristics, is supported by Gui et al. (2023), who found that digital educational game effectiveness is primarily determined by game design features, alignment with instructional objectives, and the quality of implementation rather than by learner background variables, and by Fitriyah et al. (2025), who demonstrated that moderators such as learner engagement, instructional design, and learning context significantly influence digital game effectiveness, suggesting that well-implemented game-based instruction can produce positive learning outcomes across diverse learner populations regardless of gender, socioeconomic status, or family background.

Taken together, the findings of this study show that the seven kindergarten teacher-respondents at Naga Central Elementary School were predominantly female, concentrated in the 26–35 age range, possessed at least baccalaureate qualifications with several pursuing graduate studies, had generally accumulated 5–6 years of teaching experience, and had all attended EdTech trainings (100.00%), establishing a teaching force that was both experienced and professionally prepared to facilitate game-based numeracy instruction. The 100 kindergarten learner-respondents, uniformly six years old, were predominantly female (57.00%), came mostly from families with high-school-educated parents, modest sibling counts, and a combined monthly income concentrated within the ₱10,001–₱15,000 bracket, conditions that reinforced rather than constrained the school's central role in numeracy development. Teachers were found to utilize educational games to a high extent, with an aggregate mean of 4.27 (SD = 0.64, "Always"), favoring concrete and movement-based activities such as songs and dance, role-playing, block building, and card matching over digital tools such as mathematics mobile applications, which obtained the lowest weighted mean of 3.00 ("Sometimes"). Correspondingly, the learners demonstrated an overall "Expert" level of numeracy skills, with a grand mean of 3.55 (SD = 0.63), performing strongest in foundational skills (M = 3.76) and number sense and operations (M = 3.69), followed by applied numeracy (M = 3.52), while patterns, time, and measurement (M = 3.24, "Advanced") emerged as the domain most in need of reinforcement. The chi-square test of independence further revealed that none of the learners' profile variables, gender, parents' educational attainment, number of siblings, birth order, or combined monthly income, were significantly related to their numeracy skills (all $p > .05$), indicating that instructional factors, particularly the consistent and extensive use of educational games, rather than demographic background, more plausibly accounted for the learners' strong numeracy performance. Collectively, these results directly address the study's objectives by establishing that a well-qualified, EdTech-trained teaching force, through the frequent use of concrete and play-based educational games, can foster expert-level numeracy outcomes among kindergarten learners regardless of their family or socioeconomic background, while also identifying patterns, time, and measurement as a specific area requiring targeted, game-based reinforcement. These findings contribute to the early childhood education literature by reaffirming the equitable, instruction-driven potential of game-based pedagogy in numeracy development and by providing an empirical, data-grounded basis for the intervention plan to be presented in the succeeding chapter, which is designed to strengthen existing game-based practices, particularly in the domain of patterns, time, and measurement, and to sustain the gains already evident in foundational skills, number sense and operations, and applied numeracy.

CONCLUSION

The findings of this study directly affect my professional practice as a kindergarten teacher and future early childhood educator by reinforcing that intentional, play-based instruction through educational games is not merely an enrichment activity but a core pedagogical strategy for developing numeracy skills. Teachers must practice on improving classroom instruction, game design, and facilitation quality to ensure equitable numeracy outcomes for all children. The identification of patterns, time, and measurement as the lowest-performing domain guides me to intentionally redesign my daily lessons to include more concrete, repetitive, and playful experiences such as calendar routines, clock matching games, sequencing activities, and non-standard measurement tasks using classroom objects. For program development, the results justify the creation and implementation of the PLAYMATH Intervention Plan, which provides a structured yet flexible framework for reinforcing least-mastered competencies, integrating low-cost and locally available game materials, and bridging school-based and home-based numeracy experiences through parent involvement activities. At the policy implementation level, this study provides empirical evidence supporting DepEd's Kindergarten Education Act (RA 10157) and the Basic Education Development Plan 2030, demonstrating that developmentally appropriate, game-based numeracy instruction can effectively serve diverse learners regardless of socioeconomic background. Therefore, I recommend that school administrators allocate resources for teacher training on game-based pedagogy, particularly in teaching patterns, time, and measurement; establish a shared repository of low-cost numeracy game materials; and create structured opportunities for parent orientation on simple home-based educational games, ensuring that numeracy development becomes a shared responsibility between the school and the home.

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