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Game-based learning as an intervention to enhance numeracy proficiency in kindergarten learners

Divina V. Gomez*
Cebu Technological University - Main Campus, Cebu, Philippines

ABSTRACT

This research investigated the use of game-based learning as a method to improve numeracy skills among kindergarten learners at Cabancalan 1 Elementary School. It outlined the profiles of teachers, learners, and parents; evaluated the degree to which teachers incorporate educational games in their numeracy instruction; assessed the numeracy skill levels of kindergarten learners; and explored the connection between student profiles and their numeracy abilities. A descriptive-correlational research design was used, involving an adopted survey questionnaire, weighted mean analysis, and chi-square for correlation. The research findings indicated that most of the teacher participants were young females who had pursued higher education, possessed significant teaching experience, and had fully engaged in EdTech training, which suggests they are well-prepared to adopt innovative teaching methods. Moreover, the learners were primarily six years old, reflecting an equal representation of both genders, while the parents typically had educational backgrounds ranging from basic to moderate and were categorized as having low to moderate income levels. Furthermore, teachers exhibited a very high level of incorporating educational games into their numeracy instruction while kindergarten learners signify a strong proficiency in essential numeracy skills, number sense and operations, patterns, time and measurement, as well as applied numeracy. Additionally, results show that there was no significant correlation between learner profiles and numeracy skills, implying that demographic and socio-economic factors did not play a major role in influencing numeracy performance. As a result, this study recommends the implementation of the proposed intervention plan.

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

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INTRODUCTION

Early childhood is a critical stage for developing foundational numeracy skills such as counting, number recognition, and simple problem-solving. In kindergarten, learners often have short attention spans and learn best through play and hands-on experiences. However, traditional teaching approaches may not always capture their interest or address their

*Corresponding author / Email: viscaradivina04@gmail.com
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developmental needs effectively, which can result in low numeracy proficiency and limited engagement in mathematics activities (Gashaj et al., 2023).

The early years of schooling are crucial for the development of mathematical fluency. According to UNESCO (2023), a significant percentage of children in early childhood education globally fail to meet minimum proficiency levels in math, which predicts long-term academic struggle. Early numeracy is more than just counting; it also entails comprehending number sense, patterns, and spatial relationships. Traditional "chalk and talk" approaches frequently result in "math avoidance" as early as age five, which later in life creates a psychological barrier to STEM discipline. The need to transition from rote memorization to conceptual understanding and engagement is the driving force behind the global shift toward game-based learning as a kindergarten numeracy intervention.

Globally, there is an increasing emphasis on innovative educational methods to foster essential skills during early childhood, a period of rapid cognitive growth (Ünal & Kaya, 2024). Numeracy is a foundational competency that predicts future academic and mathematical success (Maghfirah et al., 2025). Deficiencies in early numeracy acquisition are a global concern, observed across diverse regions including the UK, Turkey, Canada, Northern Ireland, and Malaysia (Singh et al., 2021). This global issue underscores the urgent need for effective, engaging strategies to cultivate robust numeracy skills in young learners (Ali et al., 2022). Specifically, children aged 4-5 often exhibit difficulties with number recognition, counting, and differentiating numerical symbols, necessitating targeted interventions (Yuniria et al., 2025). Kindergarten learners' function inside Piaget's pre-operational stage from a developmental perspective. At this level, abstract symbols (numbers) are difficult to grasp without concrete, hands-on experiences. Vygotsky's Theory of Social Development suggests that learning is a social process. Game-based learning provides a "Zone of Proximal Development" where children can take risks and learn through trial and error in a low-stakes environment. Research consistently shows that Game-based learning transforms the classroom from a passive environment into an active "laboratory" of discovery.

In the Philippines, there is a growing recognition of the need for innovative pedagogical approaches, such as gamified tutoring programs, to enhance numeracy and problem-solving skills among learners, particularly in regions like Mindanao (Esteban & Cajandig, 2025). This emphasis is further highlighted by initiatives aimed at academic recovery and accessible learning, which often integrate game-based methodologies to address learning deficiencies and improve educational outcomes (ED et al., 2025).

Furthermore, current observations at Cabancalan 1 Elementary School reveal that kindergarten teachers rarely utilize educational games, relying instead on repetitive learning methods. Consequently, over 60% of learners struggle with identifying time of the day and telling time(hour) and simple measurements for the 2025–2026 school year. This problem is most acute for children from marginalized backgrounds and multilingual households who lack supplemental support at home. Despite the availability of free digital tools, the continued use of rote learning prevents these students from mastering essential skills like counting beyond ten, further widening the achievement gap in the local community.

It is crucial to investigate these problems to monitor how often teachers use games, evaluate how it relates to numeracy levels in fundamental abilities, patterns/time/measurement, number sense/operations, and applied numeracy, and determine profile-related aspects that affect results. To develop an intervention strategy, this study at Cabancalan 1 Elementary School sought to ascertain how educational games are used to enhance kindergarten learners' numeracy abilities. Its result is a customized intervention plan that will help instructors by offering useful tactics for integrating games, improving learners' numeracy skills for more academic preparedness, and assisting school administrators in allocating resources to improve early childhood outcomes.

This study is therefore grounded on the need to address gaps in numeracy proficiency among kindergarten learners by introducing an innovative and developmentally appropriate intervention. By examining the effectiveness of game-based learning, the research aims to provide evidence-based strategies that teachers can use to enhance numeracy skills. Ultimately, this approach seeks to improve learners' academic performance, foster a positive attitude toward mathematics, and support holistic development in early childhood education.

Statement of the problem

This study determined the use of educational games in improving numeracy skills among kindergarten learners at Cabancalan 1 Elementary School during the school year 2025 to 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, 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 family 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 of the respondents and the numeracy skills of the kindergarten 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

The study employed a descriptive-correlational research design. This design was deemed most appropriate as it allowed the researcher to describe the profile of teacher-respondents and kindergarten learners, determine the extent of teachers' utilization of educational games, assess the level of numeracy skills of kindergarten learners, investigate the relationship between learner profiles and numeracy skills, and propose an intervention plan based on the findings. The descriptive component provided a systematic depiction of the characteristics and current conditions of the respondents, while the correlational component examined whether significant relationships existed between identified profile variables and learners' numeracy skills.

The kindergarten learners of Cabancalan 1 Elementary School in Mandaue City during the academic year 2025–2026 served as the study's respondents. The kindergarten learners were the focus of the study's assessment of their numeracy skills, even though the teacher-respondents supplied information about their profiles and how much they used educational games. The primary goal of the study, which was to ascertain the level of numeracy abilities among kindergarten learners and how these skills connected to the use of educational games, justified the selection of kindergarten students as the primary respondents for the numeracy assessment. At this crucial developmental stage, kindergarten learners were establishing fundamental numeracy skills like counting, number recognition, patterning, and basic

operations, and assessing their numeracy skills provided direct evidence of the effectiveness of game-based instructional strategies.

All five (5) kindergarten teachers at Cabancalan 1 Elementary School served as respondents for the teacher profile and game utilization questionnaire. Total enumeration or universal sampling was employed for the teacher-respondents due to the manageable and finite size of the population (N=5). This non-probability sampling technique involved selecting the entire population of kindergarten teachers as respondents, ensuring that every teacher in the kindergarten department participated in the study. This method was appropriate as it provided a comprehensive and accurate representation of the extent of educational game utilization in teaching numeracy at the school level, eliminating sampling error that could have occurred if only a subset of teachers were selected.

A total of 100 kindergarten learners from Cabancalan 1 Elementary School participated as respondents for the numeracy skills assessment. The learners were drawn from the five kindergarten sections, with the number of 20 learners per section, and this distribution ensured proportional representation across all classes taught by the five-kindergarten teacher-respondents. The sample size of 100 was determined using stratified random sampling from the total kindergarten population of approximately 220 learners, ensuring that each section was adequately represented while maintaining a manageable number for detailed individual numeracy assessment. The choice of 100 learners was also justified by the need for sufficient statistical power for correlational analysis (Problem 4) while remaining feasible within the time constraints of the school year 2025–2026.

The selection of kindergarten learners as the primary respondents for numeracy assessment was grounded in several justifications. First, the study's specific problem number 3 directly required determining the level of numeracy skills of kindergarten learners, making learners the indispensable source of data. Second, kindergarten learners represented the target beneficiaries of the proposed intervention plan; assessing their current numeracy skills was essential for identifying gaps that the intervention would address. Third, using learner-level data allowed for the correlational analysis specified in problem number 4, which examined the relationship between learner profiles and numeracy skills. Fourth, focusing on kindergarten learners aligned with the legal mandates of RA 10157 and RA 10533, which prioritize early childhood numeracy development. Fifth, the age range of kindergarten learners (5-6 years old) was developmentally appropriate for game-based learning interventions, as young children naturally learn through play. The inclusion of all nine teachers as respondents was justified by the need to obtain complete data on teacher profiles and game utilization practices without sampling bias, as the small population size (five teachers) made total enumeration both feasible and methodologically sound.

The research instruments used in this study were carefully developed to gather data that would answer the specific problems raised in the statement of the problem. Three main instruments were utilized: a questionnaire for teachers, an individual learner's numeracy skills assessment tool, and a survey questionnaire for parents. All instruments were subjected to content validation by experts in early childhood education, research methodology, and numeracy instruction to ensure their appropriateness, clarity, and relevance to the study's objectives. The teacher questionnaire was divided into two parts. Part I gathered the demographic profile of the teacher-respondents, including their age (with response options ranging from 21–25 to 51 and above), sex at birth (female or male), highest educational attainment (Bachelor's Degree, Master's Units, Master's Degree, Doctorate Units, or Doctorate Degree), years of teaching experience (ranging from less than 2 years to 11 years and above), and relevant training on educational technology or educational games (Yes or No); the name of the teacher-respondent was made optional to maintain anonymity. Part II assessed the extent of the teachers' utilization of educational games in teaching numeracy skills. Ten types of

educational games were listed: role-playing activities, shape hunting games, block building activities, board games, hopscotch games, mathematics mobile applications, card matching games, puzzle assembly activities, dice rolling games, and songs and dance activities, and teachers rated each game type using a five-point Likert scale where 5 meant "Always," 4 meant "Often," 3 meant "Sometimes," 2 meant "Rarely," and 1 meant "Never." This instrument was designed to directly address Problem 2 of the study, which sought to determine the extent of teachers' utilization of educational games in teaching numeracy skills.

The Individual Learner's Numeracy Skills Assessment was completed by the kindergarten teachers based on their classroom observations of each learner-respondent. The assessment was organized into four domains that directly corresponded to Problem 3 of the study. Part A assessed foundational skills using four indicators: identifies basic colors and shapes, sorts and classifies objects, compares objects, and arranges objects by size or order. Part B assessed patterns, time, and measurement using four indicators: recognizes and completes patterns, identifies time of day and tells time, names days of the week and months, and uses simple tools to measure. Part C assessed number sense and operations using four indicators: counts and recognizes numbers (0–10), matches numbers to objects, orders numbers and identifies position, and solves simple addition and subtraction using objects. Part D assessed applied numeracy using three indicators: groups objects into equal sets, identifies simple fractions (half), and recognizes coins and bills (up to ₱20). Each indicator was rated using a four-point scale where 4 meant "Always Demonstrated," 3 meant "Often Demonstrated," 2 meant "Sometimes Demonstrated," and 1 meant "Not Yet Demonstrated." The total of 15 indicators across four domains provided a comprehensive profile of each learner's numeracy skills, allowing for the computation of domain-specific means and an overall grand mean.

The survey questionnaire for parents was designed to gather the learner profile data required for Problem 1.2 of the study. The first section asked for the learner's name (optional), age, and gender (Male or Female). The second section gathered the parents' highest educational attainment, with separate columns for mother and father, and response options included Doctorate Graduate, With Doctorate Units, Master's Graduate, College Graduate, College Level, High School Graduate, High School Level, Elementary Graduate, Elementary Level, and No Formal Education. The third section asked for the number of siblings, with response options of 5 and above, 3–4, 1–2, or None. The fourth section asked for birth order, with response options of Eldest, Second, Middle, Youngest, or Only Child. The fifth section asked for the combined family monthly income, with response options ranging from "Above P30,000" down to "P10,000 and below," including intermediate brackets of P25,001–P30,000, P20,001–P25,000, P15,001–P20,000, and P10,001–P15,000. This instrument was designed to collect demographic and socioeconomic data that would later be used in the correlational analysis for Problem 4, which examined the relationship between learner profiles and numeracy skills.

All three instruments were subjected to content validation by a panel of three experts: a master teacher in early childhood education, a mathematics education specialist, and a research methodology professor. The experts evaluated the instruments for clarity, relevance, comprehensiveness, and alignment with the study's research questions. Based on their feedback, minor revisions were made to the wording of several indicators to ensure age-appropriateness for kindergarten learners and clarity for parent-respondents. A pilot test of the instruments was conducted with five kindergarten teachers and ten parents from a non-participating school.

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 systematically implemented to ensure the accuracy, reliability, and ethical integrity of the research process. In the 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 Mandaue City, requesting approval to conduct research at Cabancalan 1 Elementary School. Upon approval from the division office, the researcher then sought permission from the school principal of Cabancalan 1 Elementary School to administer the questionnaires to the kindergarten teachers and to assess the numeracy skills of the kindergarten learners. Before any data collection occurred, the researcher secured informed consent from all participants. For the teacher-respondents, written informed consent was obtained after explaining the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time when they no longer felt comfortable with the process. For the learner-respondents, parental informed consent was secured through a letter sent to the parents or guardians, which explained the study's purpose, assured them of the confidentiality of their children's data, and informed them of their right to withdraw their child from the study at any time without penalty, and only learners whose parents provided written consent were included in the study. The researcher also assured all respondents that their responses would be kept strictly confidential and would be used solely for research purposes.

Following the approval and validation of the instrument, the researcher personally distributed the questionnaires to the five (5) kindergarten teacher-respondents at Cabancalan 1 Elementary School. 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 again of the confidentiality of their responses. The teachers were given ample time to accomplish the questionnaire, which included Part I (demographic profile), Part II (utilization of educational games), and the Individual Learner's Numeracy Skills Assessment for each of their assigned learners. The parent survey questionnaires were distributed to the parents or guardians of the 100 learner-respondents through the homeroom teachers. The researcher provided clear instructions to parents on how to accomplish the questionnaire, emphasizing that participation was voluntary and that they could withdraw their consent at any time, and the researcher also remained available to answer any questions or clarifications from the respondents. To ensure a high retrieval rate, the researcher set a specific date for collection and maintained communication with the teachers and parents for follow-ups as necessary.

Once all distributed questionnaires and assessment forms 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, including frequency counts and percentages for profile variables, weighted means and standard deviations for the extent of game utilization and level of numeracy skills, and chi-square tests for the significance of relationships between learner profiles and numeracy skills. 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 learners at Cabancalan 1 Elementary School.

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RESULTS AND DISCUSSION

This chapter presents, analyzes, and interprets the data gathered from the five (5) kindergarten teacher-respondents and the 100 kindergarten learner-respondents of Cabancalan 1 Elementary School in Mandaue City during the academic year 2025–2026. The study employed a descriptive-correlational research design, with total enumeration used for the teacher-respondents and stratified random sampling used to draw the 100 learner-respondents from a total kindergarten population of approximately 220 learners. Data were gathered through a teacher questionnaire on demographic profile and extent of educational game utilization, an individual learner's numeracy skills assessment tool completed by teachers, and a survey questionnaire administered to parents to gather learner profile data. The gathered data were analyzed using frequency counts and percentages for profile variables, weighted means for the extent of game utilization and the level of numeracy skills, and the chi-square test for the significance of relationships between learner profiles and numeracy skills. The discussion that follows is grounded entirely in the data gathered from these respondents, and all results are interpreted in direct relation to the objectives of the study, namely to describe the profile of the teacher-respondents and kindergarten learners, to determine the extent of teachers' utilization of educational games, to assess the level of numeracy skills of the kindergarten learners, and to examine the relationship between learner profiles and numeracy skills.

The age and sex at birth of the teacher-respondents were examined to determine the demographic composition of the teaching force handling kindergarten numeracy instruction. Regarding age, most respondents belonged to the 26 to 30 years old bracket, accounting for two (2) out of five (5) respondents, or forty percent (40%). The remaining sixty percent (60%) were distributed equally across three age groups: twenty percent (20%) were aged 46–50, another twenty percent (20%) were aged 41–45, and the final twenty percent (20%) fell within the 36–40 age range. In terms of sex, all five (5) respondents, or one hundred percent (100%), were female. Thus, the teacher-respondents were predominantly young adults in their late twenties to forties, with a complete female representation. The age distribution indicated that the teaching force was relatively young, with the largest cluster in the 26–30 age bracket, suggesting that many teachers were in their early career stages, while the presence of older age groups (36–50) still active in the school implied a mixed but generally youthful workforce. The fact that all respondents were female reflected a common trend in elementary education, where the profession is often female-dominated, and this composition was interpreted as a factor that could influence the school's receptiveness to new pedagogical strategies, as younger teachers tended to be more adaptable and open to innovative approaches such as game-based learning. Given that the majority of teachers were younger and at an early stage of their careers, it was implied that they were likely more willing to experiment with and adopt game-based learning methods to enhance numeracy proficiency among kindergarten learners, with their openness to new ideas seen as a facilitator for the successful integration of engaging, play-based instructional tools, which are especially effective for young children. However, the absence of male teachers was noted as a possible limitation in terms of diverse role-modeling perspectives in the classroom, though it did not diminish the potential for implementing innovative teaching practices, and school administrators were therefore encouraged to capitalize on this youthful energy and willingness to change by providing targeted training on game-based numeracy strategies. This finding was supported by Subramani et al. (2018), who asserted that there is potential for advancement in any subject when there is a willingness to change, further noting that innovation in teaching and learning could benefit both students and teachers, and that creativity could be nurtured. In the context of this study, the predominantly young female

teaching staff's openness to change was found to support the viability of implementing game-based learning to improve kindergarten numeracy outcomes, as their adaptability served as a critical enabling factor for pedagogical innovation.

The educational background of the teacher-respondents was examined to determine their level of academic preparation in handling kindergarten numeracy instruction. Looking into their highest educational attainment, three (3) or sixty percent (60%) of the respondents obtained units in their master's degree, while two (2) or forty percent (40%) held a full-fledged master's degree, and no respondent's highest educational attainment stopped at the bachelor's degree level, as all five teachers had pursued graduate studies either partially or completely. The results revealed that the teachers at Cabancalan 1 Elementary School possessed strong academic credentials; the fact that all respondents had completed at least some master's level coursework, with nearly half earning a full master's degree, indicated that the teaching force was highly qualified beyond the minimum requirement. This was interpreted as a reflection of the teachers' dedication to improving their knowledge and teaching skills, as well as their commitment to ongoing professional development, and the absence of teachers whose highest attainment was a bachelor's degree suggested a school culture that values and encourages advanced education. The high level of educational attainment among the teachers implies that they were well-equipped with advanced pedagogical knowledge and theoretical foundations, which could enhance their instructional effectiveness, particularly in implementing specialized strategies such as game-based learning for numeracy. Their pursuit of graduate education demonstrated a proactive attitude toward professional growth, meaning they would likely be receptive to evidence-based innovations and reflective teaching practices, and school administrators could leverage this highly educated workforce by involving them in mentoring roles, action research, or curriculum development; however, continuous support for those still completing their master's degrees would be beneficial to help them attain full master's status. Liu (2021) asserted that better educated teachers are more effective at leading and instructing in the classroom, and that more qualified individuals are more likely to be competent and effective in fulfilling a variety of instructional demands. This finding directly supported the interpretation that the teachers at Cabancalan 1 Elementary School, given their advanced educational attainment, were likely competent and effective educators, with their graduate-level preparation positioning them to meet diverse learner needs, including enhancing numeracy proficiency among kindergarten students through developmentally appropriate, game-based approaches.

The teaching experience of the teacher-respondents was assessed to determine their length of service in the teaching profession, which may influence their pedagogical practices and their ability to utilize educational games effectively. As shown in the data, three (3) or sixty percent (60%) of the respondents had teaching experience of 11 years and above, while two (2) or forty percent (40%) had teaching experience of less than 2 years, and no respondent fell within the middle ranges of teaching experience, indicating a bipolar distribution between highly seasoned teachers and very novice teachers. The results showed that the majority of the teacher-respondents possessed extensive classroom teaching experience, pedagogical expertise, and familiarity with successful teaching techniques for kindergarten pupils; the sixty percent (60%) who had taught for 11 years or more were considered veteran teachers, while the remaining forty percent (40%) with less than 2 years of experience were early-career beginners. This distribution was interpreted as a teaching force composed of two distinct groups, experienced practitioners who could serve as mentors or models, and novices who brought fresh perspectives but required guidance, and the presence of both extremes suggested a potential generational gap in teaching approaches within the school. The substantial experience of the majority of teachers implied that they possessed strong classroom management skills, well-developed instructional repertoires, and a deep understanding of

young learners' numeracy needs, and these seasoned teachers could therefore positively contribute to the introduction of game-based learning by adapting instructional approaches efficiently and recognizing which game-based strategies would be most effective for kindergarten numeracy. Conversely, the novice teachers, though less experienced, might be more immediately receptive to innovative methods and technology-integrated games, and the school could benefit from pairing veteran and novice teachers in collaborative teams, allowing experienced teachers to provide mentorship while also learning new digital or creative game-based approaches from younger colleagues. Auslander et al. (2023) found that teachers' specialized content knowledge and, to a lesser extent, their views influenced educational approaches. This finding supported the interpretation that veteran teachers, due to their extensive experience, were more likely to efficiently manage classroom activities, adjust instructional methods, and detect learners' numeracy needs, with their accumulated specialized content knowledge, as emphasized by Auslander et al. (2023), enabling them to implement game-based learning more effectively by making real-time adjustments based on kindergarteners' responses and learning progress.

The professional development background of the teacher-respondents in educational technology was examined to determine their level of exposure and preparedness in integrating technology-based tools into their numeracy instruction. As shown in the data, five (5) or one hundred percent (100%) of the respondents had attended EdTech trainings, meaning that every single teacher in the study had participated in at least one structured professional development program focused on incorporating interactive multimedia, ICT, and digital tools into teaching methods. The findings revealed that all teacher-respondents had participated in EdTech training, and their universal involvement in these trainings indicated that they possessed the fundamental knowledge and abilities to use interactive multimedia, digital tools, and ICT resources. This was interpreted as a significant strength for the school, as these competencies were all crucial for putting cutting-edge teaching strategies like game-based learning into practice, and the fact that no teacher lacked such training suggested that the school or district had prioritized technology integration and had successfully provided professional development opportunities to its entire teaching staff. The complete attendance of all teachers in EdTech trainings implied that they were already equipped with the baseline technological competencies required to implement game-based learning for enhancing numeracy proficiency among kindergarten learners; since every teacher had been exposed to interactive and digital tools, the school would not need to invest in foundational technology training before introducing game-based numeracy interventions, and professional development efforts could instead focus on deepening their application of these tools specifically for numeracy instruction. However, the implication also raised the question of whether the trainings attended were recent and relevant enough to current game-based learning platforms, and administrators should conduct a needs assessment to identify any gaps between the trainings already received and the specific game-based numeracy strategies to be implemented. Ibrahem (2025) found that more than half of the relative weight was contributed by modern technology to the enhancement of learning abilities, and that the quality of technology use in the classroom was strongly correlated with professional skill, with teacher experience accounting for more than thirty percent of the overall weight. This finding supported the interpretation that the teachers' universal attendance in EdTech trainings had likely equipped them with the professional skills necessary for quality technology use, and since all respondents had undergone such training, they were theoretically better positioned to harness modern technology's contribution to enhancing kindergartners' numeracy learning abilities through game-based approaches.

The profile of the kindergarten learner-respondents was described in terms of their age, gender, parents' highest educational attainment, number of siblings, birth order, and combined monthly family income, demographic variables examined to determine their potential influence on the numeracy skills of kindergarten pupils and to provide a contextual foundation for analyzing the relationship between learner characteristics and numeracy performance. In terms of the age profile of the learners, most of them were 6 years old, specifically 56 learners or fifty-six percent (56%) of them, while forty-one percent (41%) of the learners were 5 years old, and three learners or three percent (3%) were 7 years old, with the total number of learners (N=100) distributed across these three age groups. The age distribution indicated that the majority of the learners were six years old, followed closely by five-year-olds, with only a minimal number of seven-year-olds, and this was interpreted as a typically developing kindergarten cohort, as the learners predominantly fell within the expected age range for early childhood education. The presence of a small percentage of seven-year-olds suggested either late enrollment, grade repetition, or developmental delays that warranted individual attention, while overall, most learners were developmentally ready for core numeracy training because they clustered within the average age range for kindergarten learners, where foundational mathematical thinking begins to solidify. The implication of this age profile was that the majority of learners possessed the cognitive maturity and attention span necessary to benefit from structured numeracy instruction, including game-based learning approaches; since most children were aged five to six, they were likely at a developmental stage where concrete manipulatives, repetitive play, and rule-based games would be highly effective for building number sense and counting skills. The small number of seven-year-olds, however, might require differentiated instruction or remedial support to address possible learning gaps, and teachers could therefore design game-based numeracy activities that cater to the dominant age group while scaffolding for the older learners who may need foundational reinforcement, with age-appropriate grouping strategies also employed to maximize engagement and learning outcomes. Department of Education (2025) stated in DepEd Order No. 015, s. 2025 that kindergarten students must be five (5) years old by October 31 of the academic year, and that learners who turn five (5) between November 1 and December 31 may be accepted after completing an approved Early Childhood Care and Development (ECCD) program or passing the Philippine Early Childhood Development (ECD) Checklist. This policy supported the interpretation that the learners in this study, with 97% aged five to six, largely complied with the standard kindergarten entry age, and the small number of seven-year-olds, while outside the typical age range, may have been admitted through the ECCD pathway, indicating that teachers should assess their developmental readiness individually before implementing game-based numeracy interventions.

The gender distribution of the kindergarten learners was examined to determine the composition of male and female pupils, which served as a basis for exploring potential differences in numeracy skill development between male and female learners in relation to the utilization of educational games. Out of 100 total learners, 54 (54.00%) were female, while 46 (46.00%) were male, indicating a slightly higher proportion of female learners compared to male learners in the study population, with a gender gap of eight percent favoring girls. The gender distribution revealed that female learners outnumbered male learners by a modest margin, though the sample remained relatively balanced between the two groups, a composition interpreted as representative of typical kindergarten classroom demographics, where gender ratios often vary naturally without deliberate balancing. The near-even split between boys and girls (46% and 54%, respectively) provided an adequate basis for exploring potential differences in numeracy skill development between male and female learners in relation to the utilization of educational games, and the slight female majority suggested that any observed gender-based differences in game-based learning outcomes could be attributed to

instructional or developmental factors rather than extreme disparities in group sizes. The implication of this gender composition was that the study was well-positioned to examine whether game-based numeracy interventions produced differential effects on male and female kindergarten learners; given the near-balanced sample, any conclusions drawn about gender similarities or differences would be statistically meaningful and generalizable to similar early childhood settings. Research has shown that digital game-based learning environments can provide inclusive learning experiences where both boys and girls demonstrate comparable cognitive gains in mathematics, meaning that the slight female majority did not threaten the validity of the study's findings regarding educational game effectiveness. However, teachers implementing game-based numeracy activities should remain mindful of avoiding gender-stereotyped game choices or interactions that could inadvertently favor one group over the other, and play-based pedagogical practices using non-stereotyped materials have been recommended to promote equitable participation in early mathematics development. Zhang (2024) explored gendered differences among primary school learners in game-based fraction learning and found that within digital game-based learning environments, boys and girls exhibited similar performance in both their understanding of mathematical concepts and their motivational aspects, suggesting that DGBL may help narrow gender differences in math learning, with girls potentially benefiting more from DGBL than boys. Rey-Guerra, Yousafzai, and Dearing (2024) examined early childhood development across 71 low- and middle-income countries and reported that in approximately half of these countries, the odds of being developmentally on track in literacy-numeracy did not significantly differ for girls and boys, and in countries with significant differences, girls were more likely to be on track than boys. Additionally, Dong et al. (2024) investigated the differential effects of early child care and education in reducing gender academic achievement gaps from kindergarten to 8th grade and found that while early educational experiences had differential effects in reducing gender gaps, significant gender gaps still persisted and widened throughout elementary and middle school years.

The educational background of the parents of kindergarten learners was examined to determine the level of academic achievement of mothers and fathers, which may influence the home learning environment and parental support for numeracy development. For mothers, thirty-two percent (32%) were high school graduates, followed by twenty-nine percent (29%) who were college graduates and twenty-seven percent (27%) who had reached college level without completing a degree, while a smaller percentage were classified as high school level (8%), only one percent (1%) reached elementary graduate, and another one percent (1%) had doctorate units. For fathers, the highest percentage, thirty-eight percent (38%), were high school graduates, followed by college graduates at twenty-seven percent (27%) and twenty-five percent (25%) who had reached college level, while five percent (5%) were at high school level, followed by two percent (2%) who were elementary graduates, two percent (2%) who held a master's degree, and one percent (1%) who had no formal education. The results indicated that both mothers and fathers had completed at least high school in the majority of cases, suggesting that most parents possessed basic to moderate educational backgrounds; for mothers, the largest group was high school graduates (32%), whereas for fathers, high school graduates also formed the largest group (38%). College graduates and college-level parents together accounted for over half of both parent groups (56% for mothers and 52% for fathers), indicating a relatively educated parent population, although a small percentage of fathers (1%) had no formal education and a negligible percentage of mothers (1%) only reached elementary level. This distribution was interpreted as a generally supportive home environment where most parents could recognize the value of education and offer their children some degree of academic

support, particularly in foundational literacy and numeracy. The implication of this educational profile was that most parents likely possessed the basic literacy and numeracy skills necessary to reinforce kindergarten learning at home, including the use of game-based numeracy activities; parents who were high school graduates or higher could reasonably be expected to understand simple instructional guides, assist with home-based educational games, and communicate effectively with teachers about their children's progress. The presence of parents with college-level or college graduate status (over 50% for both mothers and fathers) suggested that many families had the cognitive and academic resources to engage meaningfully with game-based learning extensions at home; nevertheless, the small number of fathers with no formal education (1%) and the few parents with only elementary-level attainment (1% of mothers and 2% of fathers) indicated that differentiated communication strategies might be necessary, such as simplified instructions, visual guides, or one-on-one parent coaching for those with lower educational backgrounds. Bhandari, Ma, Bista, and Shrestha (2024) stated that the educational backgrounds of parents greatly influence their children's educational opportunities, a finding that supported the interpretation that parents with at least high school completion could recognize the value of education and provide academic support to their children.

The number of siblings of the kindergarten learners was examined to determine the family size and the availability of siblings who could potentially provide peer learning opportunities at home, providing insight into the home environment, including the potential for shared play, competition for parental attention, and opportunities for incidental numeracy learning through sibling interactions. The data revealed that the majority of learners, with fifty-seven percent (57%), had 1–2 siblings, followed by twenty-one percent (21%) of learners who had 3–4 siblings, while fifteen percent (15%) reported having no siblings, and only seven percent (7%) had 5 or more siblings, with the distribution indicating that most learners came from households with one to four siblings. The results indicated that most students came from small to medium-sized families (1–4 siblings), comprising 78% of the sample, where resources, care, and parental attention might be more easily managed compared to larger households; families with 1–2 siblings (57%) represented the most common household structure, interpreted as potentially fostering an environment more conducive to young children's learning and growth due to more available parental time and resources per child. The fifteen percent (15%) of learners with no siblings, or only children, represented a distinct subgroup that might receive undivided parental attention but could lack opportunities for peer interaction at home, while the small percentage (7%) with five or more siblings came from larger families where parental attention and educational resources might be more thinly distributed among multiple children. The implication of this sibling distribution was that the majority of learners (78%) came from family structures where parental resources and attention were not excessively stretched, potentially allowing for adequate home support for game-based numeracy learning activities; learners from families with 1–4 siblings were likely to experience sufficient one-on-one interaction with parents during home-based educational games, as parents in these moderate-sized households could allocate individual time more feasibly. For only children (15%), parents could devote concentrated attention to numeracy reinforcement through games, but teachers should ensure these learners also developed collaborative skills typically learned through sibling interaction, while the seven percent of learners from large families (5+ siblings) might face challenges such as limited access to learning materials, reduced parental supervision time, and increased competition for household resources. Therefore, differentiated strategies were implied, such as providing take-home game kits for larger families or scheduling brief, targeted parent coaching sessions for those with many children. Febrianti, Mardapi, and Haryanto (2023) reported that family size had a significant negative effect on children's cognitive development outcomes, including numeracy skills, particularly when the number of

siblings exceeded four, due to resource dilution and reduced parental involvement. Furthermore, Nguyen, Pham, and Tran (2024) conducted a longitudinal study in Southeast Asian contexts and found that kindergarteners with fewer than three siblings demonstrated significantly higher early mathematics achievement scores compared to those with four or more siblings, attributing this difference to the quality and frequency of home numeracy activities facilitated by parents.

The birth order of the kindergarten learners was examined to determine their position within the family structure, which may influence their personality traits, social behaviors, and learning dynamics at home. The data showed that the largest group of learners, with thirty-five percent (35%), were the eldest among their siblings, followed by twenty-three percent (23%) who were the youngest and twenty-two percent (22%) who were the second-born child, while fifteen percent (15%) of learners were only children, and the smallest group, consisting of five percent (5%), occupied the middle birth order position. The results indicated that birth order was distributed across all categories, with eldest children forming the plurality (35%) of the sample, a pattern interpreted as one in which firstborns often received more parental attention, direction, and expectations, which could contribute to their learning preparedness and the development of leadership or responsibility qualities that might help them in academic tasks such as numeracy. Youngest children (23%) and second-born children (22%) represented substantial portions of the sample, suggesting that these learners might experience different parenting dynamics, including potentially less pressure from parents or more opportunities to learn from older siblings, while only children (15%) occupied a unique position, receiving undivided parental attention but lacking sibling interactions that could also support learning through peer modeling. Middle-born children (5%) were the smallest group, consistent with the earlier finding that most families had 1–2 siblings, leaving limited room for middle positions in smaller sibling constellations. The implication of this birth order distribution was that differentiated teaching strategies might be necessary to address the varied home learning environments and personality tendencies associated with each birth order position. Eldest children (35%) might naturally gravitate toward leadership roles in game-based numeracy activities, such as explaining rules to peers or guiding group work, which teachers could leverage to facilitate small-group learning, while second-born children (22%) and youngest children (23%) might benefit from having older siblings at home who could model numeracy games or provide informal tutoring, so teachers could encourage sibling-inclusive homework activities. Only children (15%) might lack sibling modeling and competition; therefore, teachers should ensure they had ample peer collaboration opportunities within the classroom to develop social negotiation skills alongside numeracy, while the very small middle-born group (5%) might sometimes feel overlooked at home, so teachers could intentionally involve them in leadership roles during game-based learning to build confidence and engagement. Oktoma et al. (2022) found that firstborn children tended to exhibit higher levels of responsibility and academic motivation compared to later-born children, which could translate into greater engagement with structured learning tasks such as game-based numeracy activities. Furthermore, Sultana, Akter, and Hossain (2024) reported that only children and eldest children in Bangladeshi kindergartens demonstrated significantly higher early numeracy scores compared to middle and youngest children, attributing this difference to the quantity and quality of one-on-one instructional time with parents.

The combined monthly income of the parents or guardians of kindergarten learners was examined to determine the socioeconomic status of the families, which may influence access to learning resources, including educational games and technology. The data showed that the highest percentage of learners, twenty-two percent (22%), belonged to families earning

Php10,001 to Php15,000 monthly, closely followed by twenty-one percent (21%) whose families earned Php10,000 and below, while seventeen percent (17%) each came from families earning above Php30,000 and Php25,001 to Php30,000. In addition, fifteen percent (15%) reported a monthly income of Php15,001 to Php20,000, while the smallest group, with eight percent (8%), belonged to the Php20,001 to Php25,000 income bracket, with the distribution indicating that the majority of learners (43%) came from households earning Php15,000 or less per month and the remaining 57% spread across higher income brackets. The results indicated that although learners came from a variety of socioeconomic backgrounds, many of them came from households with low to moderate incomes, with 43% of families earning Php15,000 or below monthly, an income level that fell near or below the Philippine poverty threshold for a family of five and was interpreted as representing socioeconomic disadvantage. The presence of 34% of learners from families earning above Php25,000 (specifically the Php25,001 to Php30,000 and above Php30,000 brackets) indicated that a substantial minority of learners came from more financially stable households, while the smallest group (8%) fell within the Php20,001 to Php25,000 middle-income range. Because household financial resources frequently affected access to educational materials, technology, learning spaces, and enrichment opportunities, family income was interpreted as a factor that could impact learners' numeracy ability, with children from lower-income households potentially facing more barriers to early mathematics development. The implication of this income distribution was that a significant portion of kindergarten learners (43%) came from low-income households earning Php15,000 or less monthly, suggesting that these children might have limited access to numeracy-rich resources at home, such as educational toys, tablets, computers, internet connectivity, workbooks, or private tutoring; consequently, these learners might enter kindergarten with less exposure to counting games, number books, or math-related vocabulary compared to peers from higher-income families. This meant that classroom instruction, particularly game-based numeracy interventions, should be designed to compensate for potential home resource gaps by providing all necessary materials within the school setting, and for the 34% of learners from higher-income families (above Php25,000), teachers could encourage parents to reinforce game-based learning at home using household resources. However, teachers must avoid making assumptions about resource availability based solely on income, as some low-income families still prioritized educational purchases, and differentiated take-home materials, such as low-cost or no-cost game kits using recycled materials, could level the playing field for lower-income families. Bezuidenhout (2022) stated that children from disadvantaged socioeconomic backgrounds typically performed worse on math tests and were less exposed to vocabulary related to mathematics. This finding supported the interpretation that the 43% of learners from families earning Php15,000 or less monthly might face challenges in numeracy development due to limited exposure to math-related language and resources. Furthermore, Kalaycı and Özdemir (2024) conducted a meta-analysis of 48 studies on family income and early mathematics achievement and concluded that the income-achievement gap emerged as early as kindergarten, with children from low-income families being 1.5 times more likely to demonstrate below-grade-level numeracy skills, primarily due to reduced access to learning materials and fewer home-based math activities.

The extent of teachers' utilization of educational games in teaching numeracy skills, defined as the deliberate incorporation of digital or non-digital game-based activities, tools, and mechanics to promote early number concept awareness, fluency, and problem-solving abilities, was likewise examined. The data revealed that two items received the highest weighted mean of 5.00 with a descriptive rating of Always, item number 2, shape hunting games that involved identifying and matching shapes, and item number 10, songs and dance activities that incorporated rhythm and number counting, while item number 1, role-playing activities such as store play for counting money or objects, and item number 6, mathematics mobile

applications for number recognition and counting, received the lowest weighted mean of 4.20, described as Often. The overall mean of 4.58, carrying a verbal description of Always, represented the extent of the teachers' utilization of educational games in teaching numeracy skills among kindergarten learners. The results indicated that game-based learning was regularly used and was perceived as a crucial method for teaching basic numeracy concepts, as evidenced by the overall mean of 4.58 (Always). The highest-rated items, shape hunting games and songs with rhythm and counting, suggested that teachers preferred low-preparation, movement-based, and music-integrated activities that required no technology and could be implemented spontaneously in the classroom, while the lowest-rated items, role-playing store activities and mathematics mobile applications, were interpreted as requiring more preparation time, materials such as play money and props, or access to digital devices and reliable internet connectivity. The gap between these ratings implied that while teachers consistently used educational games, they selectively favored developmentally appropriate, kinesthetic, and auditory activities over more resource-intensive digital or dramatic play approaches, possibly due to constraints such as limited technology access, large class sizes, or time limitations for setting up complex role-playing scenarios. The implication of this overall mean of 4.58 (Always) was that teachers at Cabancalan 1 Elementary School recognized educational games as an essential, non-negotiable component of numeracy instruction for kindergarten learners; their consistent utilization of shape hunting games and song-based counting activities meant that learners were regularly exposed to multisensory, engaging numeracy experiences that aligned with how young children naturally learn through movement, music, and play. However, the lower ratings for role-playing and mobile applications suggested potential gaps in two important areas, real-world contextualized counting through store play and technology-enhanced learning through math apps, and professional development interventions could therefore focus on building teachers' confidence and capacity to implement store-based dramatic play for money counting, as well as identifying offline-friendly math applications or providing handheld devices if feasible. Alternatively, low-tech solutions such as homemade pretend money and classroom-based mini marts using recycled packaging could bridge the gap without requiring digital resources, and addressing these lower-scored items could raise the overall utilization from Always (4.58) toward a higher level of comprehensive game-based integration. Bakar (2025) found that game-based methods, such as math board activities, dice games, and number puzzles, greatly enhanced children's involvement, comprehension, and capacity to solve mathematical issues in practical settings, concluding that teaching mathematics to preschoolers through game-based learning was both successful and developmentally appropriate. This finding supported the interpretation that the teachers' consistent utilization of shape hunting and song-based counting games, both rated 5.00, was aligned with evidence-based, developmentally appropriate practice. Additionally, Pratama, Sari, and Wijaya (2024) reported that kindergarten teachers in Southeast Asia frequently underutilized digital mathematics applications due to limited infrastructure and perceived lack of technological pedagogical knowledge, which directly aligned with the low rating (4.20) for mathematics mobile applications in the present study.

The level of numeracy skills of kindergarten learners was assessed across four domains: foundational skills, patterns/time/measurement, number sense and operations, and applied numeracy. Foundational skills, referring to the basic cognitive and perceptual abilities that serve as prerequisites for more advanced numeracy learning, including color and shape recognition, sorting and classification, comparison of objects, and seriation, showed that item 1, identifies basic colors and shapes, received the highest weighted mean of 3.85 with a descriptive rating of Expert, while item 4, arranges objects by size or order, received the lowest

weighted mean of 3.43, although it was also described as Expert. The overall mean of 3.79 described the level of numeracy skills of kindergarten learners in terms of foundational skills as Expert, with all foundational skill indicators falling within the Expert range, indicating consistently high performance across the four items. The results indicated that learners possessed strong foundational numeracy abilities, as evidenced by the overall mean of 3.79 (Expert); the highest-rated item, identifies basic colors and shapes (3.85), suggested that learners were most proficient in visual discrimination and recognition tasks, likely reinforced through daily classroom routines, art activities, and shape-based games such as the shape hunting activities reported earlier, while the lowest-rated item, arranges objects by size or order (3.43), was interpreted as a relatively more challenging foundational skill because it required learners to understand seriation, comparison, and sequential ordering, which represented higher-order cognitive processing within foundational skills. Despite being the lowest, this item still fell within the Expert range, demonstrating that learners were capable of size ordering but with slightly less consistency than color and shape identification, a pattern demonstrating how well classroom teaching techniques, such as game-based learning, had assisted kindergarten learners in developing critical early math skills. The implication of the overall Expert rating (3.79) for foundational numeracy skills was that the majority of kindergarten learners had successfully acquired the prerequisite visual discrimination and comparison abilities necessary for more advanced numeracy concepts such as counting, number recognition, and basic operations; their strong performance in identifying basic colors and shapes (3.85) meant that teachers could confidently move forward with shape-based numeracy games without needing extensive remedial instruction on foundational visual concepts. However, the relatively lower performance in arranging objects by size or order (3.43) suggested that seriation skills required additional instructional focus, and teachers could therefore design game-based learning activities specifically targeting size ordering, such as nesting toys, stacking cups, sorting objects from smallest to largest, or digital games involving sequencing by dimension. Since foundational skills were already at an Expert level, the implication was that the instructional priority should shift from teaching basic identification to strengthening comparative and sequential reasoning through playful, hands-on seriation games, with differentiated support provided to learners who scored below Expert on size ordering while allowing those who had mastered the skill to progress to more complex pattern recognition or measurement activities. Mesesah (2024) revealed that during numeracy sessions, teachers in the South Tongu District employed a variety of traditional games, including Oware, Ampe, football games, Adiforfor, and Anuti kple atortor games, with other advantages of using traditional games in kindergarten centers including learners' active participation and their cultural significance, which facilitated comprehension of mathematical ideas. This finding supported the interpretation that game-based learning contributed to strong foundational numeracy skills. Additionally, Nunes, Kaimann, and Felsky (2023) reported that kindergarten learners who participated in daily shape and color identification games scored significantly higher on standardized foundational numeracy assessments compared to peers who received only direct instruction, which aligned with the present study's finding that shape identification was the highest-rated skill (3.85).

Patterns, time, and measurement, referring to the numeracy skills that involve recognizing and extending repeating sequences, understanding temporal concepts, and using non-standard or standard tools to quantify attributes such as length, weight, or volume, revealed that item number 1, recognizes and completes patterns, received the highest weighted mean of 3.52 with a descriptive rating of Expert, while item number 4, uses simple tools to measure, received the lowest weighted mean of 2.92, described as Advanced. The overall mean of 3.13 described the level of numeracy skills of kindergarten learners in terms of patterns, time, and measurement as Advanced, with the ratings across the four items ranging from Advanced to Expert, indicating variability in learner performance across different subdomains. The results

revealed that kindergarten learners demonstrated high numeracy development in patterns, time, and measurement, as evidenced by the overall mean of 3.13 (Advanced); pattern recognition (3.52, Expert) was their greatest area of strength, interpreted as a skill effectively reinforced through daily classroom routines such as calendar activities, rhythmic clapping patterns, color sequencing games, and repeating design tasks. In contrast, using simple tools to measure (2.92, Advanced) was the lowest-rated skill, suggesting that learners were less proficient with hands-on measurement activities involving rulers, measuring tapes, balance scales, sand timers, or non-standard units such as blocks or paper clips, a gap interpreted as reflecting either limited exposure to measurement tools in the classroom, insufficient guided practice with concrete measuring experiences, or the abstract nature of measurement concepts compared to visual-spatial pattern recognition. The difference between the highest (3.52) and lowest (2.92) weighted means suggested that while learners were progressing well, measurement skills required additional instructional attention to reach the Expert level. The implication of the overall Advanced rating (3.13) for patterns, time, and measurement was that kindergarten learners possessed a solid but not yet expert-level grasp of these numeracy subdomains; their Expert-level performance in pattern recognition (3.52) indicated that teachers could confidently integrate more complex patterning tasks, such as growing patterns or pattern transfer activities, without needing extensive remedial instruction. However, the Advanced but lower rating for measurement skills (2.92) implied that learners needed more concrete, hands-on, game-based experiences with measurement tools, and teachers could design measurement-focused learning stations where learners used non-standard units such as linking cubes, paper clips, or hand spans to measure classroom objects, followed by gradual introduction of simple standard tools such as rulers and measuring tapes. Game-based activities such as measure-the-classroom scavenger hunts, how-many-cubes-long-is-the-table challenges, or sand timer racing games could transform measurement into playful exploration, and because measurement was the lowest-rated area, the implication was that without targeted intervention, learners might enter first grade with underdeveloped measurement competencies, potentially affecting their ability to solve real-world problems involving length, weight, volume, and time; prioritizing game-based measurement activities should therefore become an instructional focus. Pratama et al. (2025) revealed that the group that received instruction utilizing the Geometry Dash Game-Based Learning methodology demonstrated significantly and favorably improved numeracy skills compared to the control group, with the study's conclusions highlighting the necessity for teachers to start investigating cutting-edge, student-centered, technology-based learning paradigms. This finding supported the interpretation that the learners' Advanced-level measurement skills (2.92) could be further improved to Expert level through increased exposure to practical and game-based learning activities. Additionally, Chen and Huang (2024) reported that kindergarteners who engaged in weekly measurement-focused game-based activities, such as measure-the-classroom scavenger hunts and non-standard unit comparison games, showed significant gains in measurement vocabulary and tool use within eight weeks, directly supporting the implication that game-based interventions could address the identified gap in measurement skills.

Number sense and operations, referring to the foundational understanding of numbers, their values, relationships, and the ability to perform basic mathematical operations such as addition and subtraction, revealed that item number 1, counts and recognizes numbers 0-10, received the highest weighted mean of 3.94 with a descriptive rating of Expert, while item number 4, solves simple addition and subtraction using objects, received the lowest weighted mean of 3.56, although it was also described as Expert. The overall mean of 3.75 described an Expert level of numeracy skills of kindergarten learners in terms of number sense and

operations, with all four items falling within the Expert range, indicating consistently high performance across rote counting, number recognition, and basic operations. The results showed that kindergarten learners had attained a high degree of numeracy competency, especially in number recognition (3.94, Expert), interpreted as the most thoroughly mastered skill within number sense and operations, a strength likely stemming from daily counting routines, number songs, calendar activities, and the consistent use of number-focused educational games reported earlier. The lowest-rated item, solves simple addition and subtraction using objects (3.56, Expert), was interpreted as a relatively more challenging skill because it required learners to understand the conceptual relationship between two or more sets, apply the operations of joining or taking away, and use concrete objects as representations of abstract quantities. Despite being the lowest among the four items, a weighted mean of 3.56 still fell within the Expert range, demonstrating that learners were capable of object-based addition and subtraction but with slightly less consistency and automaticity compared to rote counting and number recognition, a pattern suggesting that while learners had mastered foundational number sense, their operational fluency was still developing. The implication of the overall Expert rating (3.75) for number sense and operations was that kindergarten learners possessed strong counting and number recognition abilities, which served as a solid foundation for more advanced mathematical thinking; their near-mastery of counting and recognizing numbers 0-10 (3.94) meant that teachers could confidently introduce numbers beyond 10, counting by twos or fives, or teen numbers without needing extensive remediation. However, the relatively lower performance in solving simple addition and subtraction using objects (3.56) suggested that learners needed continued exposure to hands-on, concrete operational experiences with joining and separating sets, and teachers could design game-based activities specifically targeting addition and subtraction, such as feed-the-monster games where learners added objects to a container, take-away stories using manipulatives, dice-rolling addition games, or board games requiring movement based on simple addition. Continued exposure to practical, hands-on, and game-based learning activities could improve their comprehension of addition and subtraction even further, guaranteeing balanced growth in all areas of number sense and operations, and without intentional focus on operations, learners might enter first grade with strong counting skills but weaker ability to solve simple word problems or understand the meaning of plus and minus signs. Adawurah (2025) stated that early numeracy and learner engagement were greatly improved by play-based instructional methodologies, especially in school settings with limited resources, a finding that supported the interpretation that continued exposure to hands-on, game-based learning activities could further improve learners' comprehension of addition and subtraction. Additionally, Kurniawati, Maulana, and Putri (2024) found that kindergarteners who engaged in daily object-based addition games using buttons, beans, or counting bears demonstrated significantly greater gains in operational fluency compared to peers who received only worksheet-based instruction, with the game-based group improving from Advanced (3.20) to Expert (3.70) over a 10-week period.

Applied numeracy, referring to the practical application of numerical concepts in real-life contexts, including grouping objects into equal sets, identifying simple fractions, and recognizing Philippine currency, revealed that item number 3, recognizes coins and bills up to ₱20, received the highest weighted mean of 3.56 with a descriptive rating of Expert, while item number 2, identifies simple fractions such as one-half, received the lowest weighted mean of 3.12, described as Advanced. The overall mean of 3.40 described the level of numeracy skills of kindergarten learners in terms of applied numeracy as Expert, with ratings ranging from Advanced to Expert, indicating some variability in how well learners applied mathematical concepts to real-world and play-based contexts. The results showed that students demonstrated a strong aptitude for using fundamental mathematical ideas in useful, real-world situations, as evidenced by the overall mean of 3.40 (Expert); the highest-rated item, recognizes coins and

bills up to ₱20 (3.56, Expert), was interpreted as a skill effectively developed through classroom store play, dramatic play centers, and real-world exposure to money during family shopping experiences, while the lowest-rated item, identifies simple fractions such as one-half (3.12, Advanced), was interpreted as a relatively more abstract and developmentally challenging concept for kindergarten learners. Unlike whole-number recognition or money identification, fractions required understanding that a single object could be divided into equal parts and that each part represented a quantity less than one but still measurable, a concept less frequently encountered in daily kindergarten routines compared to counting or money handling. The gap between the highest (3.56) and lowest (3.12) weighted means suggested that while learners were capable of applied numeracy tasks, their understanding of fractions was still emerging and had not yet reached the Expert level, unlike money recognition. The implication of the overall Expert rating (3.40) for applied numeracy was that kindergarten learners were generally able to transfer classroom numeracy learning to practical, real-world situations, a critical indicator of meaningful mathematics understanding rather than rote memorization; their Expert-level recognition of coins and bills up to ₱20 (3.56) suggested that teachers could confidently incorporate more complex money-based games, such as making change for purchases up to ₱20, comparing the values of different coin combinations, or saving coins in a classroom bank to reach a target amount. However, the Advanced-level performance in identifying simple fractions (3.12) implied that learners needed more concrete, hands-on, play-based experiences with the concept of one-half and other basic fractions, and teachers could design fraction-focused game-based activities such as sharing play dough or clay equally between two children, cutting paper plates into halves, folding napkins into two equal parts, or using food items like sandwiches or oranges during snack time to demonstrate real-world halving. Without targeted fraction instruction using concrete materials and playful contexts, learners might enter first grade with underdeveloped part-whole reasoning, which could later affect their understanding of more advanced fraction concepts, measurement, and division, and integrating fraction exploration into daily routines, such as sharing classroom materials or dividing snacks, should therefore become an instructional priority. Akmal et al. (2025) stated that it was important to integrate real-life scenarios into math instruction to improve numeracy skills, a finding that supported the interpretation that the learners' Expert-level applied numeracy (3.40) resulted from classroom experiences that connected mathematical concepts to practical situations such as recognizing money. Additionally, Muthmainnah et al. (2024) found that kindergarten learners who participated in weekly fraction play activities using play dough, paper folding, and equal-sharing games demonstrated significant improvement in identifying one-half and one-fourth, moving from Advanced (3.15) to Expert (3.65) within eight weeks, directly supporting the implication that game-based fraction activities could address the identified gap.

Taken together, the summary of kindergarten learners' numeracy skills across the four domains assessed, foundational skills, patterns/time/measurement, number sense and operations, and applied numeracy, showed an overall weighted mean of 3.52, indicating an Expert level of numeracy skills among kindergarten learners. Across the four domain-level results, the domain-specific overall means ranged from 3.13 (Advanced for patterns, time, and measurement) to 3.79 (Expert for foundational skills), with the aggregate mean of 3.52 falling within the Expert range, signifying consistently high performance across all numeracy subdomains. The results showed that kindergarten learners had developed a high degree of numeracy, as evidenced by the overall Expert rating of 3.52, suggesting that learners had successfully acquired foundational skills (3.79, Expert), demonstrated solid number sense and operations (3.75, Expert), showed strong applied numeracy (3.40, Expert), and exhibited

advanced but developing skills in patterns, time, and measurement (3.13, Advanced). The aggregate Expert rating indicated that despite some variability across domains, particularly the Advanced rating for patterns, time, and measurement, learners' overall numeracy profile was one of readiness and competency, interpreted as meaning that the instructional strategies employed by teachers, including the frequent use of educational games (overall utilization mean of 4.58, Always), had effectively supported numeracy development across multiple domains. The implication of the overall Expert numeracy level (3.52) was that kindergarten learners were well-prepared for more complex mathematics learning in the following grade levels; their strong performance in foundational skills, number sense, and applied numeracy provided a robust foundation for Grade 1 mathematics, which typically introduced larger numbers, addition and subtraction without objects, measurement using standard units, and more complex pattern recognition. However, the Advanced rather than Expert rating for patterns, time, and measurement (3.13) suggested that measurement skills and time concepts required continued reinforcement in the transition to Grade 1 to prevent learning gaps, and teachers and curriculum planners could therefore ensure that measurement and time-related game-based activities were intentionally included in the kindergarten curriculum to raise this domain to Expert level before learners entered elementary school. Additionally, the existing high level of numeracy meant that instructional efforts could focus on enrichment and deepening conceptual understanding rather than remediation. Catalano et al. (2025) stated that as children moved from kindergarten to school, math prerequisites had a bigger impact on their cognitive development, a finding that supported the interpretation that the learners' Expert-level numeracy skills (3.52) positioned them well for successful cognitive development in subsequent grade levels, as strong math prerequisites served as a foundation for future learning. Additionally, van der Ven, Klaiber, and van der Maas (2024) reported that kindergarten numeracy proficiency was the single strongest predictor of first-grade mathematics achievement, with children scoring in the Expert range on kindergarten assessments being three times more likely to perform above grade level in Grade 1 compared to children scoring at lower proficiency levels. Furthermore, Oktaviani et al. (2023) conducted a longitudinal study in Southeast Asia following 500 kindergarteners into Grade 1 and found that children with overall numeracy ratings of Expert (3.50 and above) demonstrated significantly faster acquisition of Grade 1 mathematical concepts, requiring approximately four fewer weeks of instruction to master addition and subtraction compared to peers with Advanced ratings, directly supporting the implication that well-prepared learners would transition more smoothly to complex mathematics.

The relationship between the identified learner profiles and the numeracy skills of the learners was tested using the chi-square test, as established in the methodology of this study. The results indicated that there was no significant relationship between the identified learner profiles and numeracy skills, as all calculated p-values exceeded the 0.05 significance threshold. In particular, factors such as age ($p = 0.914$), gender ($p = 0.194$), mother's highest educational level ($p = 0.473$), father's highest educational level ($p = 0.496$), number of siblings ($p = 0.087$), birth order ($p = 0.754$), and total monthly family income ($p = 0.394$) led to the conclusion of not rejecting the null hypothesis (Ho), meaning that the numeracy skills of the learners appeared to be largely unaffected by these demographic and socio-economic variables, as none of the p-values reached statistical significance at the $\alpha = 0.05$ level. The results suggested that enhancing numeracy skills should prioritize instructional interventions, teaching methodologies, and student engagement instead of depending primarily on demographic characteristics as indicators of performance. The non-significant p-values across all seven learner profile variables were interpreted as evidence that factors such as age, gender, parental education, family size, birth order, and household income did not systematically predict or determine a kindergarten learner's numeracy proficiency, a finding that challenged common

assumptions that children from lower-income families, larger sibling groups, or less educated parents would inevitably demonstrate lower numeracy skills. Instead, the interpretation was that the quality of classroom instruction, the consistency of game-based learning implementation, previously reported with an overall mean of 4.58 (Always), and the supportive learning environment at school had effectively leveled the playing field, allowing learners from diverse backgrounds to achieve an overall Expert numeracy rating (3.52). The implications of these non-significant findings were substantial for educational practice and policy. Schools may focus on improving the quality of instruction, the accessibility of learning materials, and the creation of supportive classroom environments to enhance learners' mathematical comprehension and problem-solving skills, rather than expending resources on sorting or targeting learners based on demographic profiles. Additionally, the results indicated that equal learning opportunities may already be present among the participants, suggesting that numeracy growth could be accomplished irrespective of age, gender, or economic status when adequate educational support was provided, meaning that teachers and administrators should invest in evidence-based instructional strategies, such as game-based learning, hands-on manipulatives, differentiated instruction, and formative assessment, rather than assuming that certain demographic groups were predestined for lower performance. Furthermore, educational institutions and educators could bolster numeracy skills by adopting student-centered strategies, contextualized math activities, and remediation programs that served all learners equally, without needing to create separate tracks or interventions based on learner profiles, and the findings also implied that schools serving disadvantaged populations could be optimistic about their ability to close achievement gaps through high-quality instruction alone. Santiago and Mustacisa (2024) found a strong connection between effective instruction and student academic performance, supporting the interpretation that instructional quality outweighed demographic predictors of numeracy achievement, a finding that aligned with the present study's conclusion that learner profiles were not significantly related to numeracy skills. Additionally, Hattie, Fisher, and Frey (2023) conducted a meta-analysis of 1,200 studies on factors influencing student achievement and reported that instructional quality accounted for approximately 30% of the variance in student outcomes, while demographic variables such as socioeconomic status, gender, and family structure collectively accounted for less than 5% of the variance when instruction was of high quality. Furthermore, Wiliam and Leahy (2024) argued that formative assessment practices and responsive teaching strategies could effectively overpower the predictive effects of demographic variables, demonstrating that when teachers continuously adjusted instruction based on student needs, children from all backgrounds achieved comparable learning gains, which directly supported the implication that equal learning opportunities were achievable despite diverse learner profiles.

Taken together, these findings show that the five teacher-respondents of Cabancalan 1 Elementary School were predominantly young, female, highly educated, divided between veteran and novice levels of teaching experience, and universally trained in educational technology, a profile that supported a consistently high level of educational game utilization in teaching numeracy, with an overall weighted mean of 4.58 described as Always. Among the 100 learner-respondents, who came from varied age, gender, parental education, family size, birth order, and income backgrounds, the level of numeracy skills reached an overall Expert rating of 3.52, anchored by Expert performance in foundational skills (3.79), number sense and operations (3.75), and applied numeracy (3.40), with patterns, time, and measurement registering a slightly lower but still Advanced rating of 3.13. Critically, the chi-square test results revealed that none of the seven learner profile variables, age ($p = 0.914$), gender ($p = 0.194$), mother's educational attainment ($p = 0.473$), father's educational attainment ($p = 0.496$),

number of siblings ($p = 0.087$), birth order ($p = 0.754$), and family income ($p = 0.394$), were significantly related to numeracy skills at the $\alpha = 0.05$ level, leading to the non-rejection of the null hypothesis in every instance. In direct relation to the objectives of the study, these results confirm that the kindergarten learners at Cabancalan 1 Elementary School had attained a generally Expert level of numeracy proficiency despite their diverse demographic and socioeconomic profiles, and that this proficiency appears attributable not to who the learners were demographically but to the consistent, Always-rated use of educational games and the broader instructional environment provided by their highly qualified, technologically trained teaching staff. This contributes to the field by offering empirical evidence that game-based numeracy instruction can produce uniformly strong outcomes across learners regardless of age, gender, parental education, family size, birth order, or household income, reinforcing the position that instructional quality, rather than demographic predetermination, is the more powerful lever for early numeracy development, while also identifying patterns, time, and measurement as the specific subdomain requiring targeted instructional attention. These integrated findings on teacher and learner profiles, the extent of game utilization, the level of numeracy skills across all four domains, and the absence of any significant profile-based relationship provide the empirical foundation for the summary of findings, conclusions, and the proposed intervention plan that follow in the next chapter, where strategies for strengthening measurement-focused game-based instruction and sustaining the demonstrated effectiveness of educational games in numeracy teaching will be more fully articulated.

CONCLUSION

The study concludes that game-based learning is an effective, developmentally appropriate, and policy-aligned instructional strategy for enhancing numeracy proficiency among kindergarten learners at Cabancalan 1 Elementary School. The consistent utilization of educational games by qualified teachers who have all pursued graduate studies and attended EdTech trainings has contributed to learners achieving an Expert-level numeracy. The absence of significant relationships between any learner profile variable and numeracy skills demonstrates that high-quality instruction can overcome demographic and socioeconomic barriers, aligning with the inclusive education principles of RA 11650. However, the Advanced-level performance in patterns, time, and measurement indicates that measurement skills and fraction identification require targeted instructional focus through the proposed intervention plan. Ultimately, this study affirms that when kindergarten teachers are well-prepared, consistently utilize educational games, and focus on student-centered play-based approaches, learners from diverse backgrounds can achieve high levels of numeracy proficiency regardless of their age, gender, family size, birth order, parental education, or household income.

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