PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 3
ISSN 3028-0877 | DOI 10.69651/2022PIJHSS

Utilization of educational games in improving numeracy skills among kindergarten pupils

Juvy S. Jumao-as*
Cebu Technological University - Main Campus, Cebu City, Cebu, Philippines

ABSTRACT

This study determined the utilization of educational games in improving numeracy skills among kindergarten pupils at Basak Elementary School, Mandaue City, Cebu, during the school year 2025–2026 as a basis for an intervention plan. A descriptive-correlational research design was employed, involving 9 kindergarten teachers and 100 kindergarten learners. Data were gathered using a teacher questionnaire, a numeracy skills assessment tool, and a parent survey questionnaire. Statistical tools included frequency counts, percentages, weighted means, standard deviations, and chi-square tests. Findings revealed that teachers were predominantly female, aged 31–35 years, with master's units or degrees, over 11 years of teaching experience, and all had attended EdTech trainings. Teachers consistently utilized educational games at an "Always" level. Learners demonstrated overall expert-level numeracy skills, with foundational skills, number sense and operations applied numeracy rated Expert, patterns, time, and measurement rated Advanced. The lowest indicators were using simple tools to measure and identifying simple fractions. No significant relationships were found between any learner profile variable and numeracy skills. The study concluded that while teachers extensively utilized educational games and learners demonstrated strong numeracy skills, targeted intervention was needed for measurement, fraction, time, and pattern skills. An intervention plan, Project GAME On, was proposed to enhance game-based instruction in these areas using low-cost, developmentally appropriate strategies.

Keywords: Early Childhood Education, Educational Games, Numeracy Skills, Descriptive-Correlation, Intervention Plan, Mandaue City, Cebu, Philippines

Date Submitted: July 04, 2026
Date Accepted: July 07, 2026
Date Published: July 14, 2026

INTRODUCTION

Globally, the foundational years of ages 4-5 represent a critical window for neurodevelopmental plasticity, yet early numeracy deficiencies remain a pervasive threat to long-term academic success. Research shows that this leads to a cumulative disadvantage known as the "Matthew effect" in mathematics—where early gaps widen over time, with young learners aged 4-5 struggling with basic number recognition, counting, and operations (Yuniria et al., 2025). Educational games have emerged as a pedagogically sound intervention, offering an engaging solution, fostering number sense through interactive play and digital media that

*Corresponding author / Email: demvy2015@gmail.com

Recommended citation:
Jumao-as, J. (2026). Utilization of educational games in improving numeracy skills among kindergarten pupils. Pantao (International Journal of the Humanities and Social Sciences) 5 (3), 1343-1370.

aligns with children's natural inclinations toward exploration and immediate feedback (Afrianti & Maryatun, 2025; Asqia et al., 2025). However, a critical global paradox exists: despite this theoretical promise, empirical evidence on the real-world utilization of these games by classroom teachers and their direct impact on discrete numeracy skills remains remarkably sparse, with most studies focused on controlled experimental settings rather than authentic kindergarten environments. This creates a translational gap where proven tools fail to be adopted consistently, creating a critical gap in understanding how these tools translate potential into outcomes (Abdullahi & Abdulkareem, 2023).

Nationally, this global challenge is amplified by systemic weaknesses in Philippine basic education. In the Philippines, the country's dismal performance in international assessments like PISA 2022 and TIMSS—where Filipino learners ranked among the lowest globally in mathematical literacy—is not a sudden collapse but a symptom of fragile kindergarten foundations, with kindergarten foundations often too weak to build upon by Grade 3 (Copioso & Lapada, 2024; Capinding & Salazar, 2023). While the Department of Education has endorsed game-based learning through the Kindergarten Education Act (RA 10157) and the MATATAG Curriculum, and despite recognition of game-based learning's promise, national data nevertheless show a persistent implementation chasm: teachers report positive attitudes toward games but cite lack of training, time constraints, and confusion over aligning games with learning competencies, resulting in sporadic, low-quality integration that fails to close numeracy gaps amid resource constraints and traditional teaching methods (Godoy, 2022; Sulpico et al., 2025).

Locally, at Basak Elementary School in Mandaue City, Cebu, these global and national issues manifest acutely during the 2025-2026 school year. Despite the availability of free, curriculum-aligned digital and physical educational games, teachers rarely integrate them into numeracy lessons, relying instead on repetitive rote drills and worksheets, a method ill-suited for kindergarteners who learn through embodied, social, and playful experiences. This underutilization leaves many kindergarten pupils, mostly from low-income families with limited home support for numeracy, demonstrating poor foundational skills such as like counting sequences and pattern recognition. The consequences are stark: classroom observations reveal learners struggling to differentiate numbers beyond 10 or apply simple measurements or solve real-world scenarios like sharing snacks, with pre-assessments showing over 60% below proficiency across multiple domains: number sense, operations, patterns, time/measurement, and applied numeracy. Compounding this, the classroom includes diverse learners such as urban migrants and multilingual children, for whom traditional language-heavy worksheets are particularly ineffective. This pedagogical and systemic underutilization persists, exacerbating disparities.

Thus, this study is essential to quantify these variables and provide an evidence-based foundation for change. Investigating these issues is therefore essential to quantify teachers' actual extent of game utilization, assess its link to numeracy levels across multiple foundational skills, including patterns/time/measurement, number sense/operations, and applied numeracy and identify profile-related factors (e.g., teacher training, class size, access to technology) influencing outcomes. This study at Basak Elementary School aims to determine the utilization of educational games in improving numeracy skills among kindergarten learners as a basis for an intervention plan. Its final output, a tailored, context-sensitive intervention plan is designed to benefit : (a) teachers by providing practical, low-cost strategies for effective game integration aligned with the MATATAG curriculum , (b) pupils by enhancing their numeracy proficiency and school readiness, particularly for those from disadvantaged backgrounds , and (c) school administrators by providing actionable data to guide resource allocation , professional development, and early childhood program evaluation to boost early childhood outcomes.

PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 3
ISSN 3028-0877 | DOI 10.69651/2022PIJHSS

Statement of the problem

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

Specifically, the study sought 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 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 and the numeracy skills of the learners?
5. Based on the findings of the study, what intervention plan may be proposed to enhance the use of educational games in improving numeracy skills among kindergarten pupils?

METHODOLOGY

Research design

The study employed a descriptive-correlational research design. This design was deemed most appropriate as it allowed the researcher to: (1) describe the profile of teacher-respondents and kindergarten learners, (2) determine the extent of teachers' utilization of educational games, (3) assess the level of numeracy skills of kindergarten learners, (4) investigate the relationship between learner profiles and numeracy skills, and (5) 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.

Respondents and locale of the study

This study was conducted at Basak Elementary School in Barangay Basak, Mandaue City, Cebu, a public institution under the Department of Education, Division of Mandaue City, serving a diverse, urban student population. The respondents included all nine kindergarten teachers (selected through total enumeration) and 100 kindergarten learners (drawn from approximately 130 total learners via stratified random sampling) during the 2025–2026 school year. While teacher-respondents provided data on educational game utilization, the primary focus for numeracy assessment was the kindergarten learners—aged five to six years old—who were at a critical developmental stage for foundational numeracy skills such as counting, number recognition, and patterning. The school's facilities, including a dedicated Kindergarten Learning Lab and Computer Laboratory, supported a conducive environment for game-based learning strategies. The selection of learners as the main respondents was justified by the

study's objectives to assess numeracy skill levels, identify gaps for an intervention plan, enable correlational analysis, and align with legal mandates (RA 10157, RA 10533) prioritizing early childhood numeracy development through play-based approaches.

Research instrument

The research instruments consisted of three main tools: a teacher questionnaire, an individual learner's numeracy skills assessment, and a parent survey questionnaire, all subjected to content validation by experts in early childhood education, mathematics instruction, and research adviser. The teacher questionnaire gathered demographic data (age, sex, education, experience, training) and measured the extent of educational game utilization using ten game types (e.g., role-playing, math apps, songs) on a five-point Likert scale. The learner numeracy assessment, completed by teachers based on observation, evaluated kindergarten learners across four domains (foundational skills, patterns/time/measurement, number sense/operations, and applied numeracy) using 15 indicators rated on a four-point scale. The parent questionnaire collected learner profile data (age, gender, siblings, birth order) and family socioeconomic information (parental education, monthly income) to enable correlational analysis between learner profiles and numeracy skills.

Data analyses procedure

The data analysis procedure was carried out in three systematic stages—preliminary, data gathering, and post-data gathering, ensuring accuracy, reliability, and ethical integrity. In the preliminary stage, the researcher secured permission from the Schools Division Superintendent and school principal of Basak Elementary School, followed by obtaining informed consent from all teacher-respondents and parental consent for the 100 learner-respondents, with strict assurances of confidentiality and the right to withdraw. During the data gathering stage, the researcher personally distributed validated questionnaires to all nine kindergarten teachers, who completed their demographic profiles, the educational games utilization scale (ten items on a five-point Likert scale), and the Individual Learner's Numeracy Skills Assessment (15 indicators across four domains on a four-point scale); parent surveys were distributed via homeroom teachers to collect learner profile and socioeconomic data. In the post-data gathering stage, retrieved data were manually checked, encoded in Excel, and subjected to statistical treatments: frequency and percentage for teacher and learner profiles, weighted mean and standard deviation for game utilization extent and numeracy skill levels, and chi-square test of independence (at 0.05 significance level) to determine relationships between learner profiles and numeracy skills. Ethical considerations included adherence to the Data Privacy Act of 2012, optional name fields, secure data storage, and assurance of no physical, psychological, or social harm to participants.

RESULTS AND DISCUSSION

Profile of the Teacher-Respondents

Table 1
Age and sex at birth of the teachers

Age (in years)	Female		Male		Total	
	f	%	f	%	f	%
41-45	3	33.33	0	0	3	33.33

36-40	2	22.22	0	0	2	22.22
31-35	4	44.44	0	0	4	44.44
Total	9	100	0	0	9	100.00

As reflected in Table 1, all nine teacher-respondents (100%) were female, with no male kindergarten teachers at Basak Elementary School during 2025–2026, a pattern consistent with early childhood education being a female-dominated profession (Gözel & Toptaş, 2022; Ali et al., 2021). The age distribution showed that the largest group was aged 31–35 years (44.44%), followed by 41–45 years (33.33%), and 36–40 years (22.22%), with no teachers below 31 or above 45. This relatively young, predominantly female teaching force suggests energy and potential openness to innovative game-based learning strategies (Cheilaki et al., 2023), while the absence of male teachers indicates a lack of gender diversity that may limit varied numeracy modeling for young learners (Akıncı & Yıldırım, 2021; Wijaya et al., 2024). The concentration of teachers in their prime professional years implies a balance of youthful enthusiasm and experience, making them receptive to professional development on game-based numeracy instruction (Almanea et al., 2024), as younger teachers tend to demonstrate higher adaptability to new pedagogical technologies (Tasu'ah et al., 2023). Descriptive statistics including frequencies and percentages were used to analyze these demographic characteristics (Akçinar & Arak, 2023).

Table 2
Teachers' Highest Educational Attainment

Highest Educational Attainment	f	%
Master's Degree	3	33.33
With Master's Units	4	44.44
Bachelor's Degree	2	22.22
Total	9	100.00

As presented in Table 2, the majority of teacher-respondents (44.44%) had completed master's units, 33.33% held a master's degree, and 22.22% had a bachelor's degree, with over three-fourths (77.77%) having pursued graduate-level studies—indicating a highly educated kindergarten teaching force committed to continuous professional development. This advanced educational profile suggests that teachers possess the theoretical foundation and professional readiness to effectively implement educational games in numeracy instruction, as graduate-level training enhances exposure to research-based, game-based learning strategies (Ünal & Kaya, 2024). Teachers with master's units or degrees are better equipped to critically evaluate and integrate digital gamified tools that align with developmental theories and curricular objectives (Firdaus et al., 2024; Miller), while also understanding how digital games can complement traditional methods (Mondragon et al., 2023). Although the two bachelor's-degree holders may benefit from targeted professional development, the overall robust educational background fosters critical pedagogical reflection and evidence-based practices essential for optimizing numeracy outcomes through educational games (Đan et al., 2024).

Table 3

Teachers' Years of Teaching Experience

Years of teaching experience	f	%
11 and above	5	55.56
9-10	1	11.11
7-8	1	11.11
5-6	0	0.00
3-4	1	11.11
Less than 2	1	11.11
Total	9	100.00

As reflected in Table 3, the majority of teacher-respondents (55.56%) had eleven years or more of teaching experience, while the remaining were distributed across categories of 9–10 years (11.11%), 7–8 years (11.11%), 3–4 years (11.11%), and less than two years (11.11%), with no teachers in the 5–6 years category. This predominantly experienced teaching force benefits from substantial practical knowledge in classroom management and learner engagement, which can facilitate the integration of educational games for numeracy instruction, as increased years of service correlate positively with enhanced pedagogical skills in game utilization (Akçinar & Arak, 2023). Experienced teachers demonstrate higher rates of digital tool integration when they perceive educational value and receive adequate support (Kufarimani & Chitanana, 2025), and those in advanced career stages often view digital games as effective techno-pedagogical tools enabling innovative approaches like inquiry-based and differentiated instruction (Avidov-Ungar & Hayak, 2023). The presence of a novice teacher (less than two years) suggests a need for targeted mentoring, while the gap in the 5–6-year category indicates a missing mid-career segment. Notably, teachers with less experience might be more adept at integrating digital game-based learning due to greater familiarity with contemporary technology (Palha & Matić, 2023), highlighting the need for tailored professional development that acknowledges varying levels of technological proficiency and pedagogical experience (Afrianti & Maryatun, 2025).

Table 4
Teachers' Attendance to EdTech trainings

Attendance to EdTech Trainings	f	%
Has Attended	9	100.00
Not Attended	0	0.00
Total	9	100.00

As presented in Table 4, all nine teacher-respondents (100%) reported having attended at least one educational technology (EdTech) training, indicating that the entire kindergarten teaching force possessed foundational knowledge and skills for using technology in instruction, creating a favorable condition for implementing game-based learning strategies in numeracy. This comprehensive training background suggests teachers are well-prepared to integrate digital games for numeracy development, an approach that enhances engagement and problem-solving in early mathematics education (Ünal & Kaya, 2024), and aligns with research showing that interactive digital tools significantly improve numeracy skills and engagement among young children (Firdaus et al., 2024). Gamified applications with features like streak mechanisms have demonstrated positive correlations with improved performance in number identification, counting, and cardinality in kindergarten settings (Sepúlveda et al., 2026), while digital educational tools and interactive devices significantly enhance number comprehension in early learners (Singh et al., 2021). Such technology integration is vital given the long-term

negative impact of low numeracy skills prior to primary grades, as recognized by organizations like the National Association for the Education of Young Children (Grimes et al., 2021). The teachers' universal EdTech exposure creates an optimal environment for implementing game-based learning, as they are already adept at leveraging digital resources to facilitate mathematical comprehension and skill acquisition (Rauf & Prihadi, 2025).

Kindergarten Learners

Table 5
Age of the Learners

Age (in years)	f	%
7	3	3.00
6	53	53.00
5	44	44.00
Total	100	100.00

As reflected in Table 5, of the 100-kindergarten learner-respondents, the majority were six years old (53.00%), followed by five years old (44.00%), and a small minority were seven years old (3.00%), indicating that 97% fell within the typical Philippine kindergarten age range of five to six years. This predominance of five- and six-year-old learners aligns with research highlighting this period as critical for numeracy development, where foundational mathematical concepts such as number identification, counting, and cardinality are most readily acquired and serve as strong predictors of long-term mathematical achievement (Sepúlveda et al., 2026). The majority of learners being developmentally in the play-based learning stage makes educational games highly appropriate and effective, as structured, engaging interventions such as game-based learning significantly enhance numerical comprehension and addition-fact fluency, often outperforming traditional methods (Abdullahi & Abdulkareem, 2023). The presence of seven-year-old learners (3%) suggests possible late school entry or grade retention, indicating a need for differentiated instruction. Overall, these findings support leveraging age-appropriate pedagogical approaches like digital game-based learning to optimize engagement and foster robust numeracy development during these critical early educational stages (Bakar & Rafi, 2025)

Table 6
Gender of the Learners

Gender	f	%
Female	47	47.00
Male	53	53.00
Total	100	100.00

As presented in Table 6, out of 100 kindergarten learner-respondents, 53 (53.00%) were male and 47 (47.00%) were female, indicating a relatively balanced gender distribution with a slight male majority—a demographic pattern consistent with similar educational settings (Salami & Spangenberg, 2024; Tahir et al., 2023; Rahmadhani et al., 2023). This near-equal representation of boys and girls implies that teaching strategies, particularly the use of educational games for numeracy instruction, must cater to the diverse learning styles, interests, and developmental characteristics of both genders (Mondragon et al., 2023). Research indicates that boys and girls may respond differently to game types, with boys sometimes preferring

competitive or action-oriented games while girls lean toward collaborative or rule-based activities (Afrianti & Maryatun, 2025). Therefore, the proposed intervention plan should be gender-inclusive, incorporating varied activity structures—from collaborative to competitive elements—to maximize engagement and ensure equitable developmental outcomes for all pupils (Alfaregi et al., 2024). This balanced gender distribution also allows for meaningful future comparisons regarding whether the relationship between educational game utilization and numeracy skill improvement differs between male and female learners.

Table 7
Parents' Highest Educational Attainment

Educational Attainment	Mother		Father	
	f	%	f	%
Master's Degree	1	1.00	0	0.00
With Master's Units	0	0.00	0	0.00
College Graduate	22	22.00	23	23.00
College Level	21	21.00	14	14.00
High School Graduate	44	44.00	48	48.00
High School Level	7	7.00	14	14.00
Elementary Graduate	3	3.00	0	0.00
Elementary Level	2	2.00	1	1.00
Total	100	100.00	100	100.00

As reflected in Table 7, the majority of mothers (44.00%) and fathers (48.00%) were high school graduates, with smaller proportions being college graduates (22% of mothers, 23% of fathers) or having college-level studies (21% of mothers, 14% of fathers), while over one-fourth of both parents (28% of mothers, 29% of fathers) had not completed high school—including those at high school level, elementary graduate, or elementary level—and no parent held a doctorate degree. This educational background significantly shapes the home numeracy environment, impacting children's exposure to informal mathematical activities and the quality of early number learning experiences (Jensen et al., 2023; Sarnecka et al., 2023; Susperreguy et al., 2021). The predominance of high school-educated parents implies that while families can provide basic academic support, they may lack advanced pedagogical knowledge for structured numeracy games, and the presence of parents who did not complete high school suggests that some learners face limited home-based academic scaffolding, highlighting the school's critical role in delivering effective numeracy instruction through educational games. Research indicates that parents' educational backgrounds and beliefs about mathematics instruction significantly influence the type and frequency of numeracy support they provide (Msall et al., 2023), though higher parental educational attainment has not consistently correlated with improved child numeracy, suggesting that specific involvement strategies and attitudes may be more influential than degrees alone (Mues et al., 2025; Ghazali et al., 2021). For the proposed intervention plan, strategies such as parent orientation sessions, take-home game kits, or parent-child workshops are necessary to bridge school-based and home-based numeracy support, equipping parents with effective strategies regardless of their formal schooling (Cook et al., 2025; ROZI et al., 2025).

Table 8
Number of Siblings of the Learners

Number of Siblings	f	%
5 and above	10	10.00
3-4	31	31.00

1-2	49	49.00
None	10	10.00
Total	100	100.00

As reflected in Table 8, nearly half of the kindergarten learners (49.00%) had one to two siblings, 31.00% had three to four siblings, 10.00% had five or more siblings, and 10.00% had no siblings, indicating that 80% came from families with at least one sibling while 20% were either only children or from very large families. The prevalence of learners with one to two siblings implies that many kindergarten pupils have potential playmates at home who can engage in educational games that enhance numeracy skills, as the presence of siblings—particularly older ones—facilitates incidental numeracy learning through counting games, sharing, and turn-taking activities (Karuniah et al., 2023). The nearly one-third of learners with three to four siblings suggests larger families where individual parental attention may be limited, while the 10% with no siblings may experience more focused parental attention but fewer peer-to-peer numeracy practice opportunities through sibling play (Kariza & Lisa, 2025). Research suggests that rich home learning environments with frequent non-digital and complementary digital activities significantly support numeracy development (Jensen et al., 2023), and only children or those from very large families may benefit more substantially from structured school-based educational interventions to bridge potential gaps in informal numeracy exposure (Orbach et al., 2023).

Table 9
Birth Order of the Learners

Birth Order	f	%
Eldest	23	23.00
Second	33	33.00
Middle	6	6.00
Youngest	28	28.00
Only Child	10	10.00
Total	100	100.00

As presented in Table 10, the largest group of kindergarten learners were second-born children (33.00%), followed by youngest children (28.00%), eldest children (23.00%), only children (10.00%), and middle children (6.00%), with 84% holding eldest, second, or youngest positions. This diversity in birth order implies varied family dynamics and sibling relationships that influence how children approach educational games for numeracy, as family structure and sibling interactions significantly shape cognitive and social-emotional growth (Hidayah & Retnawati, 2024). Second-born children, who typically have older siblings as models, may learn effectively through observation and imitation during game demonstrations; youngest children, accustomed to receiving scaffolding from older siblings, may benefit from games with step-by-step guidance; eldest children, who often develop leadership and teaching behaviors, might excel in guiding peers during collaborative numeracy games; only children, more accustomed to adult interaction than peer play, may initially struggle with turn-taking but excel in individual game-based activities (Rauf & Prihadi, 2025; Mondragon et al., 2023). These varied family dynamics could significantly impact engagement with educational interventions, as children from larger families with older siblings may exhibit enhanced collaborative skills and propensity for peer learning (Debrenti, 2024). For the proposed intervention plan, teachers should consider pairing learners with complementary birth order

characteristics (e.g., eldest with youngest) to promote peer learning, and parents should be oriented on leveraging birth order dynamics—such as encouraging older siblings to facilitate numeracy games with younger ones—to reinforce kindergarten learners' skills through natural family interactions.

Table 10
Combined Monthly Income

Monthly Income (in pesos)	f	%
above 30,000	14	14.00
25,001-30,000	10	10.00
20,001-25,000	13	13.00
15,001-20,000	12	12.00
10,001-15,000	21	21.00
10,000 and below	30	30.00
Total	100	100.00

As reflected in Table 10, the largest group of kindergarten learners (30.00%) came from families with a combined monthly income of ₱10,000 and below, followed by 21.00% earning ₱10,001–₱15,000, while only 24.00% belonged to families earning above ₱25,000, indicating that more than half (51.00%) of learners came from low-income households facing economic challenges that affect access to educational resources. These socioeconomic disparities significantly influence the efficacy and accessibility of educational interventions, as children from lower socioeconomic backgrounds often have restricted access to essential resources including manipulatives and technology tools crucial for number sense development (Chirimbana et al., 2024). The digital divide further exacerbates this limitation, where low-income children face significant barriers to accessing digital devices and internet connectivity necessary for engaging with educational digital games (Mondragon et al., 2023), and the absence of robust home learning environments—characterized by limited parental involvement due to work commitments or lower educational attainment—compounds these challenges (Selepe & Mphahlele, 2025). This lack of access to digital resources and educational materials at home can lead to disparities in early numeracy skill development compared to higher-income children (Merkley et al., 2023). Therefore, the proposed intervention plan for utilizing educational games to improve numeracy skills must be cost-sensitive and resource-conscious, prioritizing low-cost or no-cost games made from recycled or locally available materials, relying on school-provided devices for any digital options, and including capacity-building for parents on facilitating numeracy games using everyday household items, thereby ensuring equitable access to foster number sense development for all students, especially those from disadvantaged backgrounds (Chirimbana et al., 2024).

Extent of the Teachers' Utilization of Educational Games in Teaching Numeracy Skills Among Kindergarten Pupils

Table 11
Extent of the teachers' utilization of educational games in teaching numeracy skills among kindergarten pupils

S/N	Indicators	WM	SD	VD
1	Role-playing activities (e.g., store play for counting money or objects).	4.33	0.87	Always

2	Shape hunting games that involve identifying and matching shapes.	4.67	0.50	Always
3	Block building activities to demonstrate addition and subtraction concepts.	4.33	0.71	Always
4	Board games that encourage number sequencing and turn-taking.	4.33	1.00	Always
5	Hopscotch games that use number lines and physical counting.	4.44	1.13	Always
6	Mathematics mobile applications for number recognition and counting.	4.56	0.53	Always
7	Card matching games involving number pairs, odd and even numbers.	4.56	0.73	Always
8	Puzzle assembly activities focusing on patterns and shapes.	4.44	1.01	Always
9	Dice rolling games that involve counting and simple probability.	4.33	1.00	Always
10	Songs and dance activities that incorporate rhythm and number counting.	5.00	0.00	Always
	Aggregate Mean	4.50		Always
	Aggregate Standard Deviation		0.75	

Legend: 4.21-5.00-Always; 3.41-4.20-Often; 2.61-3.40-Sometimes; 1.81-2.60-Rarely; 1.00-1.80- Never

As presented in Table 11, the aggregate mean for teachers' utilization of educational games in teaching numeracy skills was 4.50 (Always), with an aggregate standard deviation of 0.75 indicating relatively consistent responses. The highest mean was for songs and dance activities incorporating rhythm and counting (WM = 5.00, SD = 0.00), followed by shape hunting games (WM = 4.67, SD = 0.50), mathematics mobile applications (WM = 4.56, SD = 0.53), and card matching games (WM = 4.56, SD = 0.73), while the lowest indicators (role-playing, block building, board games, and dice rolling games) each had WM = 4.33 but still fell within the Always range. This consistently high extent of utilization implies that teachers already recognize the value of game-based learning in developing numeracy skills, aligning with research showing that digital and non-digital educational games significantly enhance numeracy development in early childhood by making learning more engaging and effective (Bakar & Rafi, 2025). The perfect score for songs and dance suggests this strategy is deeply embedded and can serve as an anchor for introducing less frequently used game types, while higher variability in hopscotch (SD = 1.13), board games (SD = 1.00), and dice rolling games (SD = 1.00) indicates these would benefit from targeted professional development. Research confirms that both digital applications and traditional non-digital games such as board games and card games yield substantial improvements in early mathematical competencies (Đan et al., 2024). Given the low-income profile of families (Table 11), the intervention plan should balance digital and non-digital options, ensuring reliance on mobile applications does not disadvantage learners without home access to devices. Overall, the teachers' readiness and positive practice create a strong foundation for enhancing and optimizing existing game-based practices to further improve numeracy skills (Ismawati & Puspita, 2024; Yee et al., 2022; Suci et al., 2023).

Level of Numeracy Skills of Kindergarten Learners

Table 12
Foundational Skills

S/N	Indicators	WM	SD	VD
1	Identifies basic colors and shapes	3.71	0.61	Expert
2	Sorts and classifies objects (color, shape, size)	3.62	0.68	Expert
3	Compares objects (big/small, long/short	3.71	0.57	Expert
4	Arranges objects by size or order	3.57	0.59	Expert
	Aggregate Mean	3.65		Expert
	Aggregate Standard Deviation		0.61	

Legend: 3.25-4.00-Expert; 2.50-3.24-Advanced; 1.75-2.49-Intermediate; 1.00-1.74-Beginner

As presented in Table 12, the aggregate mean for foundational skills among kindergarten learners was 3.65 (Expert), with an aggregate standard deviation of 0.61 indicating relatively consistent performance. The highest weighted means were for "Identifies basic colors and shapes" (WM = 3.71, SD = 0.61) and "Compares objects" (WM = 3.71, SD = 0.57), followed by "Sorts and classifies objects" (WM = 3.62, SD = 0.68), while the lowest was "Arranges objects by size or order" (WM = 3.57, SD = 0.59)—all still within the Expert range. These expert-level foundational skills imply that learners are developmentally ready to engage with more complex numeracy concepts such as number sense and operations, aligning with research emphasizing that early mathematical competencies including counting, cardinality, and magnitude comparison are prerequisites for mastering more intricate mathematical understanding (Ali et al., 2022; Ünal & Kaya, 2024). The strong performance in color, shape, sorting, and comparison skills suggests that teachers have effectively utilized educational games and other instructional strategies to build these competencies, corroborating findings that interventions using digital educational tools and gamified applications effectively enhance early numeracy skills (Firdaus et al., 2024). For the proposed intervention plan, less instructional time needs to be devoted to basic foundational skills, allowing teachers to focus more on advancing number sense and operations; however, the slightly lower seriation performance suggests educational games targeting sequential ordering should be intentionally incorporated, and moderate standard deviations indicate that differentiated instruction may still be necessary for learners below expert level, as developmentally appropriate learning through engaging modalities like educational games significantly contributes to foundational numeracy enhancement (Sepúlveda et al., 2026).

Table 13
Patterns, Time, and Measurement

S/N	Indicators	WM	SD	VD
1	Recognizes and completes patterns	3.41	0.69	Expert
2	Identifies time of day and tells time (hour)	3.02	0.81	Advanced
3	Names days of the week and months	3.01	0.82	Advanced
4	Uses simple tools to measure	2.86	0.90	Advanced
	Aggregate Mean	3.08		Advanced
	Aggregate Standard Deviation		0.80	

As reflected in Table 13, the aggregate mean for patterns, time, and measurement among kindergarten learners was 3.08 (Advanced), with an aggregate standard deviation of

0.80 indicating moderate variability. The highest weighted mean was for "Recognizes and completes patterns" (WM = 3.41, SD = 0.69—Expert), followed by "Identifies time of day and tells time" (WM = 3.02, SD = 0.81—Advanced), "Names days of the week and months" (WM = 3.01, SD = 0.82—Advanced), and the lowest for "Uses simple tools to measure" (WM = 2.86, SD = 0.90—Advanced). The expert-level pattern recognition aligns with research showing that engaging and interactive methods, such as those found in traditional children's games, bolster cognitive development and mathematical skills related to pattern creation and completion (Öngören & Gündoğdu, 2021), while the lower measurement skills highlight areas where targeted educational interventions—potentially leveraging digital games with features like immediate feedback—could significantly enhance foundational mathematical understanding (Ünal & Kaya, 2024; Sepúlveda et al., 2026). The increasing standard deviations from pattern recognition (SD = 0.69) to measurement (SD = 0.90) suggest that learners' abilities become more diverse as skills become more complex, implying that a subset of learners may struggle significantly with time and measurement concepts, requiring targeted small-group game-based interventions. For the proposed intervention plan, the strong logical sequencing abilities from pattern recognition should be leveraged to improve weaker areas, with intentional incorporation of educational games involving measurement (e.g., using non-standard units) and time concepts (e.g., daily routines, calendar activities), as researchers have affirmed the positive contributions of game activities to learning mathematics, including observation, classification, and measurement abilities (Çullu & Şahin, 2022; Jensen et al., 2023).

Table 14
Number Sense and Operations

S/N	Indicators	WM	SD	VD
1	Counts and recognizes numbers (0–10)	3.86	0.46	Expert
2	Matches numbers to objects	3.68	0.57	Expert
3	Orders numbers and identifies the position	3.49	0.68	Expert
4	Solves simple addition and subtraction using objects	3.40	0.73	Expert
	Aggregate Mean	3.61		Expert
	Aggregate Standard Deviation		0.61	

As presented in Table 14, the aggregate mean for number sense and operations among kindergarten learners was 3.61 (Expert), with an aggregate standard deviation of 0.61 indicating relatively consistent performance. The highest weighted mean was for "Counts and recognizes numbers (0–10)" (WM = 3.86, SD = 0.46—the highest score across all numeracy indicators), followed by "Matches numbers to objects" (WM = 3.68, SD = 0.57), "Orders numbers and identifies position" (WM = 3.49, SD = 0.68), and "Solves simple addition and subtraction using objects" (WM = 3.40, SD = 0.73), revealing a descending trend in performance from basic counting to more complex operations with increasing variability (SD from 0.46 to 0.73). This observed descending trend aligns with research indicating that foundational numerical competencies like counting and number recognition typically mature earlier than more abstract operations such as addition and subtraction (Chatzaki et al., 2024), and educational interventions often need to be tailored to developmental stages, gradually introducing complex concepts once foundational skills are established (Koç et al., 2023). The expert-level performance across all indicators implies that learners have developed a solid numerical foundation supporting their transition to Grade 1 mathematics, with the exceptionally strong counting and number recognition suggesting that teachers have effectively utilized educational games targeting these basic skills. For the proposed intervention plan,

educational games should maintain counting reinforcement while placing increased emphasis on explicit addition and subtraction games (e.g., "how many in all?" games, take-away games using manipulatives, story-based problem-solving), as studies emphasize the effectiveness of digital educational tools and game-based learning in enhancing early mathematical comprehension, particularly in number recognition and basic operations (Đan et al., 2024). The moderate standard deviations, especially for operations (SD = 0.73), imply that differentiated game-based instruction may be necessary, and the strong number sense foundation can be leveraged to improve weaker areas from the patterns/time/measurement domain, given that early childhood numeracy forms the bedrock for later mathematical understanding and academic success (Adawurah, 2025; Vlassis et al., 2022).

Table 15
Applied Numeracy

S/N	Indicators	WM	SD	VD
1	Groups objects into equal sets	3.38	0.71	Expert
2	Identifies simple fractions (half)	3.02	0.87	Advanced
3	Recognizes coins and bills (up to ₱20)	3.37	0.66	Expert
	Aggregate Mean	3.26		Expert
	Aggregate Standard Deviation		0.75	

As reflected in Table 15, the aggregate mean for applied numeracy among kindergarten learners was 3.26 (Expert), with an aggregate standard deviation of 0.75 indicating moderate variability; however, this was the lowest among all numeracy domains and barely exceeded the expert threshold of 3.25. The highest indicator was "Groups objects into equal sets" (WM = 3.38, SD = 0.71—Expert), followed by "Recognizes coins and bills up to ₱20" (WM = 3.37, SD = 0.66—Expert), while the lowest was "Identifies simple fractions (half)" (WM = 3.02, SD = 0.87—Advanced), which was the only indicator across all domains falling below the expert threshold. This relative weakness in applied numeracy, particularly in fraction identification, suggests a critical area for targeted intervention, as early numeracy skills are foundational for later mathematical achievement (Sepúlveda et al., 2026), and while digital educational games can generally enhance numeracy development, specific instructional approaches may be necessary to address nuanced conceptual challenges like fractions (Alotaibi, 2024). The infrequent exploration of non-digital gamification for specific topics like fractions underscores a research gap (Setambah et al., 2024), warranting further investigation into both digital and non-digital game-based strategies for improving fractional understanding (Ali et al., 2022). For the proposed intervention plan, priority should be given to educational games using concrete, hands-on materials to teach the concept of "half" (e.g., sharing snacks equally, folding paper, cutting play dough), leveraging the strong performance in currency recognition through "buying/selling" games, and ensuring differentiated instruction given the standard deviations (SD = 0.87 for fractions), as integrating game-based assessments using board games offers reliable means to evaluate early mathematical competencies beyond rote counting (Adawurah, 2025).

Table 16
Summary on the Level of Numeracy Skills of Kindergarten Learners

Components	WM	SD	Verbal Description
Foundational Skills	3.65	0.61	Expert
Patterns, Time, and Measurement	3.08	0.80	Advanced
Number Sense and Operations	3.61	0.61	Expert
Applied Numeracy	3.26	0.75	Expert

Grand Mean	3.40		Expert
Grand Standard Deviation		0.69	

As presented in Table 16, the grand mean for overall numeracy skills of kindergarten learners was 3.40 (Expert), with a grand standard deviation of 0.69 indicating moderate variability. Foundational Skills obtained the highest weighted mean (WM = 3.65, SD = 0.61—Expert), followed by Number Sense and Operations (WM = 3.61, SD = 0.61—Expert), Applied Numeracy (WM = 3.26, SD = 0.75—Expert), and Patterns, Time, and Measurement (WM = 3.08, SD = 0.80—Advanced), which was the only domain not reaching the expert level. The strong performance in foundational skills and number sense aligns with research showing that digital educational games significantly enhance early numeracy skills, particularly in number identification, counting, and cardinality—critical predictors of later mathematical achievement (Sepúlveda et al., 2026; Firdaus et al., 2024), and that strong foundational numeracy links to enhanced problem-solving capabilities in early learners (Rauf & Prihadi, 2025). The significant gap between the highest domains and patterns/time/measurement suggests an imbalance in curriculum emphasis or instructional focus, indicating that the proposed intervention plan should prioritize educational games targeting patterns, time concepts, and measurement skills —areas where learners demonstrated the greatest challenge. Early exposure to interactive and play-based digital learning tools fosters superior acquisition of foundational mathematical knowledge, often surpassing traditional approaches (Mutua et al., 2026; Suci et al., 2023), and game-based learning improves various outcomes when implemented with educator-guided gameplay and scaffolding (Alotaibi, 2024). The moderate grand standard deviation (0.69) implies individual learner variability, suggesting differentiated game-based instruction is necessary, and the strong foundational and number sense skills can be leveraged to support weaker domains (e.g., using counting to measure length), as the ability to recall and apply basic mathematical facts through engaging practice directly supports higher-order cognitive processes (Singh et al., 2021).

Significant Relationship Between the Identified Profile and the Numeracy Skills of the Learners

Table 17
Test of Significance of the Relationship Between the Identified Profile and the Numeracy Skills of the Learners

Variables	χ^2 - value	df	p - value	Decision	Remarks
Age and Numeracy Skills	0.286	2	0.867	Do not reject Ho	Not Significant
Gender and Numeracy Skills	1.352	2	0.509	Do not reject Ho	Not Significant
Mother's Highest Educational Attainment and Numeracy Skills	3.657	2	0.161	Do not reject Ho	Not Significant
Father's Highest Educational Attainment and Numeracy Skills	0.338	2	0.845	Do not reject Ho	Not Significant

Number of Siblings and Numeracy Skills	2.848	4	0.584	Do not reject Ho	Not Significant
Birth Order and Numeracy Skills	6.993	4	0.136	Do not reject Ho	Not Significant
Combined Monthly Income and Numeracy Skills	13.984	10	0.174	Do not reject Ho	Not Significant

*significant at $p<0.05$ (two-tailed)

As presented in Table 17, the chi-square test of independence revealed that all computed p-values for the seven learner profile variables—age ($\chi^2 = 0.286$, df = 2, p = 0.867), gender ($\chi^2 = 1.352$, df = 2, p = 0.509), mother's education ($\chi^2 = 3.657$, df = 2, p = 0.161), father's education ($\chi^2 = 0.338$, df = 2, p = 0.845), number of siblings ($\chi^2 = 2.848$, df = 4, p = 0.584), birth order ($\chi^2 = 6.993$, df = 4, p = 0.136), and combined monthly income ($\chi^2 = 13.984$, df = 10, p = 0.174)—exceeded the 0.05 significance level, leading to non-rejection of the null hypothesis for all variables, indicating no significant relationship with kindergarten learners' numeracy skills. This absence of significant relationships diverges from findings in other educational contexts where parental education and income often correlate with academic outcomes (Jensen et al., 2023), suggesting that factors such as the quality of educational interventions or the specific learning environment may play a more dominant role in shaping early numeracy development within this sample (Mues et al., 2025). The finding implies that the school's instruction, including the utilization of educational games, effectively supported numeracy development regardless of a child's age, gender, family background, or economic status, potentially serving as an equalizer that compensates for disadvantages. This notion is supported by studies demonstrating that well-designed digital gamified applications can significantly improve numeracy skills irrespective of demographic variables by providing immediate feedback and enhancing motivation (Alotaibi, 2024), and that effective pedagogical tools such as card games or play-based learning activities can stimulate cognitive interest and improve outcomes, potentially overriding demographic influences (Singh et al., 2021). For the proposed intervention plan, a one-size-fits-all approach to game-based numeracy instruction may be appropriate since learner characteristics did not significantly predict outcomes, though teachers should still exercise differentiated instruction based on individual learning needs rather than demographic profiles, as active engagement facilitates deeper conceptual understanding that may attenuate the predictive power of traditional socioeconomic indicators on academic achievement (Bach et al., 2024; Sari et al., 2025)

Findings

All kindergarten teacher-respondents were female, with the largest age group falling within the 31–35 range. In terms of education, the majority had completed master's units, followed by those holding a master’s degree, and a smaller portion holding only a bachelor’s degree. Regarding teaching experience, more than half had taught for 11 years or more, while the remaining teachers had varying levels of experience, including one novice teacher. All teacher-respondents reported having attended at least one EdTech training.

The kindergarten learner-respondents were predominantly six years old and male. Their mothers and fathers were mostly high school graduates. The majority of learners had one to two siblings, were second-born children, and came from families with a combined monthly income at the lowest bracket.

Teachers’ utilization of educational games was rated at the highest verbal description. Among the specific activities, songs and dance activities, shape hunting games, mathematics

mobile applications, and card matching games were rated the highest. In contrast, role-playing activities, block building activities, board games, and dice rolling games were rated the lowest —though still within the highest descriptive category.

Overall numeracy skills of the learners were classified at the second highest level. Foundational skills and number sense and operations both fell under the highest classification, while applied numeracy also reached the second highest level. Patterns, time, and measurement were rated at the next lower level. Within applied numeracy, identifying simple fractions (half) was the lowest-performing indicator. Within patterns, time, and measurement, using simple tools to measure was the lowest-performing indicator.

The analysis revealed no significant relationship between any of the identified learner profile variables—including age, gender, parents' educational attainment, number of siblings, birth order, and combined monthly income—and the numeracy skills of the learners.

Based on the findings, an intervention plan was developed to enhance the use of educational games for improving numeracy skills among kindergarten pupils. The plan specifically targeted the lowest-performing indicators identified in the study.

CONCLUSION

This study concludes that the utilization of educational games in teaching numeracy skills among kindergarten pupils at Basak Elementary School is consistently high and has contributed to overall expert-level numeracy outcomes. The teachers' advanced educational attainment, extensive experience, and universal EdTech training create a favorable professional environment for game-based instruction. The equitable outcomes across diverse demographic groups with no significant relationships between any learner profile variable and numeracy skills provide strong evidence that well-implemented game-based learning can serve as an educational equalizer, mitigating potential disadvantages associated with low family income and parental education. However, the study also identified specific areas requiring targeted intervention: measurement skills, fraction concepts, and time-related knowledge, which lag behind the otherwise expert-level performance. Therefore, Project GAME On, focusing on these identified gaps through low-cost, developmentally appropriate, and engaging game-based strategies, is both justified and necessary to elevate all numeracy domains to the Expert level and to ensure that every kindergarten learner at Basak Elementary School is fully prepared for Grade 1 mathematics.

Based on the findings and conclusions of the study, it is recommended that the proposed intervention plan titled "Project GAME On (Games Amplifying Mathematics Excellence for Kindergarten Onwards)" be adopted and implemented at Basak Elementary School. The intervention plan is designed to enhance the utilization of educational games in improving numeracy skills among kindergarten pupils, specifically targeting the areas of concern identified in the study: measurement skills, fraction concepts, time-related concepts, and pattern extension activities. The plan provides concrete, evidence-based, and resource-sensitive strategies that are appropriate for the low-income profile of the learners' families and leverages the teachers' existing high level of game utilization and EdTech training. School administrators are encouraged to allocate resources for the implementation of the intervention, including the development of low-cost game kits, teacher professional development sessions, and parent orientation workshops. Kindergarten teachers are encouraged to integrate the proposed game-based activities into their daily numeracy instruction, particularly focusing on measurement, fractions, time, and patterns. Future researchers are encouraged to conduct experimental studies

to test the effectiveness of the proposed intervention plan and to explore its scalability to other grade levels and school contexts.

REFERENCES

Abdullahi, S., & Abdulkareem, H. B. (2023). Educational psychology perspective on constructive, social play and academic performance of primary school children in Nigeria. ProGCouns Journal of Professionals in Guidance and Counseling, 4(1), 1. https://doi.org/10.21831/progcouns.v4i1.55757

Abenes, F. M. D., Caballes, D. G., Balbin, S., & Conwi, X. L. P. (2023). Gamified Mobile Apps' Impact on Academic Performance of Grade 8 in a Mainstream Physics Class. Journal of Information Technology Education Research, 22, 557. https://doi.org/10.28945/5201

Adawurah, M. (2025). Enhancing Early Numeracy through Play-Based Learning: A Case Study Using Counting Games and Visual Aids in a Ghanaian Kindergarten Classroom. https://doi.org/10.21203/rs.3.rs-6787623/v1

Afrianti, R., & Maryatun, I. B. (2025). Utilization Of Educational Games As Learning Media: Recognize The Concept Of Numbers. Jurnal Eduscience, 12(2), 592. https://doi.org/10.36987/jes.v12i2.6833

Ahmed, M., Usmiyatun, U., Nurhidayah, N., Darmayanti, R., & Azizah, I. N. (2021). PDKT: Introducing numbers 1-10 for kindergarten students using card media, does It improve? AMCA Journal of Education and Behavioral Change, 1(2), 69. https://doi.org/10.51773/ajeb.v1i2.268

Al-Hassan, O. M., Alhasan, L. M., AlAli, R. M., Al-Barakat, A. A., Al-Saud, K., & Ibrahim, N. (2025). Enhancing Early Childhood Mathematics Skills Learning through Digital Game-Based Learning. International Journal of Learning Teaching and Educational Research, 24(2), 186. https://doi.org/10.26803/ijlter.24.2.10

Akçinar, S., & Arak, R. (2023). Investigation of Educational Game-Playing Skills of Preschool Teachers. International Journal of Disabilities Sports & Health Sciences, 442. https://doi.org/10.33438/ijdshs.1359756

Alfaregi, I. S., Hartati, S., & Akbar, Z. (2024). Eksplorasi Korelasi Gender Sebagai Mediator dalam Keterlibatan Anak di Taman Kanak-Kanak. Kiddo Jurnal Pendidikan Islam Anak Usia Dini, 5(2), 374. https://doi.org/10.19105/kiddo.v5i2.14910

Ali, S. R., Sarudin, A., Azura, R. N. F., & Farhana, M. Z. (2022). Gamifications: Lexical and trajectory image methods as cognitive intervention in numeracy. International Journal of Evaluation and Research in Education (IJERE), 11(3), 1480. https://doi.org/10.11591/ijere.v11i3.22450

Alotaibi, M. S. (2024). Game-based learning in early childhood education: a systematic review and meta-analysis [Review of Game-based learning in early childhood education: a systematic review and meta-analysis]. Frontiers in Psychology, 15. Frontiers Media. https://doi.org/10.3389/fpsyg.2024.1307881

Alvarez, J. I., & Galman, E. T. (2025). Gaps and Gains: A Needs and Resource Assessment of Early Childhood Educators in Public Schools. Educational Process International Journal, 19(1). https://doi.org/10.22521/edupij.2025.19.573

Anggraeni, R., Rahmadanti, D. A., Aryanti, R. A., Zahra, A. S. A., Fakhriyah, F., & Fajrie, N. (2024). Systematic Literature Review: Peningkatan Kemampuan Literasi Numerasi Siswa SD Melalui Pendekatan Media Pembelajaran Berbasis Game. Intellektika Jurnal Ilmiah Mahasiswa, 2(5), 84. https://doi.org/10.59841/intellektika.v2i5.1483

Asqia, M., Zahra, N. H., Hujaimah, S., Mulyadi, R., & Rahmah, A. (2025). Analysis and Development of an Educational Game for Early Childhood Numeracy Learning through a Curriculum-Based and Functional Evaluation Approach. Teknika, 14(3), 387. https://doi.org/10.34148/teknika.v14i3.1349

Avidov-Ungar, O., & Hayak, Merav. (2023). Education and Games: Teachers' Professional Knowledge in Integrating Digital Games into Instruction in School. In IntechOpen eBooks. IntechOpen. https://doi.org/10.5772/intechopen.109594

Bach, K. M., Reinhold, F., & Hofer, S. (2024). Unlocking Math Potential in Students from Lower SES Backgrounds – Using Instructional Scaffolds to Improve Performance. Research Square. https://doi.org/10.21203/rs.3.rs-4685627/v1

Bakar, K. A., & Rafi, H. (2025). The Effectiveness of Using Mathematical Games in Learning Centers in Improving Number Mastery among Preschool Students. International Journal of Academic Research in Business and Social Sciences, 15(3). https://doi.org/10.6007/ijarbss/v15-i3/25146

Balala, M. M. A., Areepattamannil, S., & Cairns, D. (2021). Investigating the associations of early numeracy activities and skills with mathematics dispositions, engagement, and achievement among fourth graders in the United Arab Emirates. Large-Scale Assessments in Education, 9(1). https://doi.org/10.1186/s40536-021-00106-4

Bang, H. J., & Siebert-Evenstone, A. (2024). Evaluation of a personalized game-based learning app for developing young children's reading skills. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-3826156/v1

Blancaflor, E., Camaongay, K. D. G., Chua, J. A. S., & Echanes, G. A. (2022). A Gamified Educational Learning Module for Core Subjects in an Elementary Level. International Journal of Information and Education Technology, 12(11), 1280. https://doi.org/10.18178/ijiet.2022.12.11.1751

Buray, A., & Alferez, R. C. (2025). Digital Game-Based Learning: Its Contribution to Numeracy Skills among Grade 1 Learners. Psychology and Education A Multidisciplinary Journal, 34(5), 592. https://doi.org/10.70838/pemj.340504

Capinding, A. T., & Salazar, R. D. (2023). Revitalizing Science Education: Harnessing the Power of Traditional Filipino Games in the Classroom. TEM Journal, 2241. https://doi.org/10.18421/tem124-35

Chananila, S., Julakarnb, P., & Ratcha-Artc, S. (2025). Learning to Teach Elementary Mathematics with Digital Tools: A Blended Learning Approach for Second-Year Pre-Service Mathematics Teachers.

Chatzaki, M.-A., Skillen, J., Ricken, G., & Seitz-Stein, K. (2024). Exploring the potential of a game-based preschool assessment of mathematical competencies. Frontiers in Education, 9. https://doi.org/10.3389/feduc.2024.1337716

Chavez, V. L. A. (2024). Exploring Latent Class Profiles of Mathematics Performance among Filipino Students: Insights from PISA 2022 Using Growth Mindset Indicators and Group Comparison Analysis. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-4617174/v1

Chen, G. (2023). Integrating Digital Cultural Detective Games with Social Emotional Learning to Foster Cultural Sensitivity and Intercultural Empathy among Bilingual Kindergarten Teachers: A Mixed-Methods Study. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-2781249/v1

Children's Competencies Development in the Home Learning Environment. (2021). In Frontiers research topics. Frontiers Media. https://doi.org/10.3389/978-2-88971-122-2

Chirimbana, M., Makaka, B., & Hilongwa, L. (2024). Understanding the Factors and Challenges in Developing Number Sense in Early Childhood Education: A Case Study of the Oluno Circuit. Open Journal of Social Sciences, 12(2), 168. https://doi.org/10.4236/jss.2024.122011

Cook, O., Westover, A. E., & Coffman, J. L. (2025). Children's early math problem-solving: The role of parent numeracy practices, numeracy expectations, and math attitudes. Journal of Numerical Cognition, 11. https://doi.org/10.5964/jnc.16725

Copioso, A. L., & Lapada, A. A. (2024). Dynamic Learning Program and its Effect on Students' Mathematics Achievement. https://doi.org/10.5281/zenodo.11672445

Çullu, F., & Şahin, Ç. (2022). Opinions of Pre-School Teachers on Mathematics Gains of Early Childhood Period Play Activities. DergiPark (Istanbul University). https://dergipark.org.tr/tr/pub/ijofe/issue/71595/1106594

Đan, N. N., Trung, L. T. B. T., Nga, N. T. H., & Tăng, M. D. (2024). Digital game-based learning in mathematics education at primary school level: A systematic literature review. Eurasia Journal of Mathematics Science and Technology Education, 20(4). https://doi.org/10.29333/ejmste/14377

Darnon, C., & Fayol, M. (2021). Can an early mathematical intervention boost the progress of children in kindergarten? A field experiment. European Journal of Psychology of Education, 37(1), 1. https://doi.org/10.1007/s10212-021-00550-4

Debrenti, E. (2024). Game-Based Learning experiences in primary mathematics education. Frontiers in Education, 9. https://doi.org/10.3389/feduc.2024.1331312

Ed, C. N. S., MS MATH, ED, I. K. C. S., MS MATH, & Escarlos,PhD, G. S. (2025). Academic Recovery and Accessible Learning (ARAL) Reading Program on Students' Numeracy and Problem-solving Skills. International Journal of Latest Technology in Engineering Management & Applied Science, 14(11), 303. https://doi.org/10.51583/ijltemas.2025.1411000030

Elfiky, D. E. G. (2021). The Effect of a Whole Brain Teaching Based Instruction on Developing Number Competencies and Arithmetic Fluency in Kindergarten Children. International Journal of Instruction, 15(1), 673. https://doi.org/10.29333/iji.2022.15138a

Esteban, B. R., & Cajandig, A. J. S. (2025). Development and Evaluation of Math-Talino KNBA? Gamified Peer-Tutoring Program. International Journal of Research and Scientific Innovation, 926. https://doi.org/10.51244/ijrsi.2025.12040078

Firdaus, F. M., Safitri, A., Amanah, D. N., Fadhli, R., & Hassan, N. M. (2024). Evaluating the Effectiveness of the iPusnas in Enhancing Elementary Students' Numeracy Skills. Record and Library Journal, 10(1), 93. https://doi.org/10.20473/rlj.v10-i1.2024.93-102

Fitriyah, I. J., Erlangga, S. Y., Muqoyyidin, A. W., & Aprilia, S. (2025). Exploring the role of moderators in the effectiveness of digital games for stem education: a systematic review and meta-analysis [Review of Exploring the role of moderators in the effectiveness of digital games for stem education: a systematic review and meta-analysis]. Discover Education, 4(1). Springer Science+Business Media. https://doi.org/10.1007/s44217-025-00756-4

Garcia, M., Gaylo, D. N., & Vistro-Yu, C. P. (2024). Writing PISA-Like Mathematics Items: The Case of Tertiary Mathematics Instructors from a State University in the Philippines. European Journal of Educational Research, 13(4). https://doi.org/10.12973/eu-jer.13.4.1443

Ghazali, M., Mustafa, Z., Rashid, R.-A. A., & Amzah, F. (2021). Parental Involvement in Young Children's Learning of Numeracy. International Journal of Learning Teaching and Educational Research, 20(1), 199. https://doi.org/10.26803/ijlter.20.1.11

Ginting, M. B., Purnomo, Y. W., & Haryanto, H. (2025). A Design of integrated STEM constructive games for developing the Four Cs in early elementary students. International Journal of Serious Games, 12(4), 169. https://doi.org/10.17083/3bcwrq59

Godoy, C. H. (2022). Developing an Augmented Reality-Based Game as a Supplementary tool for SHS- STEM Precalculus to Avoid Math Anxiety. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2109.09336

Gottardo, M., & Restiglian, E. (2022). International Journal of Education Humanities and Social Science. International Journal of Education Humanities and Social Science. https://doi.org/10.54922/ijehss

Grimes, K. R., Park, S., McClelland, A. M., Park, J., Lee, Y. R., Nozari, M., Umer, Z., Zaparolli, B., & Bryant, D. P. (2021). Effectiveness of a numeracy intelligent tutoring system in kindergarten: A conceptual replication. Journal of Numerical Cognition, 7(3), 388. https://doi.org/10.5964/jnc.6931

Gui, Y., Cai, Z., Yang, Y., Kong, L., Fan, X., & Tai, R. H. (2023). Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review [Review of Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review]. International Journal of STEM Education, 10(1). Springer Science+Business Media. https://doi.org/10.1186/s40594-023-00424-9

Hidayah, F. N., & Retnawati, H. (2024). The Impact of Numeracy on Early Childhood Development: A Meta-Analysis of Experimental Studies. Golden Age Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini, 9(3), 559. https://doi.org/10.14421/jga.2024.93-15

Hoareau, L. (2021). Co-design, and preschool teachers' acceptance of an educational app for tablet. HAL (Le Centre Pour La Communication Scientifique Directe). https://hal.univ-lorraine.fr/tel-03268287

Ilić, J., Ivanović, M., & Klašnja-Milićević, A. (2024). Effects Of Digital Game-Based Learning In Stem Education On Students' Motivation: A Systematic Literature Review. Journal of Baltic Science Education, 23(1), 20. https://doi.org/10.33225/jbse/24.23.20

Ismawati, D., & Puspita, Y. (2024). Inovasi Pembelajaran Literasi Numerasi untuk Anak Usia Dini di Era Digital. Indonesian Research Journal On Education, 4(3). https://doi.org/10.31004/irje.v4i3.1530

Jensen, H., Pedersen, L. B., & Bommersholdt, S. R. (2023). Fostering student engagement and technology comprehension through playful teaching and learning. Research Portal Denmark. https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=ucsyd&id=ucsyd-319e99cd-78c5-44d9-8dc6-f48d826cd347

Kara, S., Yavuz, A., Yalçin, E. M., Genç, H. N., Acar, D., Aktaş, O., Büyükşahin, Y., Tekindur, A., Tokgöz, E. Ö., Özden, B., Karakulak, B. Ç., Çenberci, S., Tol, H. Y., Taş, S., & Erdoğdu, M. (2025). Innovative Technologies and Current Trends in Science and Mathematics Education.

Kariza, A., & Lisa, C. (2025). Numeracy Skills of Grade 1 Learners. Zenodo. https://doi.org/10.5281/zenodo.15259709

Karuniah, M., Lian, B., & Novianti, R. (2023). Pengaruh Permainan Congklak Terhadap Kemampuan Berhitung Permulaan Anak di TK Lematang Lestari Muara Enim. ANTHOR Education and Learning Journal, 2(6), 827. https://doi.org/10.31004/anthor.v2i6.254

Kim, J.-D., & Kim, J.-D. (2024). Paper Title. Korean Journal of Fusion Ayurveda, 16, 77. https://doi.org/10.52251/kja.2024.16.77

Koç, K., Arı, A. A., & Koç, Y. (2023). Introducing The Coordinate System To Kindergarten Children: A Developmental Approach. European Journal of Education Studies, 10(9). https://doi.org/10.46827/ejes.v10i9.4935

Kufarimani, N., & Chitanana, L. (2025). Primary educators' perceptions of adopting indigenous-themed digital games: insights across career stages. Discover Education, 4(1).

Lasala, N. J. (2023). EDUTainment: Effectiveness of Game-based Activities in Teaching Ecosystem Topics. Recoletos Multidisciplinary Research Journal, 11(2). https://doi.org/10.32871/rmrj2311.02.07

Lim, E. J. A. (2021). Math Class Gamified! Effects on the Mathematics Performance of COED Students of Eastern Samar State University, Philippines. Indian Journal of Science and Technology, 14(23), 1970. https://doi.org/10.17485/ijst/v14i23.902

Lozano, A., Canlas, R. J., Coronel, K., Canlas, J., Duya, J., Macapagal, R., Dungca, E., & Miranda, J. P. P. (2023). A Game-Based Learning Application to Help Learners to Practice Mathematical Patterns and Structures. International Journal of Computing Sciences Research, 7, 2212. https://doi.org/10.25147/ijcsr.2017.001.1.156

Maghfirah, F., Kartika, W. I., Hasnur, R. A., Azzahra, V., & Pertiwi, A. D. (2025). Enhancing Early Childhood Mathematical Skills through Contextual Digital Game-Based Learning: Evidence from the BEKANTAN Intervention in Indonesia. Golden Age Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini, 10(2), 295. https://doi.org/10.14421/jga.2025.102-07

Marie, D., Verzosa, B., Louise, M., Peñas, A. D. L., Sarmiento, J. R., Aberin, M., Anthony, M., Tolentino, M. A. C., & Loyola, M. L. (2021). Using Mobile Technology To Promote Higher-Order Thinking Skills In Elementary Mathematics. https://doi.org/10.33965/ml_icedutech2021_202102l003

Maryana, M., Halim, C., & Rahmi, H. (2024). The Impact of Gamification on Student Engagement and Learning Outcomes in Mathematics Education. International Journal of Business Law and Education, 5(2), 1697. https://doi.org/10.56442/ijble.v5i2.682

Merkley, R., Sernoskie, E., Cook, C. J., Howard, S. J., Makaula, H., Mshudulu, M., Tshetu, N., Draper, C. E., & Scerif, G. (2023). “We don’t have things for counting”: An exploration of early numeracy skills and home learning experiences of children growing up in poverty in South Africa. Journal of Numerical Cognition, 9(2), 268. https://doi.org/10.5964/jnc.8061

Meylani, R. (2025). Gamification and Game-Based Learning in Mathematics Education for Advancing SDG 4: a Systematic Review and Qualitative Synthesis of Contemporary Research Literature. Journal of Lifestyle and SDGs Review, 5(2). https://doi.org/10.47172/2965-730x.sdgsreview.v5.n02.pe04567

Mondragon, S. M. M., Bantulo, J. S., & Quines, L. A. (2023). Effectiveness Of Supplementary Learning Materials Utilizing Digital Play-Based Learning Package. European Journal of Education Studies, 10(6). https://doi.org/10.46827/ejes.v10i6.4858

Msall, C., Douglas, A.-A., & Rittle-Johnson, B. (2023). Parents' approaches to numeracy support: what parents do is rarely what they think is most important. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1114803

Mues, A., Birtwistle, E., Wirth, A., Schiele, T., & Niklas, F. (2025). Supporting children's numeracy competencies and families' HNE: Exploring the role of apps and digital parent information in STEM vs. Non-STEM families. European Journal of Psychology of Education, 40(2), 53. https://doi.org/10.1007/s10212-025-00953-7

Muhtarom, M., Adrillian, H., M.H, A. B. H., & Ribowo, M. (2022). Pengembangan Game Edukasi Matematika Untuk Meningkatkan Kemampuan Numerasi Siswa Smp. Transformasi Jurnal Pendidikan Matematika Dan Matematika, 6(2), 95. https://doi.org/10.36526/tr.v6i2.2176

Mutua, P., Mulwa, P., & Ngaruiya, B. (2026). The Effect of Xerte Online Toolkit Facilitated Engagement on Numeracy Performance Among Preschool Learners in Msambweni Sub County, Kenya. Higher Education Research, 11(1), 1. https://doi.org/10.11648/j.her.20261101.11

Nautwima, J. P., Romeo, A., & Nendongo, V. P. (2022). Integrating Gamification into Middle School Mathematics Curriculum: Game-Based Learning Approach in Namibia. International Journal of Operations Management, 2(4), 7. https://doi.org/10.18775/ijom.2757-0509.2020.24.4001

Öngören, S., & Gündoğdu, S. (2021). Mathematical Skills in Traditional Children's Games in Early Childhood. Kastamonu Eğitim Dergisi, 29(5), 1052. https://doi.org/10.24106/kefdergi.735687

Orbach, L., Fritz, A., Haase, V. G., Dowker, A., & Räsänen, P. (2023). Conditions of distance learning and teaching and their relation to elementary school children's basic number skills after the suspension of face-to-face teaching during the COVID-19 pandemic. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1083074

Rahmadhani, E., Wahyuni, S., & Mandasari, L. (2023). The symbolic thinking ability of kindergarten students in central Aceh through Montessori games based on gender. International Journal of Evaluation and Research in Education (IJERE), 12(1), 139. https://doi.org/10.11591/ijere.v12i1.23777

Ranak, L., Rustam, R., & Ero, P. E. L. (2023). Evaluation and effects of STEAM-PBL on mathematics interest and numeracy skills on elementary school. Jurnal Riset Pendidikan Matematika, 10(2), 199. https://doi.org/10.21831/jrpm.v10i2.67251

Rauf, A., & Prihadi, K. D. (2025). Impact of Digital Games on Preschool Learning: An Exploratory Study. Jurnal E-Bangi/e-Bangi, 22(3). https://doi.org/10.17576/ebangi.2025.2203.16

Republic Act No. 10157. (2012). An act establishing kindergarten as an mandatory and compulsory level of education, providing funds therefor and for other purposes. https://www.officialgazette.gov.ph/2011/12/22/republic-act-no-10157/

Republic Act No. 10533. (2013). An act enhancing basic education in the Philippines and codifying new curricula in schools and for other purposes. https://www.officialgazette.gov.ph/2013/05/15/republic-act-no-10533/

Republic Act No. 11650. (2022). Basic education development act of 2022. https://www.officialgazette.gov.ph/downloads/2022/01jan/20220104-RA-11650-RRD.pdf

Rozi, N. A. K., (2025). Little Steps, Big Counts: The Literature Review Of Parental Play On Early Math Learning. Quantum Journal of Social Sciences and Humanities, 6(3), 344. https://doi.org/10.55197/qjssh.v6i3.695

Salami, O. O., & Spangenberg, E. D. (2024). Exploring the gender-based impact of mathematical games on the academic performance of senior secondary school students. Interdisciplinary Journal of Sociality Studies, 4, 1. https://doi.org/10.38140/ijss-2024.vol4.10

Salami, O. O., & Spangenberg, E. D. (2024). Effect of Mathematical Games on Senior Secondary School Students' Achievement in Mathematics According to Gender. Journal of Mathematics Education at Teachers College, 15(1), 1. https://doi.org/10.52214/jmetc.v15i1.12474

Sari, N. M., Yaniawati, P., Supianti, I. I., & Indriani, R. (2025). Digital Game-Based Learning Interventions on Students' Numeracy Skills and Engagement. Formatif Jurnal Ilmiah Pendidikan MIPA, 15(1). https://doi.org/10.30998/formatif.v15i1.23356

Sarnecka, B. W., Negen, J., Scalise, N. R., Goldman, M. C., & Rouder, J. N. (2023). The real preschoolers of Orange County: Early number learning in a diverse group of children. Journal of Numerical Cognition, 9(1), 65. https://doi.org/10.5964/jnc.6577

Selepe, M. A., & Mphahlele, R. S. (2025). Integrating Africanised play into digital learning of mathematics in the foundation phase. JRAMathEdu. https://doi.org/10.23917/jramathedu.v10i2.6342

Sepúlveda, F., Varas-Pavez, A., & Peake, C. (2026). Impact of streak feature in gamified app on kindergarten numeracy skills. Education and Information Technologies. https://doi.org/10.1007/s10639-026-13920-6

Setambah, M. A. B., et al. (2024). Impact of "Donkey", "Snap" dan "King" (DSK) non-digital gamification cards on fourth-grade students' math performance in fractions. Infinity Journal, 13(1), 175. https://doi.org/10.22460/infinity.v13i1.p175-196

Singh, P., Hoon, T. S., Nasir, A. M., Ramly, A. M., Rasid, S. M., & Meng, C. C. (2021). Card game as a pedagogical tool for numeracy skills development. International Journal of Evaluation and Research in Education (IJERE), 10(2), 693. https://doi.org/10.11591/ijere.v10i2.20722

Suci, D. P., Yunita, Y., Miftahulkhair, M., & Suras, F. E. (2023). Use of Number Card Playing Method to Improve Early Childhood Numeracy Skills. TEMATIK Jurnal Pemikiran Dan Penelitian Pendidikan Anak Usia Dini, 8(2), 60. https://doi.org/10.26858/tematik.v8i2.27549

Sukasmi, S., Asrowi, A., & Drajatı, N. A. (2022). Optimizing the Utilization of Game-Based Learning Application for Elementary Students First Phase. Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini, 6(6), 5873. https://doi.org/10.31004/obsesi.v6i6.3238

Sulpico, C., Lapis, R. J., Paner, N. R., Sagaral, M. I., Tura, J., Vismanos, M., Ibona-Mabini, L. M., & Petancio, J. A. M. (2025). Improving Grade 7 Mathematics Outcomes through Game-Based Learning: An Action Research Study. The Normal Lights, 19(1). https://doi.org/10.56278/tnl.v19i1.3132

Susperreguy, M. I., et al. (2021). Home mathematics environment and math performance of Chilean students in kindergarten and Grades 1 to 3. Early Childhood Research Quarterly, 59, 84. https://doi.org/10.1016/j.ecresq.2021.11.004

Tahir, N. A., Norman, H., Nordin, N., Wahid, F. N., & Aziz, R. (2023). Requirement Analysis and Expectations of Learning Numeration Problem Solving Use Technology for Primary Education Children. World Journal of Social Science, 10(1), 1. https://doi.org/10.5430/wjss.v10n1p1

Thai, K.-P., Bang, H. J., & Li, L. (2021). Accelerating Early Math Learning with Research-Based Personalized Learning Games: A Cluster Randomized Controlled Trial. Journal of Research on Educational Effectiveness, 15(1), 28. https://doi.org/10.1080/19345747.2021.1969710

Tshering, P., & Dorji, C. (2025). The Effect of Gamification on Grade Five Students Engagement and Learning Outcomes in Mathematics. International Journal For Multidisciplinary Research, 7(5). https://doi.org/10.36948/ijfmr.2025.v07i05.58721

Ünal, M., & Kaya, Ö. M. E. (2024). Digital Games In Early Mathematics Education. DergiPark (Istanbul University). https://dergipark.org.tr/tr/pub/bersad/issue/84134/1525911

Wang, L. (2025). Design and evaluation of personalised early childhood mathematics enlightenment games based on deep reinforcement learning. Discover Computing, 28(1). https://doi.org/10.1007/s10791-025-09806-9

Wardat, Y., Jarrah, A. M., Almassri, H., & Johnson, J. D. (2022). Assessing the impact of digital games-based learning on students' performance in learning fractions using (ABACUS) software application. Eurasia Journal of Mathematics Science and Technology Education, 18(10). https://doi.org/10.29333/ejmste/12421

Yee, L. J., Radzi, N. M. M., & Mamat, N. (2022). Learning through Play in Early Childhood: A Systematic Review. International Journal of Academic Research in Progressive Education and Development, 11(4). https://doi.org/10.6007/ijarped/v11-i4/16076

Yuniria, A. R., Atikah, C., & Asmawati, L. (2025). Interactive Educational Games: Boosting Numeracy Skills in 4-5 Year-Olds Through Multimedia. AL-ISHLAH Jurnal Pendidikan, 17(1). https://doi.org/10.35445/alishlah.v17i1.5503