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Research Article

Canva-Based Spin Number Game for Improving Early Numeracy in an Indonesian Kindergarten

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Abstract

Early numeracy is a foundational capability for school readiness, yet classroom instruction can remain worksheet-dominated and offer limited opportunities for active mathematical engagement. This study examined the implementation and short-term outcomes of a teacher-guided Canva-based Spin Number game for children aged 4–5 years in Group A of an Indonesian kindergarten in Tuban. A sequential explanatory mixed-method design involved 14 children and one classroom teacher. Quantitative evidence came from pretest and posttest performance assessments covering number recognition, object counting, number–quantity matching, and number sequencing; qualitative evidence came from classroom observations, a teacher interview, and documentation. Participant-level scores showed an increase in the mean total score from 8.00 (SD = 0.88) to 15.43 (SD = 0.51), with a mean change of 7.43 points. A paired-samples t-test indicated a significant difference ($t(13) = 43.01$, $p < .001$), and a Wilcoxon signed-rank robustness check reached the same conclusion ($p < .001$). The normalized gain based on group means was 0.93. All 14 children improved, while qualitative analysis identified increased participation, sustained attention, numeracy practice, peer interaction, and teacher scaffolding. The findings support the classroom potential of simple, adaptable digital play for early numeracy while also indicating ceiling, practice, sample-size, and single-group limitations. The study contributes context-sensitive evidence for accessible, teacher-mediated digital learning in early childhood education.

Keywords: Early numeracy; Canva-based learning; Digital game-based learning; Early childhood education; Teacher scaffolding; Educational technology

INTRODUCTION

Early numeracy is a core component of school readiness because preschool children progressively learn to connect number symbols, quantities, counting actions, and ordered relations. Contemporary early-childhood scholarship places these competencies within broader developmental and educational environments rather than treating them as isolated drill-based skills [1], [2]. Home and classroom opportunities also interact with cognitive and language-related resources that support emerging numeracy [3], while equitable access to high-quality early childhood education remains central to Sustainable Development Goal 4 [4].

Intervention studies increasingly emphasize active, meaningful, and developmentally appropriate experiences. Numeracy can be strengthened when numerical relations are embedded in embodied or playful activity [5]. More broadly, a recent systematic review and meta-analysis reported positive learning potential for game-based approaches in early childhood education [6]. Experimental evidence likewise shows that well-designed digital educational games can support children's mathematical learning when game activity is aligned with explicit learning objectives [7], and research on teachable-agent mathematics games illustrates how young children process and respond to interactive numerical representations [8].

These benefits should not be interpreted as a simple technology effect. Young children's use of interactive media occurs within family, school, and social contexts [9], while longitudinal evidence indicates that developmental outcomes associated with screen media depend on exposure patterns and the quality of adult interaction [10]. In classroom settings, educator interaction quality remains particularly important for mathematical language and early numeracy [11]. This is consistent with design research showing that game features, feedback, scaffolding, and task structure shape learning processes rather than digital presentation alone [12], [13].

Motivation and engagement are also important mechanisms. Digital educational games can influence motivation through learning engagement and the surrounding digital environment [14], but implementation in ordinary classrooms is constrained by available devices, teacher competence, infrastructure, and the fit between technology and the curriculum [15]. Consequently, a practical early-numeracy intervention should not only be engaging; it should also be adaptable, easy to operate, legible for young children, and compatible with teacher-guided interaction.

Canva offers one possible route to such low-complexity instructional design. A 2024 study involving Muhammad Aridan and colleagues demonstrated that Canva could be used to develop feasible and practical instructional video media without specialized programming [16]. Earlier work by Koderi, Aridan, and Muslim showed that accessible mobile learning media could produce strong feasibility ratings and improved learning outcomes in an Indonesian educational setting [17]. More recent work involving Aridan also demonstrates the broader instructional potential of adaptive and technology-supported learning environments when digital tools are integrated around clear pedagogical goals [18]. These studies do not directly establish effects on preschool numeracy, but they provide a relevant Indonesian evidence base for teacher-manageable digital learning media.

Other recent Canva studies similarly report positive associations with creativity, learning outcomes, motivation, and instructional usability [19], [20], [21], while development studies emphasize that Canva can support the preparation of visually structured teacher-made materials [22]. Research on digital game-based learning with young children also highlights the importance of interactivity, feedback, and creative participation [23]. Taken together, these findings suggest that the educational value of a simple digital game is likely to depend on the relationship among visual design, task clarity, teacher mediation, and repeated opportunities to act on mathematical representations.

The present study was conducted in Group A (ages 4–5 years) at Pertiwi Gesikharjo Kindergarten (TK Pertiwi Gesikharjo), Tuban, Indonesia, where preliminary classroom observations indicated continuing difficulty with number recognition, object counting, number–quantity matching, and number sequencing. Mathematics learning primarily used teacher explanation, printed worksheets, number cards, and oral counting. The issue is therefore not the absence of instruction, but the limited availability of interactive, reusable media that can convert these same numeracy targets into an active and socially mediated classroom routine.

Accordingly, this study aimed to describe the implementation of a Canva-based Spin Number game and examine short-term changes in four directly observed early-numeracy indicators. It also explored the classroom processes accompanying those quantitative changes. Rather than attributing mathematical development to digital technology alone, the study evaluates an accessible teacher-guided activity within one kindergarten classroom. This focus is relevant to quality and inclusion in education because accessible instructional design, teacher capacity, and child participation are integral to educational quality in developing contexts [24], [25].

METHODS

Research Design

The study used a sequential explanatory mixed-method design. The quantitative phase examined change in children's early-numeracy performance between pretest and posttest. The qualitative phase was used to explain how children participated in the intervention and how teacher guidance, peer interaction, and visual game elements contributed to the observed classroom process. Integration occurred during interpretation by comparing the direction and consistency of quantitative change with recurring qualitative themes.

Research Setting, Participants, and Sampling

The research was conducted in Group A of TK Pertiwi Gesikharjo, Palang District, Tuban Regency, East Java, Indonesia. Participants were 14 children aged 4–5 years and one classroom teacher. The class was selected purposively because preliminary observations documented difficulties in recognizing number symbols 1–10, counting objects, matching numerals with quantities, and sequencing numbers, while interactive digital mathematics media had not yet been incorporated into regular instruction.

Intervention: Canva-Based Spin Number Game

The intervention was implemented for four consecutive weeks, twice weekly, producing eight sessions of approximately 30–40 minutes. In each session, the teacher introduced the target activity, displayed the digital wheel, invited children to take turns spinning it, asked the selected child to identify the numeral, and then connected the numeral to counting, matching, or sequencing tasks. Prompts such as “What number did the wheel stop on?”, “Can you count the animals together?”, and “Which number comes before and after this number?” were used to maintain mathematical focus. Activities were organized in small groups so that each child could participate while the teacher provided immediate feedback and corrective guidance.

Instruments and Data Collection

Early-numeracy performance was assessed using a four-indicator performance rubric: number recognition, object counting, number–quantity matching, and number sequencing. Each indicator was scored from 1 (Beginning) to 4 (Highly Proficient), yielding a maximum total score of 16. The classroom teacher and researcher used the same rubric and discussed scoring differences after observation; inter-rater agreement exceeded 90%. Pretest and posttest tasks targeted the same indicators but used different pictures, object arrangements, and numeral sequences. Qualitative evidence was obtained from observations conducted during intervention sessions, a semi-structured teacher interview after the intervention, and documentation. The indicator definitions and performance anchors are summarized in Table 1.

Table 1. Early-numeracy indicators and scoring rubric

Indicator	1 — Beginning	2 — Developing	3 — Proficient	4 — Highly Proficient
Recognizing numbers 1–10	Unable to identify independently	Identifies with substantial guidance	Mostly accurate with minor prompting	Accurate, confident, and consistent
Counting objects	Unable to count accurately	Counts with substantial assistance	Mostly independent with minor errors	Independent and accurate
Matching numerals with quantities	Incorrect matching	Partially accurate with guidance	Mostly accurate	Accurate and consistent
Sequencing numbers	Unable to sequence	Sequences with substantial assistance	Mostly correct	Correct and independent

Data Analysis

Quantitative analysis used descriptive statistics, individual change scores, normalized gain, a paired-samples t-test, and a Wilcoxon signed-rank robustness check. All derived statistics were calculated directly from the 14 participant-level pretest and posttest score pairs. Qualitative data were reduced, coded, grouped into recurring themes, and compared across observations, the teacher interview, and documentation. Quantitative and qualitative findings were then integrated through triangulation.

Ethical Considerations

Permission to conduct the study was obtained from the principal of TK Pertiwi Gesikharjo. Written informed consent was obtained from parents or legal guardians after they received information about the study purpose, procedures, confidentiality, voluntary participation, and withdrawal rights. Children received age-appropriate explanations and participated within regular teacher-supervised classroom activities. Participant identities were anonymized in analysis and reporting.

RESULTS AND DISCUSSION

Results

Quantitative Change in Early Numeracy

All 14 children recorded higher posttest scores than pretest scores. The mean increased from 8.00 (SD = 0.88) to 15.43 (SD = 0.51), producing a mean change of 7.43 points. The median increased from 8.00 to 15.00, while the posttest range narrowed to 15–16. The paired-samples t-test was significant, $t(13) = 43.01$, $p < .001$, and the Wilcoxon signed-rank test confirmed the same directional conclusion, $W = 0$, $p < .001$. The normalized gain based on the group means was 0.93. Detailed descriptive and paired-change statistics are presented in Table 2.

Table 2. Descriptive and paired-change statistics

Statistic	Pretest	Posttest / Change
N	14	14
Mean	8.00	15.43
SD	0.88	0.51
Median	8.00	15.00
Minimum	7	15
Maximum	9	16
Mean change	—	7.43
Paired t	—	$t(13) = 43.01$, $p < .001$
Wilcoxon	—	$W = 0$, $p < .001$
Normalized gain	—	0.93

Individual Gain Patterns and Score Distribution

At the individual level, gains ranged from 6 to 8 points: eight children improved by 8 points, five by 7 points, and one by 6 points. The consistency of positive change reduces the likelihood that the mean increase was produced by only a small number of children. However, the narrow posttest range and concentration near the maximum score indicate a ceiling effect that limits discrimination among children at the upper end of the rubric. The participant-level pattern is visualized in Figure 1.

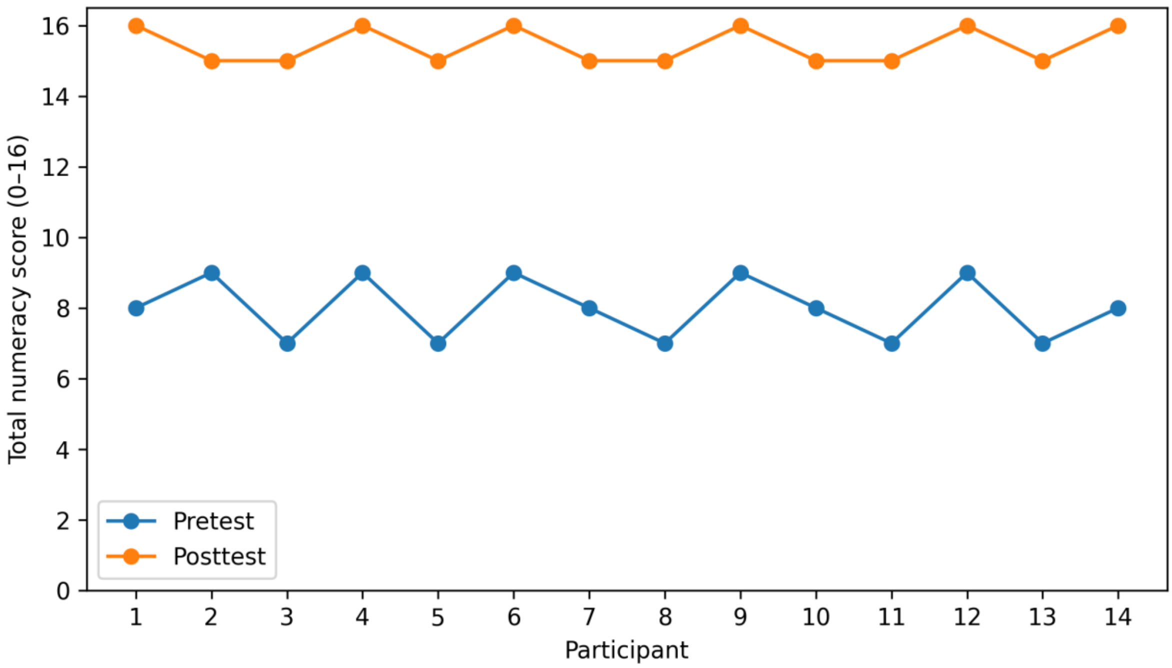

Figure 1. Individual pretest and posttest total early-numeracy scores

Classroom Process and Qualitative Themes

Qualitative analysis yielded five recurring themes: increased enthusiasm and participation; sustained attention through visual and interactive cues; repeated enactment of numeracy behaviors during gameplay; increased peer interaction and collaborative responding; and an essential role for teacher scaffolding. These themes indicate that the intervention functioned as a guided classroom activity rather than as passive screen exposure. A structured summary of the themes is provided in Table 3.

Table 3. Integrated qualitative themes

Theme	Evidence pattern
Enthusiasm and participation	Children were more eager to take turns and respond during Spin Number activities.
Sustained attention	The wheel, numerals, and animal illustrations supported longer focus during the task.
Numeracy behavior	Children repeatedly recognized numerals, counted objects, matched quantities, and sequenced numbers.
Peer interaction	Shared counting and spontaneous assistance occurred during turn-taking.
Teacher scaffolding	Prompts, correction, and sequencing of tasks were necessary to maintain mathematical focus.

Discussion

Early-Numeracy Gains in Context

The observed improvement is consistent with the wider policy and developmental literature that treats quality early childhood education as a foundation for later learning and social participation [26], [27]. It is also compatible with evidence that digital technologies can contribute to Sustainable Development Goals when they are implemented as part of purposeful educational systems rather than as isolated devices [28], [29], [30]. In the present classroom, the intervention reorganized familiar numeracy targets into a repeated cycle of visual selection, oral identification, counting, matching, sequencing, peer response, and teacher feedback.

The finding should therefore be interpreted at the level of early numeracy rather than broad "mathematical intelligence." Research links mathematical attainment to multiple cognitive resources [31], and early mathematics can interact with working memory, vocabulary, and affective factors [32]. Contemporary critiques also caution against using multiple-intelligences terminology as an explanatory shortcut when the actual measures concern specific skills [33], [34]. For that reason, this manuscript limits its claims to the four observed numeracy indicators.

Teacher Scaffolding and Digital Learning Processes

The classroom process supports a teacher-mediated interpretation of the intervention. Digital media may be useful when visual cues reduce unnecessary cognitive demand and direct attention toward task-relevant information [35], while multimodal and embodied enrichment can strengthen mathematical learning opportunities [36]. At the same time, digital-device effects in childhood remain context dependent [37], while sustainable educational transformation depends on adaptive design and institutional conditions rather than device availability alone [38]. The present findings fit this pattern: the teacher's prompts, turn management, corrective feedback, and linking of numerals to quantities were integral to the activity.

Feasibility and Conditions for Implementation

The use of Canva is also relevant to implementation feasibility. The most directly related Indonesian study involving Aridan reported successful development of Canva-based learning video media [16], while another Aridan study demonstrated the effectiveness of mobile learning in a different instructional domain [17]. These precedents support the practicality of teacher-manageable digital media but do not eliminate infrastructure constraints. The Spin Number activity still required an internet-connected device, display access, teacher preparation, and digital competence. Research on teacher readiness likewise shows that technology integration varies with pedagogical and institutional preparedness [39], [40].

Causal Boundaries and Practice Implications

The large effect observed here must be interpreted with restraint. The design did not include a comparison group, posttest performance was close to the scale ceiling, and the posttest preserved the same underlying task structure as the pretest even though surface materials differed. Maturation, repeated exposure, teacher instruction, and practice effects cannot therefore be separated from the intervention. The statistical results provide evidence of substantial short-term improvement following implementation, not definitive proof that the Spin Number game alone caused the change.

For educational practice, the main implication is not that Canva should replace concrete or social mathematics activity. Rather, a simple digital interface can serve as an organizing device for repeated mathematical talk and action when the teacher retains control of pacing, feedback, and participation. This distinction is especially important for inclusive and equitable learning environments: a technology is educationally useful only when children can access the task, understand the representations, participate meaningfully, and receive responsive support.

CONCLUSION

The Canva-based Spin Number game was associated with substantial short-term improvement in four measured early-numeracy indicators among 14 children aged 4–5 years in one Indonesian kindergarten classroom. Participant-level scores showed a mean increase from 8.00 to 15.43, and all participants improved. Qualitative evidence indicated that participation, attention, peer interaction, repeated numeracy practice, and teacher scaffolding accompanied the quantitative change. The study therefore supports the potential of simple, adaptable digital play as a teacher-guided numeracy resource where basic technological infrastructure is available. Its contribution is best understood as evidence for an accessible classroom learning system rather than as proof of an independent technology effect.

LIMITATIONS

The study used a small purposive sample from one classroom, did not include a control or comparison group, and did not include a delayed posttest. The posttest distribution was concentrated near the maximum score, indicating a ceiling effect, and the same four underlying task types were measured before and after the intervention, leaving room for practice effects. Qualitative evidence came primarily from observation, one classroom teacher interview, and documentation, without a larger independent coding team. The study also did not quantify device costs, internet reliability, teacher preparation time, or implementation feasibility across schools with different levels of technological access. Future studies should use larger multi-site samples, comparison groups, more sensitive assessments, delayed follow-up, and explicit feasibility and accessibility measures.

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AUTHOR CONTRIBUTION

E.I. conceptualization, methodology, investigation, data curation, formal analysis, and writing-original draft. A.R. supervision, theoretical validation, and writing-review and editing. H. interpretation, academic validation, and writing-review and editing. All authors reviewed and approved the final manuscript and accept responsibility for the published work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

During manuscript revision, ChatGPT (OpenAI) was used solely for language polishing, structural consistency checks, and reference-format verification. All scientific content, analyses, interpretations, and citations were reviewed and approved by the authors, who remain fully responsible for the final manuscript.

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