International Journal of Education and Learning Studies (IJELS) 2 (2) August 2026: 93-107 E-ISSN: 3109-4058
DOI: https://doi.org/10.64421/ijels.v2i2.83

Guided Play-Based Digital Learning in Early Childhood: Advancing Integrated Cognitive and Socio-Emotional Development

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To cite this article: Mendoza, J.C., Orgeta, N.I., Ruiz, C.B., & Salazar, E.B. (2026). Guided Play-Based Digital Learning in Early Childhood: Advancing Integrated Cognitive and Socio-Emotional Development. *International Journal of Education and Learning Studies, 2*(2), 93-107. https://doi.org/10.64421/ijels.v2i2.83

Articles Information

Received : 10-03-2026
Revised : 29-04-2026
Accepted : 17-06-2026
Published : 30-08-2026

Abstract

Despite the increasing use of digital technologies in early childhood education, limited quantitative evidence has examined their simultaneous effects on cognitive and socio-emotional development. This study investigated the effects of guided play-based digital learning on dual developmental outcomes. A pre-test–post-test non-equivalent control group design involved 120 children aged 4–6 years (experimental n = 60; control n = 60). The experimental group received eight weeks of guided digital play, while the control group engaged in non-digital play-based activities. Teacher-rated instruments assessed cognitive (α = 0.87) and socio-emotional development (α = 0.89). No pre-test differences were found. Post-test results showed higher cognitive ($t(118) = 6.78$, $p < 0.001$, $d = 1.24$) and socio-emotional scores ($t(118) = 7.02$, $p < 0.001$, $d = 1.30$) in the experimental group. These findings provide robust evidence that guided digital play supports integrated developmental outcomes, highlighting the importance of structured interaction and teacher facilitation in early childhood digital learning.

Keywords: Guided Play-Based Learning; Digital Learning; Early Childhood Education; Cognitive Development; Socio-Emotional Development

Author Contributions: Juan Carlos Mendoza: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft. Natalia Isabel Ortega: Data curation, Validation, Investigation, Writing – review & editing. Camila Belén Ruiz: Methodology, Resources, Project administration, Writing – review & editing. Elena Beatriz Salazar: Supervision, Conceptualization, Validation, Writing – review & editing, Corresponding author.

Funding Statement: This research received no external funding.

Ethical Approval / IRB Statement: This study was approved by the participating early childhood education institutions and conducted in accordance with ethical standards for research involving human participants.

Informed Consent Statement: Informed consent was obtained from the parents or legal guardians of all participants involved in the study.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. Restrictions apply due to participant confidentiality.

Conflicts of Interest: The authors declare no conflicts of interest.

Generative AI Use Statement: No generative AI tools were used in the design, analysis, or final writing of this manuscript.

1. INTRODUCTION

The rapid expansion of digital technologies has reshaped early childhood education (ECE), introducing interactive applications, games, and multimedia platforms into children's learning environments. While these tools offer potential to enhance learning, their educational value remains contested. Some studies emphasize their capacity to support engagement and cognitive development (OECD, 2021; Neumann, 2023), whereas others highlight risks such as superficial interaction, reduced social engagement, and passive consumption (Madigan et al., 2020). This tension suggests that the impact of digital technologies is not inherent to the tools themselves but depends on how they are pedagogically structured and integrated into developmentally appropriate learning experiences (Hirsh-Pasek et al., 2020).

Early childhood is a critical period for the development of both cognitive and socio-emotional competencies. Foundational skills such as attention, memory, and problem-solving develop alongside self-regulation, emotional understanding, and social interaction, forming an integrated developmental system that underpins later academic and life outcomes (Diamond, 2020; Blair & Raver, 2021; McClelland et al., 2021). However, prior research often treats these domains separately, overlooking their interdependence in early learning processes. This fragmentation limits a comprehensive understanding of how instructional approaches influence holistic child development.

Play-based learning has been consistently identified as a developmentally appropriate approach that supports integrated development. Grounded in constructivist and sociocultural perspectives, it promotes active engagement, meaningful interaction, and intrinsic motivation (Zosh et al., 2022). Empirical evidence shows that structured play environments can enhance both cognitive flexibility and socio-emotional competence (Fleer et al., 2021; Weisberg et al., 2023). Yet, when translated into digital contexts, these principles are not always preserved. Many digital learning environments rely on repetitive or task-driven interactions, which may support narrow cognitive gains but fail to foster deeper socio-emotional processes.

Recent studies suggest that the effectiveness of digital learning in ECE depends on the extent to which it aligns with play-based and interaction-driven pedagogies (Neumann et al., 2022). Guided digital play, characterized by structured exploration, adult facilitation, and meaningful interaction, has been proposed as a promising approach to bridge this gap. Conceptually, such an approach positions digital tools as mediational resources that support active play, which in turn fosters cognitive processes (e.g., problem-solving, executive function) and socio-emotional competencies (e.g., self-regulation, collaboration). However, empirical validation of this integrated mechanism remains limited.

Despite increasing interest in play-based digital learning, existing research reveals two key limitations. First, many studies rely on qualitative or mixed-methods approaches, which provide rich insights but limit generalizability and statistical inference (Skene et al., 2022). Second, quantitative studies often examine isolated outcomes, focusing either on cognitive performance or engagement without simultaneously addressing socio-emotional development (Domínguez et al., 2024). As a result, there is insufficient empirical evidence demonstrating how digital play-based approaches influence multiple developmental domains in a coordinated manner.

Addressing these limitations, the present study examines the effects of a guided play-based digital learning approach on both cognitive and socio-emotional development in early childhood using a quantitative design. By providing statistically grounded evidence across dual developmental domains, this study seeks to advance current understanding of how pedagogically structured digital play can support integrated child development and inform evidence-based practices in ECE.

2. LITERATURE REVIEW

2.1. Digital Learning in Early Childhood Education

The integration of digital technology into early childhood education has increased substantially over the past decade, driven by rapid technological advancement and changing educational paradigms. Digital learning in early childhood contexts commonly includes the use of educational applications, interactive games, multimedia resources, and digital storytelling tools designed to support early learning processes (Neumann, 2023). When appropriately implemented, digital learning environments have been shown to enhance young children's engagement, motivation, and access to diverse learning experiences (OECD, 2021).

Empirical research suggests that digital learning can support early cognitive development, particularly in areas such as language acquisition, early numeracy, problem-solving, and executive functioning (Hirsh-Pasek et al., 2020; Neumann et al., 2022). However, the effectiveness of digital learning in early childhood is highly dependent on pedagogical design. Passive, screen-based activities are generally associated with limited developmental benefits, whereas interactive and learner-centered digital experiences are more likely to produce positive learning outcomes (Madigan et al., 2020).

These findings indicate that digital learning should not be treated as a standalone instructional strategy but rather as a pedagogical tool that must be integrated within developmentally appropriate teaching approaches. This perspective has led to growing interest in pedagogical models that combine digital technology with play-based learning principles in early childhood education.

2.2. Play-Based Learning as a Developmentally Appropriate Approach

Play-based learning is widely recognized as a core pedagogical approach in early childhood education due to its alignment with children's natural learning processes. Grounded in constructivist and sociocultural theories, play-based learning emphasizes active exploration, imagination, and social interaction as key mechanisms for knowledge construction (Zosh et al., 2022). Through play, children engage cognitively, emotionally, and socially, allowing for holistic development.

Quantitative studies have demonstrated that play-based learning positively influences cognitive outcomes, including problem-solving ability, cognitive flexibility, and early academic skills (Fleer et al., 2021; Weisberg et al., 2023). In addition, play-based learning has been shown to support socio-emotional development by fostering self-regulation, cooperation, emotional expression, and peer interaction (McClelland et al., 2021).

Importantly, guided play, in which educators structure learning objectives while allowing children autonomy within playful activities, has been identified as particularly effective in supporting learning outcomes (Weisberg et al., 2023). This approach balances child agency with instructional support, making it suitable for integration with digital learning tools that require intentional pedagogical design.

2.3. Play-Based Digital Learning and Cognitive Development

Recent research has increasingly examined the intersection of play-based learning and digital technology in early childhood contexts. Play-based digital learning refers to digital learning environments that incorporate elements of play, such as exploration, game-like challenges, feedback, and social interaction, while maintaining clear educational goals (Hirsh-Pasek et al., 2020).

Quantitative evidence suggests that play-based digital learning can enhance cognitive development by promoting active engagement, sustained attention, and higher-order thinking skills. Studies have reported positive effects on early literacy, numeracy, and problem-solving skills when digital learning activities are designed around play-based principles (Neumann, 2023; Domínguez et al., 2024). Interactive digital games that require children to make decisions, solve problems, and reflect on outcomes have been associated with improvements in executive functioning and cognitive control.

However, the literature also highlights variability in outcomes, which is often attributed to differences in instructional design, duration of intervention, and the level of adult guidance provided during digital play activities (Skene et al., 2022). These findings underscore the importance of examining not only the presence of digital play-based learning but also its specific pedagogical characteristics and implementation.

2.4. Play-Based Digital Learning and Socio-Emotional Development

In addition to cognitive outcomes, socio-emotional development is a critical dimension of early childhood learning that has received increasing attention in digital learning research. Socio-emotional skills such as self-regulation, emotional understanding, empathy, and social interaction are essential for children's academic success and overall well-being (Blair & Raver, 2021).

Emerging quantitative studies indicate that play-based digital learning can support socio-emotional development when digital activities encourage collaboration, communication, and emotional expression (Domínguez et al., 2024). Digital games that involve role-play, storytelling, or cooperative problem-solving have been shown to foster peer interaction and emotional engagement, contributing to the development of socio-emotional competencies.

Nevertheless, concerns remain regarding the potential negative effects of digital technology on social interaction if digital activities replace rather than complement face-to-face play experiences (Madigan et al., 2020). As a result, researchers emphasize the need for balanced digital learning environments that integrate play-based digital activities with social interaction and adult facilitation.

2.5. Research Gap and Conceptual Framework

Although existing studies provide valuable insights into digital learning, play-based pedagogy, and early childhood development, several gaps remain in the literature. First, quantitative studies that simultaneously examine the effects of play-based digital learning on both cognitive and socio-emotional development are still limited. Many studies focus on a single developmental domain, which restricts understanding of the holistic impact of play-based digital learning in early childhood education.

Second, there is a lack of empirical research that provides statistically robust evidence regarding the effectiveness of play-based digital learning approaches using controlled quantitative designs. The absence of comprehensive quantitative analyses limits the generalizability of findings and their applicability to educational practice and policy.

Based on these gaps, the present study adopts a quantitative approach to examine the effects of play-based digital learning on cognitive and socio-emotional development in early childhood education. By integrating insights from digital learning theory and play-based pedagogy, this study seeks to contribute empirical evidence that supports the design of developmentally appropriate digital learning environments in the digital age.

3. METHOD

3.1. Research Design

This study employed a quantitative approach using a matching only pre-test–post-test control group design to examine the effects of guided play-based digital learning on cognitive and socio-emotional development in early childhood education. A quasi-experimental design was selected due to practical and ethical constraints that prevented random assignment of young children into groups (Creswell & Creswell, 2018; Shadish et al., 2002). This approach allowed for the examination of causal relationships while maintaining ecological validity in authentic classroom settings (Cook & Campbell, 1979). To strengthen internal validity, pre-test equivalence between groups was established, and consistent instructional time, learning objectives, and teacher involvement were maintained across conditions (Fraenkel et al., 2019).

3.2. Participants

The participants were 120 children aged 4 to 6 years enrolled in early childhood education institutions, divided into an experimental group (n = 60) and a control group (n = 60). Cluster sampling was used based on intact classroom groups to reflect natural classroom organization (Etikan & Bala, 2017). All participants had no identified developmental delays and attended school regularly. To minimize potential confounding effects, both groups were drawn from comparable institutional settings with similar socio-economic backgrounds and were taught by teachers with equivalent qualifications and teaching experience (Shadish et al., 2002). Informed consent was obtained from parents or legal guardians, and institutional approval was secured.

3.3. Intervention Procedure

The intervention was conducted over eight weeks, with three sessions per week (30–40 minutes per session). The guided play-based digital learning activities were designed to integrate exploration, problem-solving, and social interaction within structured digital environments, consistent with principles of guided play and active learning (Hirsh-Pasek et al., 2020; Zosh et al., 2018). For example, children engaged in interactive storytelling applications that required sequencing events, solving simple problems, and making decisions collaboratively, as well as game-based tasks involving pattern recognition, memory challenges, and cooperative problem-solving (Neumann, 2023). Teachers acted as facilitators by providing prompts, guiding reflection, and encouraging peer interaction rather than direct instruction, aligning with sociocultural learning principles emphasizing scaffolding and mediated interaction (Vygotsky, 1978; Weisberg et al., 2016). The control group followed the same learning objectives and instructional duration but used non-digital materials such as physical manipulatives, storytelling, and teacher-led play activities.

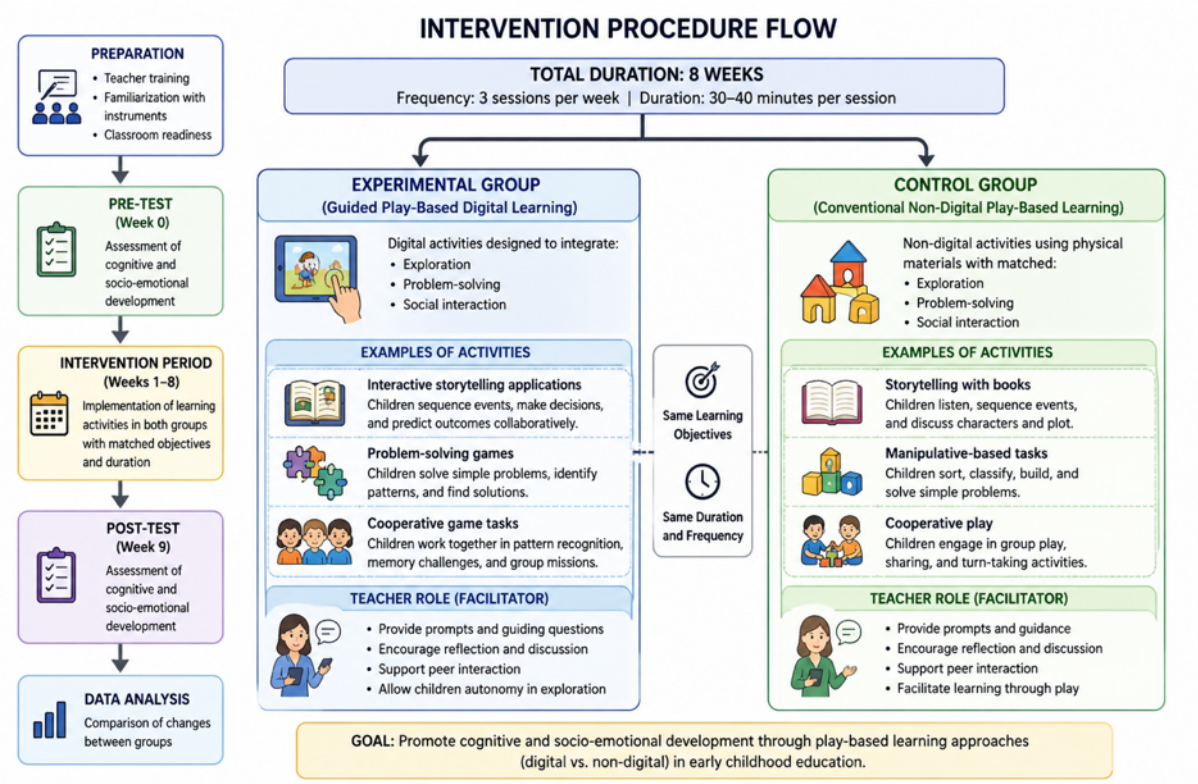

Figure 1. Flow of the guided play-based digital learning intervention in early childhood education

Figure 1 illustrates the structure of the eight-week intervention, including pre-test, guided digital play activities, control condition procedures, and post-test assessment, with equivalent instructional duration and learning objectives across groups.

3.4. Instruments

3.4.1. Cognitive Development Measurement

Cognitive development was assessed using a standardized early childhood cognitive skills instrument adapted to the study context. The instrument covered attention, memory, problem-solving, and early reasoning skills (25 items). Content validity was established through expert review by three early childhood education specialists, ensuring alignment with developmental benchmarks (Polit & Beck, 2006). Construct validity was supported through prior empirical use of the instrument in similar populations (DeVellis, 2017). Observations were rated using a Likert-type scale by trained teachers. The instrument demonstrated good internal consistency (Cronbach's $\alpha = 0.87$), exceeding the acceptable threshold for reliability (Hair et al., 2019).

3.4.2. Socio-Emotional Development Measurement

Socio-emotional development was measured using a validated scale assessing self-regulation, emotional awareness, peer interaction, and cooperative behavior (20 items). Content validity was confirmed through expert judgment (Polit & Beck, 2006), and construct validity was supported by its established use in early childhood research (Denham, 2006). The instrument showed strong internal consistency (Cronbach's $\alpha = 0.89$), indicating reliable measurement (Hair et al., 2019).

3.5. Data Collection Procedure

Data collection was conducted in three stages: pre-test, intervention, and post-test. Prior to data collection, teachers received standardized training to ensure consistency in observation and scoring procedures, which is essential to reduce observer bias in educational research (Creswell & Creswell, 2018). To reduce measurement bias, the same instruments and procedures were applied across both groups. Observations were conducted under comparable classroom conditions to ensure consistency.

3.6. Data Analysis

Descriptive statistics (mean and standard deviation) were used to summarize the data. Independent samples t-tests were conducted to compare post-test scores between groups, while paired samples t-tests were used to examine within-group changes. Effect sizes were calculated using Cohen's d to determine the magnitude of the intervention effects (Cohen, 1988). Statistical significance was set at $p < 0.05$. Prior to analysis, assumptions of normality and homogeneity of variance were checked to ensure the appropriateness of parametric tests (Field, 2018).

3.7. Ethical Considerations

This study adhered to ethical standards for research involving children. Participation was voluntary, and parental consent was obtained prior to data collection. Confidentiality and anonymity were ensured, and all data were used solely for research purposes, consistent with established ethical guidelines in educational research (British Educational Research Association, 2018).

4. RESULT AND DISCUSSION

4.1. Research Result

4.1.1. Descriptive Statistics

Descriptive statistical analyses were conducted to provide an overview of children's cognitive and socio-emotional development scores in both the experimental and control groups before and after the implementation of the play-based digital learning intervention. This analysis aimed to describe baseline conditions, post-intervention performance, and overall score distributions across groups. Mean scores and standard deviations were calculated to summarize central tendency and variability for each developmental domain.

Table 1. Descriptive statistics of cognitive and socio-emotional development scores

Variable	Group	Pre-Test Mean (SD)	Post-Test Mean (SD)
Cognitive Development	Experimental (n = 60)	62.45 (6.82)	78.30 (7.15)
	Control (n = 60)	63.10 (7.01)	69.25 (6.88)
Socio-Emotional Development	Experimental (n = 60)	64.20 (6.55)	80.10 (6.92)
	Control (n = 60)	65.05 (6.73)	71.40 (6.60)

As shown in Table 1, both the experimental and control groups demonstrated increases in mean scores from pre-test to post-test for cognitive and socio-emotional development. At the pre-test stage, the mean scores for both groups were relatively comparable across the two developmental domains, indicating similar baseline conditions prior to the intervention. The standard deviations suggest moderate variability in children's performance within each group.

Following the intervention, the experimental group exhibited a marked increase in mean scores for cognitive development, rising from 62.45 to 78.30, as well as for socio-emotional development, increasing from 64.20 to 80.10. In contrast, the control group showed more modest improvements, with cognitive development scores increasing from 63.10 to 69.25 and socio-emotional development scores increasing from 65.05 to 71.40. While improvements were observed in both groups, the magnitude of mean score gains was substantially higher in the experimental group across both developmental domains.

4.1.2. Pre-Test Equivalence between Groups

To verify baseline equivalence between the experimental and control groups prior to the implementation of the play-based digital learning intervention, independent samples t-tests were conducted on pre-test scores for both cognitive development and socio-emotional development. This analysis was performed to confirm that the two groups did not differ significantly at baseline, thereby ensuring that any observed post-intervention differences could be attributed to the intervention rather than to pre-existing disparities.

Table 2. Independent samples t-test results for pre-test equivalence

Variable	Group	Mean	SD	t	p
Cognitive Development	Experimental (n = 60)	62.45	6.82	−0.53	0.60
	Control (n = 60)	63.10	7.01		
Socio-Emotional Development	Experimental (n = 60)	64.20	6.55	−0.74	0.46
	Control (n = 60)	65.05	6.73		

As presented in Table 2, the independent samples t-test results indicate no statistically significant differences between the experimental and control groups on pre-test scores for either developmental domain. The comparison of cognitive development scores yielded a non-significant result ($t(118) = -0.53$, $p = 0.60$), while the comparison of socio-emotional development scores also showed no significant difference ($t(118) = -0.74$, $p = 0.46$).

These results demonstrate that the experimental and control groups were statistically equivalent in terms of cognitive and socio-emotional development prior to the intervention. The establishment of baseline equivalence supports the internal validity of the study and provides a solid foundation for subsequent analyses examining the effects of the play-based digital learning approach.

4.1.3. Effects of Play-Based Digital Learning on Cognitive Development

To examine changes in cognitive development within each group, paired samples t-tests were conducted comparing pre-test and post-test scores for the experimental and control groups. This analysis aimed to identify whether statistically significant improvements occurred over time within each instructional condition.

Table 3. Paired samples t-test results for cognitive development within groups

Group	Mean Difference (Post–Pre)	SD	t	p
Experimental (n = 60)	15.85	6.18	15.84	< 0.001
Control (n = 60)	6.15	6.19	6.92	< 0.001

As shown in Table 3, the experimental group demonstrated a statistically significant increase in cognitive development scores from pre-test to post-test ($t(59) = 15.84$, $p < 0.001$). The control group also showed a statistically significant improvement ($t(59) = 6.92$, $p < 0.001$), although the magnitude of the mean score increase was notably smaller compared to the experimental group.

To further examine differences between the two groups after the intervention, an independent samples t-test was conducted on post-test cognitive development scores.

Table 4. Independent samples t-test results for post-test cognitive development

Group	Mean	SD	t	p
Experimental (n = 60)	78.30	7.15	6.78	< 0.001
Control (n = 60)	69.25	6.88		

The results presented in Table 4 indicate a statistically significant difference in post-test cognitive development scores between the experimental and control groups ($t(118) = 6.78$, $p < 0.001$). Children who participated in the play-based digital learning intervention achieved higher cognitive development scores compared to those who engaged in conventional learning activities.

An effect size analysis was conducted to determine the magnitude of the intervention effect on cognitive development. The calculated Cohen's d value of 1.24 indicates a large effect size, suggesting that the play-based digital learning approach had a substantial impact on children's cognitive development outcomes.

4.1.4. Effects of Play-Based Digital Learning on Socio-Emotional Development

To examine changes in socio-emotional development within each group, paired samples t-tests were conducted to compare pre-test and post-test scores for the experimental and control groups. This analysis was performed to determine whether statistically significant changes in socio-emotional development occurred over the course of the intervention period.

Table 5. Paired samples t-test results for socio-emotional development within groups

Group	Mean Difference (Post–Pre)	SD	t	p
Experimental (n = 60)	15.90	6.09	16.12	< 0.001
Control (n = 60)	6.35	6.62	7.15	< 0.001

As shown in Table 5, the experimental group demonstrated a statistically significant improvement in socio-emotional development scores from pre-test to post-test ($t(59) = 16.12$, $p < 0.001$). The control group also exhibited a statistically significant increase in socio-emotional development scores ($t(59) = 7.15$, $p < 0.001$); however, the magnitude of improvement was considerably smaller compared to that of the experimental group.

To further examine differences between groups following the intervention, an independent samples t-test was conducted on post-test socio-emotional development scores.

Table 6. Independent samples t-test results for post-test socio-emotional development

Group	Mean	SD	t	p
Experimental (n = 60)	80.10	6.92	7.02	< 0.001
Control (n = 60)	71.40	6.60		

The results presented in Table 6 indicate a statistically significant difference in post-test socio-emotional development scores between the experimental and control groups ($t(118) = 7.02$, $p < 0.001$). Children in the experimental group achieved higher socio-emotional development scores than those in the control group following the implementation of the play-based digital learning intervention.

An effect size analysis was conducted to assess the magnitude of the intervention effect on socio-emotional development. The calculated Cohen's d value of 1.30 indicates a large effect size, suggesting that the play-based digital learning approach had a substantial impact on children's socio-emotional development outcomes.

4.2. Discussion

The present study examined the effects of a play-based digital learning approach on cognitive and socio-emotional development in early childhood education using a quantitative quasi-experimental design. The findings indicate that children who participated in play-based digital learning activities demonstrated significantly greater improvements in both cognitive and socio-emotional development compared to those who experienced conventional learning activities. These results provide empirical support for the effectiveness of integrating play-based pedagogy with digital learning tools in early childhood contexts.

4.2.1. Effects on Cognitive Development

The significant improvement in cognitive development observed in the experimental group aligns with recent research emphasizing the role of interactive and play-oriented digital learning environments in supporting early cognitive processes. Studies published between 2020 and 2025 consistently report that digital learning tools designed around active engagement, problem-solving, and exploration can enhance executive functions, early reasoning skills, and cognitive flexibility in young children (Hirsh-Pasek et al., 2020; Neumann, 2023). The large effect size found in this study further suggests that play-based digital learning can produce meaningful cognitive gains when compared to more traditional instructional approaches. These findings are also consistent with evidence showing that guided play, rather than unstructured or passive digital use, is particularly effective in promoting cognitive development (Weisberg et al., 2023). By embedding learning objectives within playful digital activities, children are encouraged to actively construct knowledge while maintaining high levels of motivation and attention. This supports the argument that digital technology, when aligned with developmentally appropriate pedagogical principles, can function as a cognitive scaffold rather than a distraction in early learning environments.

4.2.2. Effects on Socio-Emotional Development

In addition to cognitive outcomes, the present study found a substantial positive effect of play-based digital learning on socio-emotional development. Children in the experimental group demonstrated significantly higher gains in self-regulation, emotional awareness, and social interaction compared to the control group. These results corroborate emerging quantitative evidence suggesting that digital play-based activities can support socio-emotional learning when they encourage collaboration, communication, and

emotional expression (Domínguez et al., 2024). Recent literature highlights that socio-emotional development in early childhood is strongly influenced by learning environments that provide opportunities for interaction, feedback, and shared problem-solving (Blair & Raver, 2021; McClelland et al., 2021). The digital activities implemented in this study incorporated these elements through interactive tasks and guided facilitation, which may explain the observed improvements. Importantly, the findings counter concerns that digital technology inherently limits social interaction in early childhood, supporting instead the view that pedagogical design is a critical determinant of socio-emotional outcomes (Neumann et al., 2022).

4.2.3. Play-Based Digital Learning as an Integrated Pedagogical Approach

The combined cognitive and socio-emotional gains observed in this study reinforce the growing consensus that play-based digital learning represents a promising integrated pedagogical approach for early childhood education. Rather than treating digital learning and play-based pedagogy as separate or competing strategies, the results suggest that their integration can address multiple developmental domains simultaneously. This finding is consistent with recent frameworks that emphasize holistic child development in the digital age (OECD, 2021; Zosh et al., 2022).The greater gains observed in the experimental group compared to the control group also highlight the added value of digital integration when it extends beyond conventional play-based activities. While the control group demonstrated some improvement, likely due to natural developmental progression and exposure to traditional learning activities, the substantially larger gains in the experimental group suggest that play-based digital learning provides additional developmental affordances not fully captured by non-digital approaches alone.

4.2.4. Implications for Early Childhood Education Research

From a research perspective, the findings contribute to the growing body of quantitative evidence supporting play-based digital learning in early childhood education. Many previous studies in this area have relied on qualitative or mixed-methods designs, limiting the generalizability of results. By demonstrating statistically significant effects with large effect sizes, this study addresses calls in the recent literature for more robust quantitative investigations into digital learning interventions in early childhood contexts (Skene et al., 2022). Moreover, the simultaneous examination of cognitive and socio-emotional outcomes responds to the need for more comprehensive assessments of early childhood interventions. The results suggest that future research should continue to adopt multidimensional outcome measures to better capture the holistic impact of pedagogical innovations in early childhood education.

5. CONCLUSION

This study investigated the effects of a play-based digital learning approach on cognitive and socio-emotional development in early childhood education using a quantitative quasi-experimental design. The findings demonstrate that children who participated in play-based digital learning activities achieved significantly greater improvements in both cognitive and socio-emotional development compared to those who engaged in conventional learning activities. The results provide empirical evidence that integrating

digital learning tools with play-based pedagogy can support holistic child development in early childhood settings. The large effect sizes observed for both developmental domains suggest that play-based digital learning offers meaningful added value beyond traditional instructional approaches when digital activities are designed to promote active engagement, exploration, and guided interaction.

These findings contribute to the growing body of international research emphasizing the importance of pedagogically informed digital integration in early childhood education. Rather than viewing digital technology as a potential risk to early development, this study supports the perspective that digital tools, when aligned with developmentally appropriate and play-based principles, can function as effective learning resources. The study highlights the potential of play-based digital learning as an effective instructional approach for enhancing cognitive and socio-emotional outcomes in early childhood education. The findings underscore the importance of intentional pedagogical design and provide a quantitative foundation for the continued development and evaluation of play-based digital learning initiatives in early childhood contexts.

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