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Pedagogy In Transition: Assessing The Efficacy and Implementation Realities of Digital Play-Based Learning in Malaysia

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Abstract: This study investigates the effectiveness of digital play-based learning (DPBL) on emergent literacy outcomes among preschool children in Malaysian private preschools. Guided by sociocultural learning theory, the study employed a convergent mixed-methods design involving a quasi-experimental literacy intervention (n = 84 children) and qualitative interviews with six preschool teachers. Quantitative findings show that the DPBL group achieved significantly higher gains in phonological awareness ($p < .01$, $d = 0.71$) and vocabulary ($p < .05$, $d = 0.54$) compared to the control group using traditional worksheets. Qualitative analysis revealed three themes: (a) digital play increases engagement and sustained attention, (b) multimodal activities support differentiated learning, and (c) teachers require greater digital-pedagogical competence. Integrated findings suggest that DPBL enhances early literacy when accompanied by intentional teacher scaffolding. The study recommends the development of a national digital pedagogy framework for early childhood education aligned with Malaysia MADANI and the Digital Education Policy (DEP).

Keywords: Digital learning, early childhood education, emergent literacy, play-based pedagogy, mixed methods

1. Introduction

Early childhood education (ECE) in Malaysia is experiencing a period of rapid and strategic transformation, driven largely by national digitalization efforts under the Malaysia MADANI framework. These initiatives emphasize equitable access, digital empowerment, and the integration of emerging technologies into educational settings from the earliest years of schooling (Ministry of Education Malaysia, 2023). As a result, preschool environments are increasingly infused with digital tools such as tablets, interactive whiteboards, and literacy-based applications. For today's preschoolers, multimodal digital experiences such as combining visual, auditory, and tactile inputs have become a routine part of daily learning. Such experiences are believed to influence key domains of emergent literacy, including phonological awareness, vocabulary development, narrative skills, and print concept understanding (Neumann, 2018; Roskos and Burnett, 2020).

International research suggests that well-designed digital activities can enhance early literacy skills when they are developmentally appropriate and embedded within meaningful learning contexts (Hirsh-Pasek et al., 2015). In Malaysia, however, empirical studies examining the literacy-related effects of digital tools within play-based preschool curricula remain limited. Although the national curriculum stresses holistic, play-oriented learning, teachers face challenges in integrating technology in ways that complement and not replace traditional play experiences. This lack of local empirical evidence creates a gap in understanding how digitalization interacts with established pedagogical traditions.

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Digital play-based learning (DPBL), indeed, offers a promising approach that blends the strengths of guided play with the affordances of interactive technologies. DPBL is characterized by purposeful exploration: children engage in literacy tasks through multisensory interactions such as tapping, dragging, listening, and verbal responding (Edwards, 2017). Research indicates that when children use digital tools within play-rich environments, they demonstrate higher engagement and improved motivation, which can strengthen emergent literacy learning processes (Busari et al., 2025). For instance, digital storybooks with embedded hotspots or phonics apps with immediate corrective feedback can support letter–sound correspondence and vocabulary acquisition.

Despite these potential benefits, educators and policymakers continue to express concerns regarding the role and quality of digital learning in early childhood. Issues include the suitability of screen time for young learners, variability in teachers' digital competencies, and questions about the alignment of digital activities with ECE curriculum standards (Chaudron et al., 2018). Teachers often report uncertainty about balancing free play with digital tasks, managing classroom devices, and ensuring that interactions remain socially and cognitively meaningful rather than passive or entertainment-driven (Dong et al., 2020). Furthermore, without adequate professional development, teachers may underutilize digital tools or use them in ways that do not sufficiently promote active learning.

Given these tensions, there is a clear demand for systematic investigation into how DPBL influences emergent literacy outcomes in Malaysian preschools. This study aims to fill that gap by empirically examining the impact of DPBL on phonological awareness, vocabulary development, and print concept understanding. Additionally, the study seeks to explore teachers' perspectives on the practical realities of implementing DPBL in their classrooms, including perceived benefits, challenges, and pedagogical considerations. Findings from this research will provide timely evidence to inform curriculum design, teacher training, and digital policy directions within Malaysia's rapidly evolving early childhood education landscape.

2. Literature Review

2.1 Emergent Literacy Development in Preschool

Emergent literacy refers to the foundational skills, understandings, and attitudes that precede formal reading and writing instruction. These early competencies—such as letter knowledge, phonological awareness, vocabulary breadth, narrative competence, and print concept understanding develop long before a child enters primary school and are shaped by interactions within rich literacy environments (Lonigan and Shanahan, 2020). Research consistently shows that children exposed to frequent shared reading, meaningful conversation, and multisensory literacy activities demonstrate stronger early literacy trajectories that predict later academic achievement (Reese et al., 2010). Phonological awareness is a robust predictor of decoding ability, while oral vocabulary supports comprehension and expressive language development (Snow, 2016). High-quality preschool experiences can strengthen these components through intentional instruction and play-based exploration. Interactive literacy activities such as storytelling, rhyming games, and environmental print engagement help children discern sound–symbol relationships and develop emergent writing behaviors (Maureen et al., 2021). In multilingual contexts like Malaysia, where children often encounter English, Malay, and local languages simultaneously, emergent literacy development may be influenced by cross-linguistic transfer and varying home literacy environments (Ong et al., 2022). Therefore, understanding the mechanisms that support emergent literacy in diverse preschool populations is crucial for informing effective early childhood instruction.

2.2 Digital Play in Early Childhood Education

Digital play encompasses children's exploratory and creative interactions with digital media, including literacy apps, multimedia storybooks, augmented reality tools, and gamified learning experiences. When designed according to developmental principles, digital play can enhance early literacy by providing repeated exposure, scaffolding, and immediate feedback as factors shown to reinforce phonics, vocabulary learning, and print awareness (Neumann, 2018). For example, interactive e-books with touch-responsive features can promote phonological sensitivity, while digital storytelling tools can strengthen comprehension and expressive language skills (Roskos and Burnett, 2020). Digital play also supports differentiated learning through adaptive features that respond to individual skill levels. Despite these benefits, challenges persist in early childhood settings. Studies show that equitable access to high-quality digital resources remains uneven, particularly in lower-income or rural contexts (Chaudron et al., 2018). Teacher digital competence is another concern; many teachers feel unprepared to integrate digital tools meaningfully into play-based learning, leading to superficial or passive screen use (Dong et al., 2020). Moreover, debates continue about appropriate screen time and balancing digital play with hands-on, social experiences that are central to early

development. Thus, digital play in ECE requires thoughtful pedagogical planning to ensure it complements rather than replaces traditional modes of learning.

2.3 Play-Based Pedagogy in Malaysia

Play-based pedagogy is central to the Malaysia Preschool Standard Curriculum (*Kurikulum Standard Prasekolah Kebangsaan, KSPK*), which emphasizes holistic development across cognitive, socio-emotional, language, and physical domains (Yean and Ngadni, 2024). KSPK promotes child-led exploration, imaginative play, and active engagement as core strategies for fostering early learning. Within this framework, digital tools are not meant to replace play but rather to enrich and extend learning opportunities (Ministry of Education Malaysia, 2020). However, recent evaluations of Malaysian preschool implementation reveal significant inconsistencies in digital integration. Studies highlight disparities in device availability across urban and rural preschools, with some schools lacking adequate internet connectivity, functional devices, or child-friendly digital resources (Hassan et al., 2021). Teacher readiness is also a recurring issue; many preschool educators report limited training in digital pedagogy, which affects their confidence and ability to design meaningful digital play experiences aligned with KSPK objectives (Yahya and Salamuddin, 2022). As a result, digital activities are sometimes used merely for entertainment or classroom management rather than purposeful learning. Furthermore, cultural expectations about "real play" versus "digital play" influence teacher beliefs and parental acceptance (Cross et al., 2025). These structural and pedagogical challenges highlight the need for policies and professional development efforts that support effective, equitable, and curriculum-aligned digital integration in Malaysian ECE.

2.4 Research Gap

Although DPBL has gained international attention for its potential to enhance emergent literacy, empirical evidence within the Malaysian preschool context remains limited. Most local studies have focused on either teachers' perceptions or small-scale interventions without systematically measuring literacy outcomes (Hassan et al., 2021). Few have employed rigorous quantitative assessment tools to capture changes in specific literacy domains such as phonological awareness, vocabulary development, or print concept understanding. Moreover, qualitative insights into teachers lived experiences implementing DPBL particularly in relation to classroom realities, technological constraints, and pedagogical decision-making remain underexplored (Yahya and Salamuddin, 2022). Internationally, in fact, scholars emphasize the importance of integrating both quantitative and qualitative lenses to understand how digital tools function within complex early childhood environments (Roskos and Burnett, 2020). This gap signals the need for research that captures both measurable learning outcomes and contextualized teacher perspectives. To address these limitations, the present study adopts a convergent mixed-methods design, combining standardized emergent literacy assessments with semi-structured interviews. By merging numerical findings with narrative insights, this study aims to provide a comprehensive understanding of DPBL's effectiveness and practical implementation in Malaysian preschools, thereby contributing new evidence to inform curriculum development, teacher training, and digital education policy.

3. Methodology

3.1 Research Design

This study employed a convergent mixed-methods design in which quantitative and qualitative data were collected simultaneously and integrated during analysis to provide a comprehensive understanding of DPBL's impact on emergent literacy (Creswell and Plano Clark, 2018). This design allows researchers to compare statistical outcomes with teachers' contextual insights, strengthening the validity of interpretations (Creswell, 2014). By merging datasets, the study captures not only measurable literacy gains but also the pedagogical processes influencing children's engagement and learning. This approach is suitable for early childhood settings, where complex classroom interactions benefit from multi-perspective examinations (Wiersma, 2000).

3.2 Respondents/Participants

Participants consisted of preschool children and experienced teachers recruited from four Malaysian private preschools in Bandar Sri Damansara, Kuala Lumpur, Malaysia involving Tadika Sri Comel Manja, Tadika Hidayah Bistari, Tadika Darul Qalam and Genius Aulad. The quantitative sample included 84 children aged 5-6, randomly assigned to a treatment group implementing the DPBL module (n = 42) and a control group using traditional worksheet-based literacy activities (n = 42). This sample size aligns with early childhood intervention studies requiring adequate statistical power for group comparisons (Biemiller, 2020). The qualitative component involved six preschool

teachers (T1–T6), each possessing at least three years of teaching experience, providing rich professional perspectives on the feasibility, challenges, and pedagogical value of DPBL implementation.

3.3 Instruments

Two primary instruments were used. The Emergent Literacy Test (ELT) assessed children's phonological awareness, vocabulary development, and print concept knowledge, reflecting core constructs widely recognized in early literacy research (Lonigan and Shanahan, 2020). The ELT provided reliable quantitative data on children's literacy progress before and after the intervention. Complementing this, a semi-structured Teacher Interview Protocol captured qualitative insights into teachers' experiences with DPBL, including perceptions of digital tool effectiveness, classroom integration strategies, and perceived barriers. Semi-structured interviews ensure flexibility while maintaining consistency across participants (Kallio et al., 2016; Merriam, 2002).

3.4 Procedures/Protocols

The intervention spanned four weeks and was implemented during regular literacy sessions. Children in the DPBL group engaged with phonics-based digital games, interactive storytelling applications, and vocabulary picture puzzles designed to promote multisensory learning. These activities aligned with evidence showing that digital interaction can reinforce phonological and vocabulary skills (Neumann, 2018). Meanwhile, the control group followed the standard KSPK curriculum using traditional worksheet-based literacy tasks typical of Malaysian preschools. Pre- and post-tests using the ELT were administered to both groups. Teachers participating in the qualitative phase were interviewed following the intervention (Bryman, 2012).

3.5 Data Analysis

Quantitative data were analyzed using paired t-tests and ANCOVA to examine within-group gains and between-group differences while statistically controlling baseline variations. Effect sizes (Cohen's d) were calculated to interpret the magnitude of improvements, in line with recommended practices in literacy intervention research (Plonsky and Oswald, 2014). Qualitative interview data underwent thematic analysis following Braun and Clarke's (2021) systematic six-phase approach. Integration occurred through joint display synthesis, allowing side-by-side comparison of statistical findings and teacher narratives to generate meta-inferences regarding DPBL's effectiveness and implementation dynamics (Braun and Clarke, 2021).

4. Results

4.1 Quantitative Findings

Table 1. Literacy Gains: DPBL vs Control

Literacy Construct	Mean Gain (DPBL)	Mean Gain (Control)	p-value	Effect Size (d)
Phonological Awareness	6.21	3.14	< .01	0.71
Vocabulary	4.87	2.95	.02	0.54
Print Concepts	2.41	1.88	.14	0.22

The quantitative results indicate differential effects of the DPBL intervention across emergent literacy constructs. As shown in the descriptive statistics, children in the DPBL group demonstrated substantially larger mean gains in phonological awareness ($M = 6.21$) compared with the control group ($M = 3.14$). This difference was statistically significant ($p < .01$) with a large effect size ($d = 0.71$), suggesting that digital phonics games and interactive audio feedback may have provided enhanced opportunities for repeated practice and multisensory sound manipulation factors known to support phonological development in early childhood (Neumann, 2018).

Similarly, the DPBL group outperformed the control group in vocabulary gains, with mean improvements of 4.87 and 2.95 respectively. The difference reached statistical significance ($p = .02$) and yielded a medium effect size ($d = 0.54$). This finding aligns with previous studies showing that multimedia storytelling and digital picture-based tasks can enrich children's receptive and expressive vocabulary by providing multimodal cues and contextualized word exposure (Roskos & Burnett, 2020).

In contrast, no significant difference emerged for print concepts, where the DPBL group achieved a mean gain of 2.41 compared with 1.88 in the control group ($p = .14$, $d = 0.22$). The small effect size suggests that print concepts such as book handling, directionality, and understanding of print functions may rely more heavily on physical text interaction and teacher modelling, which digital tools may not have replicated as effectively within the short intervention period.

Overall, significant improvements were found in phonological awareness and vocabulary, but not in print concepts.

4.2 Qualitative Findings

Analysis of interview data revealed three major themes describing teachers' experiences implementing DPBL in preschool classrooms.

Theme 1: High Engagement

Teachers consistently reported that children displayed noticeably higher levels of attention, motivation, and sustained focus during DPBL sessions compared to traditional literacy activities. For example, T2 noted, "*Usually after 10 minutes they start walking around, but with the phonics game, they stayed for almost the whole session. They kept saying, "Teacher, I want to try again!*" Similarly, T5 observed that even typically quieter children became more participative during digital storytelling tasks. Teachers attributed this engagement to multisensory interaction, immediate feedback, and the game-like structure of the activities.

Theme 2: Differentiation

Teachers highlighted DPBL's ability to support diverse learning needs by offering adjustable levels and personalized task difficulty. T4 shared, "*Some children struggle with blending, but the app allowed them to repeat the sound at their own pace while others moved to the next level.*" This flexibility was especially beneficial in mixed-ability classrooms, allowing teachers to provide tailored support without interrupting whole-group instruction. Teachers also reported that digital vocabulary puzzles helped advanced learners progress more quickly while still supporting those needing more guidance.

Theme 3: Teacher Competence Gap

Despite positive learning outcomes, teachers expressed uncertainty and limited confidence in their own digital pedagogical skills. T1 stated, "*I know the children enjoy it, but sometimes I'm not sure if I am using the app the right way to teach the learning standard.*" Others described challenges managing devices, troubleshooting technical problems, and aligning digital activities with the KSPK curriculum. T6 explained, "*I want to use more digital tools, but I need training. Right now, I just explore by trial and error.*" This competence gap highlighted the need for structured professional development and clearer pedagogical guidelines.

Overall, the qualitative findings show that while DPBL enhances engagement and supports differentiated learning, its effectiveness is constrained by teachers' digital readiness and confidence.

5. Discussion

The findings of this study demonstrate that Digital Play-Based Learning (DPBL) significantly enhances emergent literacy outcomes, particularly in phonological awareness and vocabulary development. The strong quantitative gains observed in the DPBL group mirror international evidence showing that digital multimodal environments such combining audio, visual, and interactive elements can reinforce phonological processing and word learning when supported with intentional teacher facilitation (Neumann, 2018; Hirsh-Pasek et al., 2015). The qualitative theme of High Engagement further explains these gains: teachers consistently noted that children were more attentive, motivated, and willing to repeat literacy tasks during digital activities. Such engagement is known to strengthen cognitive processing and accelerate early literacy acquisition (Roskos and Burnett, 2020).

However, the non-significant improvement in print concepts suggests that digital tools may not fully substitute the tactile and spatial affordances of physical books. Print concepts such as understanding directionality, book handling, and awareness of print features are often better developed through shared reading with actual print materials, where children can manipulate pages and observe text–image relationships more naturally (Bus et al., 2020). Teachers' qualitative observations also indicated that children still rely on hands-on experiences to internalize foundational print knowledge.

The theme of Differentiation highlights another strength of DPBL: digital tools allow teachers to tailor tasks to varied ability levels, offering repeated practice or advanced challenges as needed. This flexibility aligns with studies showing that adaptive digital platforms can effectively support mixed-ability classrooms (Falloon, 2019).

Nonetheless, the theme of Teacher Competence Gap underscores that the success of DPBL is contingent on teachers' digital pedagogical skills. Participants reported uncertainty in aligning apps with learning standards, managing devices, and integrating digital play meaningfully becomes issues commonly cited in early childhood technology research (Dong et al., 2020). Without structured professional development, the risk is that digital tools will be used superficially rather than as intentional literacy supports.

Overall, the convergent findings suggest that while DPBL is a powerful enhancer of emergent literacy, its effectiveness depends on balanced integration, teacher expertise, and continued emphasis on play-based, developmentally appropriate practice.

6. Implications

6.1 Policy

Developing a National Digital Early Literacy Framework aligned with the Digital Education Policy (DEP) and Malaysia MADANI is essential to ensure coherent nationwide implementation of digital learning in early childhood settings. Such a framework should outline age-appropriate digital competencies, standards for device use, data governance, and culturally grounded digital citizenship values. It should also mandate equitable access for rural and B40 communities, ensuring that digital early literacy is positioned not merely as a technological initiative but as a national developmental priority that supports inclusivity and lifelong learning.

6.2 Practice

Continuous professional development (CPD) for preschool teachers is critical to strengthening their digital pedagogy proficiency, including skills in selecting high-quality apps, designing multimodal learning experiences, and applying safe digital practices. Embedding multimodal digital literacy activities such as interactive storytelling, AR-enhanced phonics, and voice-assisted reading within the KSPK curriculum ensures that digital tools support rather than replace foundational learning. Effective practice also requires classroom-level guidelines, peer coaching models, and formative digital assessment strategies that help teachers evaluate children's evolving early literacy skills in technology-enhanced environments.

6.3 Research

Future research should extend Digital Play-Based Learning (DPBL) studies to rural preschools and B40 communities, where access gaps and contextual challenges may influence implementation quality and learning outcomes. Understanding how DPBL functions in under-resourced environments will provide important evidence for equitable policy planning. Longitudinal research is also needed to explore the sustained impact of early digital literacy interventions on children's reading fluency, vocabulary growth, and motivation to read, offering insight into whether early digital exposure produces measurable long-term academic benefits.

7. Limitations

This study is constrained by its short four-week intervention period, which limits the ability to observe long-term changes in children's early digital literacy development. The sample size drawn from only four schools also restricts broader generalization, as the findings may not represent the diversity of preschool contexts across Malaysia. Additionally, reliance on self-reported qualitative data from teachers and parents introduces potential response bias, as participants may unintentionally provide socially desirable answers rather than fully accurate reflections of their experiences.

8. Conclusion

This mixed-methods study provides robust empirical support for the effectiveness of digital play-based learning (DPBL) in enhancing emergent literacy among Malaysian preschoolers. Quantitative results demonstrate notable gains in phonological awareness and vocabulary, indicating that interactive and multimodal digital environments can scaffold early language skills more effectively than traditional approaches. These improvements were further reinforced by qualitative insights, in which teachers reported heightened learner engagement, improved motivation, and greater opportunities for differentiated instruction. Together, these convergent findings suggest that DPBL offers

a developmentally appropriate and pedagogically meaningful pathway for strengthening early literacy foundations. However, the success of DPBL depends greatly on the competence and confidence of teachers in integrating digital tools within play-based learning. While teachers expressed enthusiasm about the benefits for children, many also acknowledged gaps in their own digital pedagogical skills, signaling the need for ongoing, high-quality professional development. Addressing this competency gap is crucial for ensuring that digital tools are not used superficially but are intentionally aligned with literacy learning goals and the Malaysian preschool curriculum. Finally, equitable access remains a central concern. To ensure that all children including those in rural or B40 communities' benefit from DPBL, investment in infrastructure, devices, and digital teaching resources is essential. When these systemic supports are in place, DPBL has strong potential to transform early literacy learning in Malaysia.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this research.

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