

# Interactive Digital Media to Enhance Early Literacy in Hybrid Learning

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## ABSTRACT

The development of hybrid learning models that are increasingly widespread, especially after the COVID-19 pandemic, has transformed early childhood education and created a demand for innovative approaches in early literacy development. This study examines the effectiveness of interactive digital media in improving the literacy skills of children aged 4–6 years within the hybrid learning context. Using a mixed-method design, quantitative measurement of literacy achievement was combined with qualitative observations and interviews involving educators and parents in several early childhood education institutions. The results demonstrate that interactive digital media significantly enhances basic literacy competencies, such as phonemic awareness, vocabulary enrichment, and storytelling skills, when effectively integrated with traditional learning methods. Novelty lies in the integration of early literacy development, digital media, and hybrid learning, which has rarely been explored in the Indonesian context. Factors determining effectiveness include media usability, content relevance, parental involvement, and the facilitator role of educators. These findings contribute empirical insights to optimize the use of interactive technology in early childhood hybrid learning environments. Practical implications emphasize the importance of designing digital content that is age-appropriate, culturally sensitive, and engaging, as well as strengthening hybrid learning frameworks to support literacy development as a foundation for lifelong learning success.

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## 1. INTRODUCTION

The development of digital technology has brought significant changes in various aspects of life, including early childhood education (PAUD). Over the last decade, especially since the COVID-19 pandemic, hybrid learning models that combine online and face-to-face instruction have become

increasingly common (Suryaningsih & Aisyah, 2024). This shift has created new pedagogical challenges, particularly in supporting early literacy development among children aged 4–6 years, a critical period when the foundations of reading and writing skills are established (Hudson et al., 2021; Barratt-Pugh & Rohl, 2020).

Early literacy is a fundamental determinant of future academic success. UNESCO, (2020) reported that more than 250 million children worldwide have not achieved adequate levels of basic literacy, potentially widening educational inequality and hindering cognitive development. In response, global research has increasingly examined the role of interactive digital media, such as educational apps, digital games, and e-books in improving phonemic awareness, vocabulary mastery, and narrative skills (Chuang & Jamiat, 2023). These studies generally demonstrate positive impacts, but they also emphasize that effectiveness depends heavily on content quality, parental involvement, and integration with traditional pedagogy (Haisraeli & Fogiel-Bijaoui, 2023).

Despite these global insights, there remains a research gap in understanding how digital media can be optimally integrated into hybrid learning models for early literacy in the Indonesian context (Utanto & Pristiwati, 2024). Previous international studies have focused largely on Western or high-income countries, while limited evidence addresses how cultural factors, local educational infrastructure, and parental engagement shape the success of hybrid digital literacy interventions in developing countries (Budiarti & Darmayanti, 2018; Hasibuan et al., 2024).

This study seeks to fill that gap by examining the effectiveness of interactive digital media in enhancing the literacy skills of Indonesian children aged 4–6 years within a hybrid learning environment. The novelty of this research lies in combining three elements, early literacy development, interactive digital media, and hybrid learning models, which have rarely been studied together in Indonesia. By situating the findings within global literature while highlighting local challenges and opportunities, this research contributes both to theoretical understanding and to practical strategies for improving early literacy education in developing country contexts.

More than that, digital media offers advantages in the form of interactivity and personalization that traditional learning methods cannot easily achieve. Children can learn at their own pace, get hands-on feedback, and explore different concepts of literacy through games and activities specifically designed to improve their memory and comprehension (Munna et al., 2024). In addition, digital media can accommodate a wide range of learning styles and special needs of children, including those with learning difficulties or language barriers, thereby contributing to inclusivity in early literacy education (Nurmalisa et al., 2023).

The effectiveness of digital media is highly dependent on age-appropriate content design, cultural context, and the active role of educators and parents in facilitating children's learning experiences. Media that is too complex or less relevant can cause confusion and lower children's motivation. Therefore, the integration of digital media in literacy learning must be carried out carefully by ensuring the involvement of educators in guiding and associating digital materials with conventional learning activities (Clark & Mayer, 2023; Falloon, 2020). This combination is believed to maximize the potential of digital media to support the literacy development of children aged 4-6 years optimally.

However, empirical studies that comprehensively examine the effectiveness of interactive digital media in the context of hybrid learning in Indonesia are still very limited. Most previous research has focused on face-to-face or online learning separately, so it is not able to provide a comprehensive picture of how technology can support children's early literacy in blended learning models. In fact, with the increasing adoption of hybrid learning in early childhood education institutions, the need to understand the factors supporting the success of interactive digital media is increasingly urgent.

This study aims to fill this gap by examining the effectiveness of interactive digital media in improving the early literacy of children aged 4-6 years in a hybrid learning environment. Through a

mixed-methods approach that combines quantitative and qualitative data, this study is expected to provide a comprehensive picture of literacy achievement, educator and parent experiences, and factors that affect the successful use of digital media. The findings of this study are expected to be a strategic reference for curriculum development, learning media design, and early childhood education policies in the digital era.

## **2. METHODS**

### **2.1. Research Design**

This study uses a mixed methods approach with a sequential explanatory design, which combines quantitative and qualitative data to provide a comprehensive picture of the effectiveness of interactive digital media in early literacy learning in children aged 4-6 years in the hybrid learning model (Vebrianto et al., 2020). This approach allows for quantitative analysis of children's literacy measurement results while understanding experiences, perceptions, and supporting factors through interviews and qualitative observations.

### **2.2. Location and Participants**

The research was carried out in several Early Childhood Education (PAUD) and kindergarten (TK) institutions that applied hybrid learning models in urban areas, such as Jakarta and Bandung. The quantitative participants consisted of 120 children aged 4-6 years who participated in a literacy program using interactive digital media, selected by purposive sampling based on age criteria and readiness to participate in hybrid learning. For qualitative data, in-depth interviews and observations were conducted with 15 educators and 15 parents to explore their experiences and roles in supporting children's digital learning.

### **2.3. Data Collection Instruments**

#### **2.3.1. Quantitative Data**

Early literacy was measured using standardized tests that have been validated for early childhood, which measure aspects of phonemic awareness, vocabulary mastery, and storytelling skills. The test was conducted before and after the learning intervention with interactive digital media over a period of 12 weeks.

#### **2.3.2. Qualitative Data**

Semi-structured interviews with educators and parents aimed to explore perceptions, challenges, and support in the use of interactive digital media. Observations were made during the learning session to record the child's interaction with the media and the role of the facilitator.

### **2.4. Research Procedure**

The research began with a literacy pre-test to assess the children's initial abilities. The intervention was then conducted over 12 weeks through a hybrid learning model that combined classroom (offline) and online sessions. Children participated in two sessions per week, each lasting 30–45 minutes.

In every session, interactive digital media such as educational applications, interactive storybooks, and digital games were used to strengthen phonemic awareness, vocabulary, and storytelling skills. During online sessions, parents were involved in assisting children to access the digital materials at home, while teachers facilitated learning through video calls and guided instructions. In face-to-face sessions, the same digital content was integrated with group activities, such as collaborative storytelling and vocabulary exercises, led by educators.

The digital learning materials were adapted to the Indonesian early childhood curriculum and adjusted to children's daily contexts to ensure cultural relevance. Educators also received short training prior to the program to standardize implementation. After the intervention, a literacy post-test was administered to measure progress. In addition, observations and semi-structured interviews with 15 educators and 15 parents were conducted to gather qualitative insights about their experiences and the children's responses during the hybrid learning program (Osei et al., 2016).

## **2.5. Data Analysis**

### **2.5.1. Quantitative Analysis**

The data of pre-test and post-test results were analyzed using descriptive and inferential statistics, including paired t-tests to determine the significance of improving children's literacy skills.

### **2.5.2. Qualitative Analysis**

Interview and observation data were analyzed thematically to identify key themes related to media effectiveness, supporting factors, and constraints in interactive digital learning (Braun & Clarke, 2023).

## **3. FINDINGS AND DISCUSSION**

### **3.1. Increasing Literacy of Children Aged 4-6 Years through Interactive Digital Media**

The results of quantitative analysis obtained from pre-test and post-test measurements showed a significant improvement in the literacy skills of children aged 4-6 years after receiving learning interventions using interactive digital media in the hybrid learning model. The paired t-test showed a statistically significant difference ( $p < 0.01$ ) in three main aspects of early literacy, namely phonemic awareness, vocabulary mastery, and storytelling skills. In detail, the average increase in phonemic awareness scores reached 15%, which suggests that children are better able to recognize and manipulate sounds in words, a fundamental skill that is crucial in the process of learning to read and write. In addition, children's vocabulary mastery increased by 18%, which enriched their ability to understand and use new words, thereby improving communication skills and understanding of texts. The aspect of storytelling skills also experienced the highest increase, which was 20%, which reflects the child's ability to compose narratives in a coherent and creative manner, an important competency in comprehensive literacy (Huda et al., 2022; Maureen et al., 2020).

This significant increase confirms the effectiveness of interactive digital media as a learning tool that not only attracts children visually and auditorily but also stimulates cognitive and language development holistically. From the perspective of early literacy theory Lenhart et al., (2022), meaningful interactions with texts and symbols, supported by engaging media, help build foundational skills such as phonological awareness, vocabulary growth, and narrative competence. The integration of educational games, interactive animations, and live feedback features provides opportunities for active participation, which aligns with Vygotsky's sociocultural theory emphasizing guided interaction as a driver of literacy development (Septiani & Syaodih, 2021).

These findings are consistent with previous global studies. For example, Ningtyas & Amirudin, (2025) highlighted the role of digital media in strengthening children's engagement and improving language skills in the Indonesian context, while Maureen et al., (2018) demonstrated that well-structured and developmentally appropriate digital media significantly enhances early literacy outcomes. Similar evidence from global research, reinforces that interactive technologies can effectively support early literacy when integrated with adult scaffolding and contextual learning (Fitriani et al., 2025).

This study contributes to the literature by showing how interactive digital media, when applied within a hybrid learning framework in Indonesia, provides not only entertainment but also pedagogically grounded opportunities for children aged 4–6 to strengthen their literacy foundations. This highlights its relevance as a culturally contextualized approach that complements global evidence on digital literacy development (Patel et al., 2025).

In addition, interactive digital media interventions in the context of hybrid learning allow children to learn in a variety of conditions, both face-to-face and online, which provides flexibility and continuity of learning. This is particularly relevant in modern learning situations that demand rapid adaptation to social and technological changes, while overcoming the limitations of access to conventional education. Thus, interactive digital media not only improves individual literacy skills, but also expands access and quality of literacy education for children of diverse backgrounds and conditions.

**Table 1.** Comparison of Pre-Test and Post-Test Scores of Literacy Aspects in Early Childhood

Literacy Aspect	Pre-Test Score (Average)	Post-Test Score (Average)	Increase (%)	Signifikansi (p-value)
Phonemic Awareness	65.0	74.8	15%	< 0.01
Vocabulary Mastery	60.5	71.4	18%	< 0.01
Storytelling Skills	58.0	69.6	20%	< 0.01

Overall, these results indicate that the integration of interactive digital media in hybrid learning programs is an effective strategy and needs to be seriously considered in the early childhood education curriculum. This approach is not only able to strengthen the foundation of children's early literacy, but also prepare them for the next learning challenges in the increasingly complex and dynamic digital era.

### 3.2. The Role of Educators and Parents in Supporting Digital Learning

Qualitative data obtained through in-depth interviews and participatory observation show that the successful use of interactive digital media in early literacy learning is highly dependent on the active role of educators and parental involvement. Educators do not only play the role of presenting material, but rather as facilitators who proactively guide and accompany children during the learning process. They ensure that children are not just passive spectators, but actively involved in understanding, exploring, and applying the material delivered through digital media. This is especially important because literacy learning at an early age requires an interactive and contextual approach so that children can connect digital content with real experiences and traditional learning that they are undergoing.

One educator emphasized, *"The success of this digital media is highly dependent on how we accompany children during the session, ensuring they not only watch, but also interact and understand the material"* (Interview, code C1-24 August 2024).

This statement describes how important the role of educators is as a mediator who helps children optimize the digital learning experience, including providing additional explanations, answering questions, and directing reflective activities that are strengthen children's understanding. Without intensive and responsive assistance, digital media has the potential to be less effective or even confusing for children who are still in the early stages of developing literacy skills.

In addition, parental involvement also emerged as a key factor that was no less important. In the context of hybrid learning that combines online and face-to-face sessions, parents play the role of primary supporters at home helping to maintain consistency and stimulation of children's literacy outside of the school environment (Topping et al., 2022). Parents who actively accompany and

participate in the online learning process can provide emotional and technical support that strengthens children's motivation to learn and helps overcome difficulties that may arise when using digital media. This role greatly contributes to creating a holistic and well-rounded learning environment (Silinskas et al., 2020).

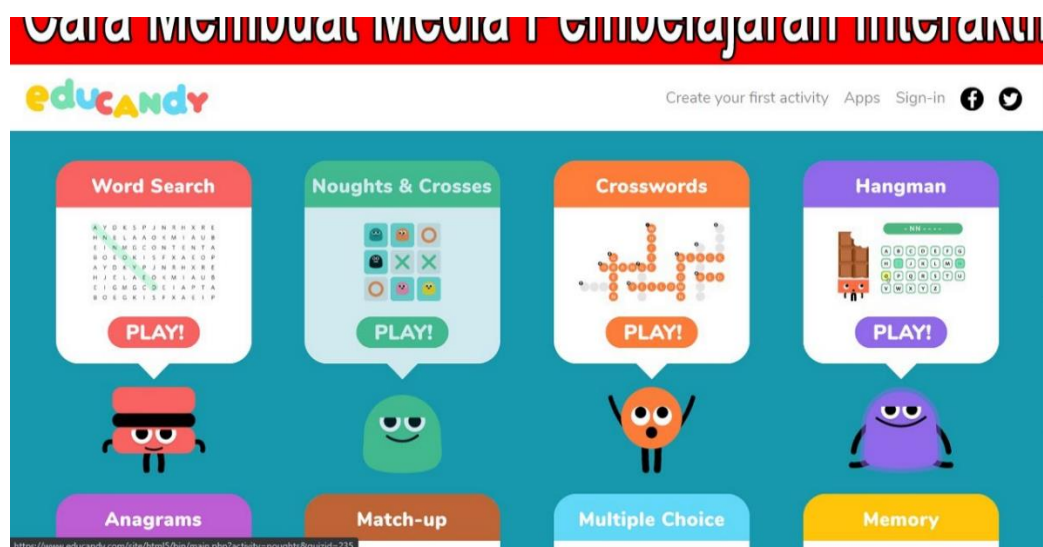
The involvement of educators and parents in accompanying digital learning is in accordance with the principles of social learning theory put forward by Bandura (1977), which emphasizes that social interaction and observation are crucial elements in the learning process, especially in early childhood (Rumjaun & Narod, 2025). Learning does not only happen through direct experience, but also through observation and guidance from important figures around the child. Therefore, interactive digital media must be equipped with pedagogical and social support so that its effectiveness can be optimized. The integration of interactive digital media in early literacy learning must be complemented by active mentoring strategies from educators and collaborative involvement from parents. This approach not only strengthens children's literacy understanding and skills, but also builds harmonious relationships between home and school, which is critical in a flexible and adaptive hybrid learning framework (Dikilitas & Fructuoso, 2023; Liu et al., 2024).

### 3.3. Factors Determining the Effectiveness of Interactive Digital Media

Thematic analysis of qualitative data obtained from interviews and observations revealed a number of key factors that significantly affect the effectiveness of interactive digital media in supporting literacy learning in children aged 4-6 years. One of the main factors that is often highlighted is the ease of use of media. The media is designed with an intuitive and easy-to-understand interface that allows them to interact independently without experiencing confusion or frustration. This is very important considering that at an early age, children's motor and cognitive abilities are still developing, so that complex or difficult to navigate media have the potential to hinder the learning process and reduce children's interest in learning materials (Sulianta, 2024).

In addition to ease of use, the relevance and cultural context of the content are also equally important. Media that presents content that is appropriate to the child's social and cultural environment tends to be better able to build a sense of emotional and intellectual connection. Children find it easier to understand and internalize material that is close to their daily experiences, so that interest in learning becomes higher and the learning process becomes more meaningful (Sa'adah et al., 2022). Conversely, content that is irrelevant or culturally unfamiliar has the potential to create psychological distance and reduce learning effectiveness. Therefore, digital media content design must consider aspects of local culture and the values lived by children and their families (Sa'adah et al., 2022; Hamideh Hosseini et al., 2025).

The third factor is the level of media interactivity. Digital media that provide interactive features such as educational games, tasks that require active responses, and exploratory activities provide children with the opportunity to be actively involved in the learning process. This interactivity not only increases the child's cognitive and emotional engagement, but also stimulates the intrinsic motivation to learn. Children who actively participate in learning tend to have more in-depth learning experiences and are able to remember and apply knowledge better. In addition, interactive features that provide direct and constructive feedback allow children to know their mistakes and successes in real time, making the learning process more adaptive and personalized. This feedback also plays a role in building children's confidence and facilitating continuous learning (Behnamnia et al., 2020; Maier & Klotz, 2022).



Source: <https://www.educandy.com>

**Figure 1.** Example of Digital-Based Interactive Learning Media on the Educandy Platform

This image is sourced from the Educandy website which can be accessed via the URL: <https://www.educandy.com>. Educandy is a platform that provides interactive learning media such as Word Search, Noughts & Crosses, Crosswords, Hangman, and others, designed to enhance children's learning experiences in a fun and interactive way. The site's main page interface displays the different types of educational games that can be created and played live, providing a concrete example of how interactive digital media can be implemented in the context of early childhood learning.

The findings are consistent with Buckingham's argument that the design of digital learning media must be developmentally appropriate and culturally relevant. This aligns with early literacy theories Taylor & Leung, (2020), which stress that children's literacy growth is shaped through rich and meaningful interactions with texts, symbols, and their social environment. Interactive digital media that combines visual, auditory, and participatory elements thus provides not only a channel for delivering information but also a medium for scaffolding cognitive and linguistic development through active engagement.

Global studies reinforce this perspective. Kearns, (2024) found that well-designed digital tools significantly enhance phonological awareness, vocabulary building, and narrative competence when paired with adult facilitation. Similarly, Pramerta et al., (2025) emphasized that tailoring content to children's developmental stages increases both motivation and literacy outcomes. Within this framework, the success of interactive digital media in improving early literacy lies not solely in its technical sophistication, but in its ability to integrate with children's daily experiences, cultural contexts, and learning needs holistically.

By situating the findings within both theoretical and global evidence, this study contributes uniquely to the Indonesian context, demonstrating that hybrid learning combined with interactive digital media can serve as an effective and culturally sensitive approach to strengthening early literacy foundations.

### 3.4. Implications of Hybrid Learning in Early Literacy Development

This research emphatically confirms that the hybrid learning model which combines the advantages of face-to-face methods and online learning offers a flexible and effective paradigm in supporting the development of early childhood literacy. This hybrid approach provides flexibility for

children to learn not only in traditional physical classrooms, but also in a virtual environment that can be accessed anytime and anywhere according to their individual needs. This flexibility is crucial, especially for children aged 4-6 years who have diverse learning needs and are prone to concentration disorders, thus allowing for more personalized and comfortable adjustment of the learning rhythm (Liparoti & Minino, 2021; Bicenturk, 2024).

The use of interactive digital media in the framework of hybrid learning is increasingly optimal because these media are able to present interesting, interactive, and adaptive learning content. This media not only presents material passively, but also encourages active involvement of children through educational games, exploration activities, and direct feedback that facilitate the understanding and mastery of literacy concepts (Anggraini & Sriemulyaningsih, 2024). Thus, interactive digital media acts as a catalyst that enriches children's learning experiences, strengthens intrinsic motivation, and significantly improves learning outcomes.

The findings of this study confirm that the success of technology integration in children's literacy learning does not only depend on the availability of digital tools or platforms, but also on the application of adaptive and contextual pedagogical methods. The method must be able to adapt to the characteristics of child development, local cultural needs, and the challenges of diverse learning environments. This approach ensures that technology is not a replacement, but rather a complement and reinforcement of traditional teaching and learning processes, thus creating a holistic and sustainable learning ecosystem.

Furthermore, this hybrid learning model supported by interactive digital media is not only relevant and crucial during the COVID-19 pandemic, where face-to-face learning is very limited, but also offers a long-term solution that is able to accommodate the dynamics and needs of education in the current and future digital age. This model is an important foundation for developing an early childhood education system that is inclusive, flexible, and responsive to technological changes and evolving social needs. Thus, hybrid learning supported by interactive digital media is a strategic innovation that can bridge the gap in access to education and accelerate the achievement of children's literacy competencies as a whole.

#### 4. CONCLUSION

This study demonstrates that the hybrid learning model, which integrates face-to-face and online methods, provides a flexible and effective framework for improving literacy among children aged 4–6 years. The integration of interactive digital media within this model significantly enhances fundamental literacy competencies, including phonemic awareness, vocabulary mastery, and storytelling skills. Importantly, the findings extend existing theories of early literacy and digital pedagogy by highlighting how technology-mediated interactions can serve as both cognitive and socio-cultural tools, enriching children's learning through multimodal and participatory engagement. This reinforces global literacy theories (e.g., emergent literacy and social constructivism) by providing empirical evidence from the Indonesian context, where hybrid learning in early childhood education remains underexplored.

From a theoretical perspective, this research contributes to the growing body of knowledge on digital literacy in early childhood, emphasizing that effective literacy development requires not only exposure to digital tools but also their meaningful integration with cultural relevance, age-appropriate design, and guided interaction. These insights underline the need for future frameworks of digital pedagogy to account for both technological affordances and socio-cultural dynamics in literacy acquisition.

Practically, the study provides actionable guidance for educators and parents. For teachers, the findings underscore the importance of selecting interactive digital media that are intuitive, engaging,



and aligned with developmental milestones, while ensuring a balanced combination with traditional literacy practices. For parents, the results emphasize their role as active co-facilitators, whose involvement in monitoring and reinforcing learning at home is critical for sustaining children's literacy growth. Collaborative partnerships between schools and families, therefore, become a strategic foundation for maximizing the impact of hybrid learning interventions.

Overall, this study suggests that hybrid learning supported by interactive digital media has long-term potential as a sustainable and inclusive educational approach in the digital era. By combining theoretical insights and practical strategies, the research offers a roadmap for strengthening early literacy development, not only in Indonesia but also in other contexts facing similar challenges of access and quality in early childhood education.

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