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Implementation of *Deep Learning* Through the Integration of Digital Interactive Boards

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Abstract

This study examines the implementation of deep learning through the integration of digital interactive boards at TKIT Husnul Khotimah, Cikarang District, West Java. The use of interactive screen-based technology in early childhood education institutions is growing in line with the demands of the digital era, which encourages more innovative, interactive, and child-centered learning. The study used a descriptive qualitative approach with a case study method. Data were obtained through observation, in-depth interviews, and documentation involving the principal, class teachers, and students aged 4–6 years in the 2025/2026 academic year. The results showed that the implementation of digital interactive boards had a positive impact on the quality of the learning process. This media was able to create more interesting, interactive, and child-centered learning through the use of visual materials, audio, educational videos, and various interactive activities directly on the screen. Students showed increased attention, learning motivation, active participation, creativity, and conceptual understanding. In addition, teachers were helped in delivering material more effectively and variedly. Although there are still obstacles in the form of limited mastery of technology by some teachers and less than optimal use of device features, overall, the implementation of digital interactive boards has proven effective in supporting in-depth learning and improving the quality of early childhood education.

INTRODUCTION

The development of digital technology has brought a new paradigm to early childhood education, particularly at the kindergarten level. A recent study by Papadakis et al. (2023) showed that digital interactive boards, as large-scale interactive touchscreen technology, can increase learning engagement. *learning engagement*kindergarten children up to 67% compared to traditional learning methods.

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This finding is supported by research (Neumann & Neumann, 2023), which revealed that the features of *multi-touch* dynamic visualization and visualization of digital interactive boards significantly support the development of fine motor and cognitive skills in children aged 4–6 years. However, the implementation of this technology in Indonesia still faces various challenges, including limited infrastructure, lack of teacher training, and the digital divide between regions (Wahyuni et al., 2023). Therefore, an in-depth study of the implementation of digital interactive boards in the local context is crucial and urgent.

A digital interactive board is an interactive touchscreen technology device designed to support modern learning processes through high-level visual, audio, and interactive features. According to research published in the *International Journal of Emerging Technologies in Learning* (iJET), a digital interactive board is classified as the latest generation of educational technology that is capable of becoming a center for learning activities because it integrates the functions of a digital whiteboard, projector, computer, and multimedia in one device (A. M. Sari, Muthoharoh, Murhartoyo, Aslamiah, & Amelia, 2026)

This technology allows teachers and students to interact directly with digital content through touch, *pen stylus*, as well as *gesture,* thus creating a more active and meaningful learning experience. Furthermore, digital interactive boards also support collaborative learning by allowing multiple students to participate simultaneously in exploration and problem-solving activities. With these advantages, digital interactive boards are one of the most relevant learning technologies for early childhood education in today's digital era(Bali & dkk, 2025).

Deep learning is a learning approach that emphasizes the process of constructing meaning, understanding concepts in layers, critical thinking skills, problem-solving, and active student involvement in discovering knowledge. According to (Ministry of Primary and Secondary Education of the Republic of Indonesia, 2025), deep learning has three main principles, namely mindful (conscious), meaningful(meaning), and joyful (L. Sari, Ristiana, & Yayuk, 2025).

Principle *mindful* refers to full mental and physical involvement in the learning process; the principle *meaningful* emphasizes the importance of linking new information to previously acquired knowledge; while the principle *joyful* emphasizes that learning must take place in a pleasant, safe, and comfortable atmosphere for students (Yusuf & Darmasyah, 2025). These three principles are highly relevant to the developmental characteristics of early childhood, which require meaningful, enjoyable, and actively involved learning experiences (Wulandari & Prayitno, 2026).

Various previous studies have examined the role of technology in education, but studies that specifically discuss the application of digital interactive boards in education ar*e still very limited.* Research on the use of interactive digital media at the early childhood education level is still very limited. In their study on the use of interactive digital media (Sari and Pratama, 2021), they found that it increases children's engagement and motivation to learn. Martinez and Chen (2022) demonstrated that digital interactive boards facilitate concept visualization and enhance student understanding. However, this research was conducted at the elementary school level.

Aulia and Prasetyo (2023) showed that digital media supports critical and exploratory thinking processes, but did not examine the context of early childhood education. Fitriani and Nugroho (2024) found that interactive media increases children's focus and curiosity, but did not address *deep learning* comprehensively. (Xu et al., 2025) studied collaboration in learning without utilizing digital interactive boards as a medium. Thus, there is a significant research gap in the study of the application of digital interactive boards to *deep learning* in PAUD that needs to be filled.

The implementation of digital interactive boards in kindergartens has a multidimensional impact on various aspects of child development. A meta-analysis conducted by Fleer (2023) showed significant improvements in early digital literacy skills, collaborative problem-solving skills, creative expression, and fine motor development in children who used digital interactive boards in a structured manner in their learning. (Sarifah Hairani et al., 2025) emphasized that introducing digital literacy from an early age helps children develop critical thinking skills and the ability to interact with digital media, which are essential for 21st-century learning. Meanwhile, longitudinal research by Straker et al. (2023) emphasized the importance of maintaining a balance between *screen time* and physical activity to minimize the negative impact on children's sensory-motor development. Therefore, the implementation of digital interactive boards requires a planned and integrated strategy to provide optimal benefits for children's overall development (Rahmi, Angraeni, Fitrasari, & Putri, 2025).

Child development theories serve as an important foundation in understanding the relevance of implementing digital interactive boards in early childhood education. Jean Piaget's cognitive theory explains that children aged 4–6 years are in the preoperational stage, where they learn through symbols, imagination, and manipulation of concrete objects, so the use of digital interactive boards that allow tactile interaction with digital objects is very appropriate. (Rahmi & Anggraeni, 2024) Vygotsky's social constructivism theory emphasizes the importance of social interaction and the role of *scaffolding* teachers in helping children learn through*Zone of Proximal Development*(ZPD), and digital interactive boards support this through collaborative displays that facilitate group discussions (Nasution & dkk, 2025).

Erik Erikson stated that children of this age are at the stage of *initiative vs guilt*, where children's confidence and initiative develop when the environment provides the right support, and the digital interactive board provides this space through various interactive activities. Maria Montessori emphasized the child's need for concrete and multisensory media to stimulate the development of senses and thinking, which is in line with the visual, audio, and tactile features of the digital interactive board.(Srianita & Rahmi, 2025).

Early childhood refers to individuals between the ages of 0 and 6 years and is experiencing the most rapid growth and development in human life. (Sari and Yuningsih, 2022) explain that early childhood is characterized by individuals experiencing simultaneous development in all aspects of their abilities, including physical, cognitive, socio-emotional, language, and moral development. Therefore, education at this age should be directed toward providing holistic stimulation, not just structured academic instruction. Early childhood is known as*golden age*The golden age, or "golden age," is a period when brain capacity develops rapidly, reaching 80% of the total adult brain development (Rahmawati, 2023). This condition requires planned, consistent, and appropriate stimulation, as experiences and stimulation during this period will form the foundation for a child's future development. A lack of appropriate stimulation during this golden period can directly impact a child's developmental delays in various aspects of their life(Meila, Sarah, & Hardiana, 2025).

TK IT Husnul Khotimah is an early childhood education institution in Cikarang District, West Java, that has begun utilizing digital interactive boards as a learning medium. Based on the distribution data of digital interactive boards in Bekasi Regency, the government has distributed these devices to several kindergartens in several sub-districts in Cibitung District as part of an effort to improve the quality of education. TKIT Husnul Khotimah was chosen as the research location because it has implemented digital interactive boards in daily learning activities and has great potential for further development (Ramadhani, Halida, D., & Amalia, 2026). By integrating the national curriculum with Islamic

values, this institution prioritizes meaningful and child-centered learning. This study aims to examine in depth how the implementation of digital interactive boards supports *deep learning* at TKIT Husnul Khotimah, so that it can contribute to the development of technology-based learning models that are effective, innovative, and appropriate to the development needs of early childhood in Indonesia (Aziz & Mulyono, 2026).

METHODS

This research uses a descriptive qualitative method with a case study approach. According to Creswell and Poth (2021), qualitative research aims to explore and understand the meanings of social or humanitarian issues through the perspectives of participants. Similarly, Sugiyono (2022) explains that qualitative research is used to examine the natural conditions of objects, where the researcher acts as a key instrument, and data analysis is inductive and emphasizes meaning rather than generalization. The case study approach was chosen because the research focused on a single educational institution, namely TK IT Husnul Khotimah, allowing researchers to gain a deep and contextual understanding of the application of digital interactive boards to support in-depth learning. *(deep learning)*. The research was conducted at TK IT Husnul Khotimah, located on Jl. Kirana Raya, Telaga Murni, West Cikarang District, Bekasi Regency, West Java, from January to May 2026, which included the initial observation stage, data collection, data analysis, and preparation of the research report.

Research informants were selected using purposive sampling techniques, taking into account their involvement, experience, and knowledge regarding the use of digital interactive boards in the learning process. Key informants included the principal, class teachers, and students aged 4–6 years. The principal was chosen because of his role in planning and policy-making related to the use of learning technology, class teachers were chosen because they were directly involved in the implementation of digital interactive boards, and students were chosen because they are the primary users who experience the learning process. In this study, the researcher acted as the primary instrument, conducting observations, interviews, document collection, and data analysis. To minimize subjectivity, the researcher applied self-reflection (reflexivity), triangulated sources and techniques, and systematically documented the entire research process to maintain the credibility of the findings.

This research obtained permission from TK IT Husnul Khotimah before the study was conducted. All participants were informed of the research's purpose, procedures, benefits, and data confidentiality, then participated voluntarily after providing informed consent. For students, consent was obtained from a parent or guardian. The identity of participants was kept confidential, and the data obtained was used only for academic and research purposes. This can be seen in the following figure:

Figure 1. Research Flow

Data collection was carried out through three main techniques. First, **observation**, namely direct observation of the learning process in the classroom during the activity, without being involved in the activity. The observation guide is compiled based on three focused aspects. *deep learning*: *mindful learning*, *meaningful*

learning, and *joyful learning*. Second, interviews, namely direct interviews with class teachers and principals, to gather in-depth information regarding the integration of digital interactive boards in learning. Third, documentation, namely data collection in the form of photos of learning activities, RPPH documents, and field notes during the research. Data analysis in this study uses an interactive analysis model developed by Miles and Huberman (Sugiyono, 2020), which consists of four stages: (1) collecting data from the field through interviews, observations, and documentation; (2) data reduction, namely grouping data according to aspects of the research problem; (3) presenting data in descriptive form according to research aspects; and (4) drawing conclusions based on an understanding of the overall data that has been collected. To ensure the validity of the data, this study uses a triangulation technique that utilizes various sources, methods, and times of data collection cross-functionally.

RESULT AND DISCUSSION

Implementation of *Deep Learning* through the integration of digital interactive boards. Based on observations made during the research at TKIT Husnul Khotimah, it was found that the integration of digital interactive boards has been routinely implemented in the daily learning process. The integration of digital interactive boards is placed in the classroom and used by teachers as the main medium for delivering material. The use of digital interactive board integration functions not only as a presentation tool but also as a means of two-way interaction between teachers and students (Ardiyanti & dkk, 2026).

Children are actively involved in the learning process through various interactive activities, including touching the screen directly to select answers, participating in colorful and engaging educational games, drawing or writing directly on the screen, and watching learning videos and responding to questions from the teacher afterwards. This active student involvement demonstrates that the use of digital interactive board integration can encourage the creation of interactive, fun, and meaningful learning in accordance with the characteristics of students. *deep learning* (Fatmawati, 2025).

The integration of digital interactive boards at Husnul Khotimah Islamic Kindergarten (TKIT) is implemented through three systematic stages: planning, implementation, and evaluation. During the planning stage, teachers develop a Daily Learning Implementation Plan (RPPH) that integrates the use of digital interactive boards as the primary medium. Teachers also prepare digital materials in the form of images, animations, videos, and educational games tailored to the learning theme and the children's cognitive development levels (Najibah, Rahayu, & Tazkiyah, 2026).

In the implementation stage, the teacher begins the learning with apperception, followed by the delivery of material through visual and audio displays on the digital interactive board, integration, simple discussions, interactive Q&A, and play-while-learning activities through the available features. In the evaluation stage, the teacher conducts assessments through observations of children's involvement, Q&A, simple assignments, direct practice activities, and reflections on the effectiveness of using the digital interactive board as material for improving further planning (Fitriani & dkk, 2026).

The results of an interview with the class B teacher (Mrs. GM) on May 20, 2026, reinforced the observation findings. The teacher stated that during learning using digital interactive board integration, children appeared more focused and paid attention to the material presented. The teacher displayed images, animated videos, and educational games that kept children interested in participating in the learning. Children also did not get bored easily because the learning seemed more interesting than just using a book or a regular whiteboard. With the visual and audio displays

from the digital interactive board integration, students became more active and easily understood the material presented by the teacher. This finding is in line with research by Martinez and Chen (2022), which proved that interactive visualization through digital interactive board integration helps students build connections between new information and prior knowledge, which is the core of learning. *deep learning* (Setianingrum & Rahmadani, 2025).

Digital Interactive Board Integration in Improving Children's Learning Motivation. The results of the study indicate that the use of digital interactive board integration has a significant impact on increasing children's learning motivation at TKIT Husnul Khotimah. Based on observations, children appeared more enthusiastic, active, and focused during learning activities using digital interactive board integration compared to conventional methods. This increase in motivation is evident from several directly observable indicators (Dwijantie, 2025).

First, children are able to maintain their attention longer on the material due to the engaging visual displays of colorful images, animations, and learning videos. Second, children demonstrate a high level of curiosity, indicated by simple questions, a desire to try things out directly, and enthusiasm when seeing new things. Third, children participate more actively in learning activities, such as answering questions and trying to touch the digital interactive board screen directly. Fourth, children show feelings of enjoyment and are less easily bored due to the interactive and varied learning environment (Fitriani & dkk, 2026).

An interview with Ms. DH, a class B teacher, on May 20, 2026, confirmed that the use of digital interactive boards significantly impacted children's enthusiasm for learning. Children seemed more engaged in learning because the material was presented in an engaging and interactive manner. The use of moving images, sounds, and educational games prevented children from getting bored easily during learning activities. This increased children's motivation to learn, and the learning environment became more active and enjoyable. These findings align with research (Fitriani and Nugroho, 2024) showing that interactive media increases children's focus and curiosity, and research (Hamidah dkk, 2025) indicating that the use of digital interactive boards can improve the quality of early childhood learning.

Integration of digital interactive boards in support of *deep learning is c*omprehensive. Implementation of digital interactive boards in *deep learning* at TKIT Husnul Khotimah it is proven to support the three principles of *deep learning*, that is, *mindful*, *meaningful*, and *joyful*. Principle *mindful* fulfilled through the ability of digital interactive boards to present attractive and dynamic visual displays so that children are able to maintain full focus and awareness during learning. (Suraningrum, Ah, Nuraini, Ismayanti, & Rahma, 2026). Principle *meaningful* realized through the presentation of contextual material that is easily linked to children's real experiences, so that children not only memorize but truly understand the concepts being learned (Istiana & Prahastiwi, 2026).

Principal *joyful*. This is reflected in a fun and non-burdensome learning environment, as learning is packaged in the form of games, videos, and interactive activities that make children feel like they are learning at play. These three principles reinforce each other and are realized simultaneously in every learning session using digital interactive boards (Mascarinhas, Sumilat, & Pangkey, 2026).

Teacher DH added that the use of digital interactive boards was very helpful in creating *deep learning* in early childhood, because children can learn through direct experience, see real pictures and videos, and participate in interactive activities that make it easier for them to understand and remember the material longer (L. Sari et al., 2025).

Although the implementation of digital interactive boards has shown many positive impacts, this study also identified several challenges encountered in the field.

The main obstacle identified was teachers' limited technological expertise, with not all teachers being able to optimally utilize all of the digital interactive board's features (Agustina, Trianggono, & Afandi, 2026). Furthermore, not all learning materials can be fully delivered using digital interactive boards, so teachers still need to combine them with other conventional learning methods and media (Lestari & dkk, 2026). Limited supporting facilities and infrastructure, such as unstable internet connections, are also inhibiting factors in optimizing the use of digital interactive boards. This finding aligns with the statement (Wahyuni dkk, 2023) that technology implementation in Indonesia still faces challenges such as limited infrastructure and a lack of adequate teacher training (Dewa & dkk, 2025). The implementation of deep learning through the integration of digital interactive boards at TKIT Husnul Khotimah has been shown to increase children's motivation, focus, and active participation in learning. This media makes learning more interactive (Aziz & Mulyono, 2026), enjoyable, and supports the principles of mindfulness, meaning, and joy. However, there are still obstacles, such as limited mastery of technology by teachers and supporting facilities. Overall, the use of digital interactive boards is effective in supporting more meaningful learning in early childhood. This can be seen in the following figure:

Figure 2. Integration of Interactive Whiteboards

Figure 3. Application of Deep Learning

CONCLUSION

Based on research regarding the implementation of deep learning through the integration of digital interactive whiteboards at TKIT Husnul Khotimah in Cikarang District, West Java, it can be concluded that the use of digital interactive whiteboards has a significant positive impact on the early childhood learning process. First, the digital interactive whiteboards were implemented in a structured manner involving systematic planning, execution, and evaluation stages; teachers utilized the boards to present materials such as images, educational videos, and interactive games, as well as to facilitate digital writing and drawing activities. Second, the use of digital interactive whiteboards proved effective in boosting children's learning motivation, evidenced by increased enthusiasm, focused attention, curiosity, and active student engagement during lessons. Third, the implementation supported the realization of the three principles of deep learning mindful, meaningful, and joyful ensuring that students did not merely receive information passively but actively engaged in exploration and

problem-solving. Although challenges remained specifically regarding teachers' limited technological proficiency and the underutilization of the boards' full range of features the overall implementation of digital interactive whiteboards at TKIT Husnul Khotimah contributed positively to enhancing the quality of learning and the holistic development of the children.

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