DEEP LEARNING CURRICULUM STRATEGIES TO FOSTER CRITICAL THINKING IN EARLY YEARS

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ABSTRACT

This study aims to analyze the implementation strategies for a deep-learning pedagogy-based curriculum that fosters young children's critical thinking skills in Early Childhood Education (ECE). The study employed a qualitative, descriptive case-study design to obtain an in-depth understanding of curriculum implementation processes. Data were collected through classroom observations, in-depth interviews with school principals and teachers, and documentation analysis of instructional planning and assessment records, and were analyzed using thematic analysis procedures consisting of data reduction, data display, and conclusion drawing. The findings indicate that deep learning-based curriculum implementation was carried out through contextual learning planning, inquiry- and exploration-based learning activities, and authentic assessment oriented toward children's thinking processes. These strategies stimulated children's abilities to observe, ask questions, compare objects, and make simple predictions appropriate to their developmental stage. This study contributes to the development of early childhood pedagogy by providing an empirical description of how deep learning pedagogy can be systematically implemented through integrated planning, implementation, and evaluation processes to support children's cognitive development.

Keywords: Early Childhood, Deep Learning, Critical Thinking Skills, Curriculum, Authentic.

INTRODUCTION

Early Childhood Education (ECE) constitutes an important foundation within the education system because, at this stage, children's cognitive, social, emotional, and moral development occurs simultaneously and intensively. The early childhood period is often referred to as the golden age because, within the age range of 0–6 years, brain development occurs very rapidly and is highly sensitive to environmental stimulation (Amiliya & Susanti, 2024). The quality of learning experiences provided during this stage has a long-term influence on children's thinking abilities; therefore, ECE cannot be viewed merely as a preparatory stage for primary education, but rather as a strategic phase in building the foundation of thinking. Therefore, learning processes in ECE need to be designed in meaningful, contextual ways to stimulate children's developmental potential optimally.

In the context of 21st-century education, critical thinking has become one of the essential competencies to develop from an early age. Increasingly complex global challenges require individuals who can analyze information, evaluate alternatives, and make rational decisions (Frisnoiry, 2024). Critical thinking skills do not emerge suddenly at higher levels of education but need to be developed gradually through learning experiences that are appropriate to children's developmental stages. Children who are accustomed to critical thinking tend to have high curiosity, ask reflective questions, and are confident in expressing opinions based on simple reasoning; therefore, the development of critical thinking skills should become an integral part of the ECE curriculum.

Nevertheless, learning practices in many ECE institutions still tend to rely on conventional approaches that prioritize routine, repetitive activities. Learning activities often focus on completing mechanical tasks without providing sufficient opportunities for children to explore and express ideas. Children are more frequently directed to follow instructions rather than to construct understanding through direct experience (Reigeluth & Moore, 2013). This condition indicates a gap between the demands for developing higher-order thinking skills and learning

practices that remain oriented toward administrative learning outcomes, resulting in suboptimal development of critical thinking skills from an early age.

The implementation of the Merdeka Curriculum provides opportunities for ECE institutions to develop more flexible and child-centered learning practices. This curriculum emphasizes contextual and meaningful learning to develop learners' competencies (Raihan, 2025). One of the main principles of the Merdeka Curriculum is the strengthening of higher-order thinking skills through reflective and exploratory learning experiences. However, curriculum implementation oriented toward higher-order thinking skills requires appropriate pedagogical strategies to avoid remaining merely at the administrative level. Teachers need to understand how to design learning experiences that are not only enjoyable but also capable of stimulating children's thinking processes more deeply.

One relevant pedagogical approach to support the implementation of a competency-oriented curriculum is deep learning pedagogy, which emphasizes meaningful understanding and the integration of knowledge with learners' real-life experiences (Diputera et al., 2024). Deep learning is not only oriented toward achieving learning outcomes but also toward developing thinking processes through reflective and exploratory learning activities. In the context of Early Childhood Education (ECE), this approach can be implemented through exploration-based learning, simple inquiry activities, and reflective interactions that encourage children to construct understanding through direct experience. Learning activities designed in this way provide opportunities for children to observe, ask questions, and develop simple reasoning abilities, which constitute important foundations for the development of critical thinking. Previous studies on early childhood learning have shown that exploratory activities such as loose-parts play can support children's problem-solving and reasoning abilities; however, these studies tend to focus on specific learning activities rather than on comprehensive curriculum implementation strategies (Lestariningrum & Wijaya, 2020).

Conceptually, deep learning is closely related to constructivist perspectives, which emphasize that knowledge is actively constructed through interaction with the physical and social environment. Children do not merely receive information from teachers but gradually develop understanding through meaningful learning experiences supported by social interaction and guided exploration. These theoretical perspectives indicate that deep learning offers a strong conceptual foundation for developing higher-order thinking skills in Early Childhood Education. Nevertheless, existing studies on deep learning pedagogy in Early Childhood Education have mostly emphasized conceptual discussions of meaningful and reflective learning without providing detailed descriptions of how deep learning principles are implemented in curriculum practices (Diputera et al., 2024).

Although the concept of deep learning has been increasingly discussed in educational research, empirical studies on its implementation in Early Childhood Education remain limited. Most empirical studies on deep learning pedagogy have been conducted at the primary education level and have focused on curriculum implementation and competency development (Darmayanti et al., 2025). Consequently, there remains limited empirical evidence on how deep learning pedagogy can be systematically implemented in Early Childhood Education curricula to foster children's critical thinking skills. Based on this gap, this study aims to analyze the implementation strategies of a deep-learning pedagogy-based Early Childhood Education curriculum to foster young children's critical thinking skills through a qualitative case study approach. This study focuses on the processes of planning, implementing, and evaluating learning that reflect deep learning principles and their contributions to children's cognitive development.

LITERATURE REVIEW

Deep learning pedagogy is a pedagogical approach that emphasizes strong conceptual understanding, the connection between knowledge and real-life experiences, and learners' ability

to reflect on their learning processes. This approach is oriented toward meaningful learning, enabling learners to connect new knowledge with prior experiences and apply it across different contexts (Diputera et al., 2024). Deep learning not only emphasizes mastery of subject matter but also the development of higher-order thinking skills through exploratory and reflective activities. In the context of modern education, deep learning is considered a pedagogical strategy that addresses the demands of 21st-century competencies, particularly in developing critical thinking and problem-solving skills (Darmayanti et al., 2025; Pebri & Wati, 2025).

Conceptually, deep learning is closely related to pedagogical approaches that emphasize learners' active engagement in the learning process. Fullan and Langworthy (2014) explain that deep learning is a learning process that enables learners to develop meaningful understanding through collaborative, reflective, and contextual activities. This approach positions learners as active subjects who construct knowledge through authentic learning experiences. In line with this perspective, Hattie and Donoghue (2016) emphasize that effective learning strategies enable learners to connect learning experiences to previously acquired knowledge structures, making the learning process active and sustainable.

In early childhood education, deep learning needs to be adapted to children's developmental characteristics, as they are still in the concrete operational stage. Children learn optimally through exploratory activities that allow them to interact directly with their surrounding environment. Siraj et al. (2017) emphasize that meaningful learning experiences determine the quality of early childhood pedagogy, responsive interactions between teachers and children, and broad opportunities for exploration. Learning approaches that provide space for exploration enable children to develop curiosity and deeper thinking; therefore, the implementation of deep learning in Early Childhood Education should be designed through structured, contextually relevant play-based activities.

Critical thinking is an essential competency that needs to be developed from an early age through meaningful learning experiences. Critical thinking can be understood as the ability to analyze information, evaluate alternatives, and make decisions based on logical reasoning (Facione, 2011). Ennis (2018) explains that critical thinking is a reflective, rational process focused on making accountable decisions. In the context of Early Childhood Education, critical thinking skills develop through concrete activities such as observing, asking questions, and making simple predictions. Exploratory play activities allow children to connect cause and effect and solve simple problems, thereby supporting the gradual development of reasoning skills (Lestariningrum & Wijaya, 2020; Juita et al., 2025).

Deep learning is closely related to constructivist theory, which views knowledge as being actively constructed through learning experiences. Piaget and Inhelder (2008) explain that young children are in the preoperational stage of development, characterized by symbolic thinking abilities that still depend on concrete experiences; therefore, learning activities involving direct experience help children construct deeper understanding. In addition to cognitive constructivism, sociocultural theory also provides an important foundation for deep learning because children's cognitive development occurs through social interaction within their environment (Vygotsky & Cole, 1978). This perspective is reinforced by studies showing that social interaction plays an important role in the development of children's learning abilities (Pello & Zega, 2024; Damanik et al., 2025), so dialogic and collaborative learning become effective strategies for supporting deep learning in early childhood education.

Inquiry-based learning is closely related to deep learning because both emphasize exploratory activities in the learning process. Inquiry-based learning provides opportunities for learners to ask questions, conduct observations, and discover concepts through direct experience (Bell et al., 2010). The implementation of a curriculum based on deep learning is influenced not only by instructional design but also by managerial and learning environment factors such as teacher competence, school management support, and the availability of learning resources (Abdurrahman, 2025). A flexible curriculum enables teachers to develop learning

experiences aligned with children's needs, as exemplified by the implementation of the Merdeka Curriculum, which is oriented toward developing learners' competencies (Raihan, 2025; Lestari, 2024). Therefore, implementing a deep learning-based curriculum requires systemic support to function optimally.

METHODOLOGY

This study employed a qualitative case study design to obtain an in-depth, contextual understanding of implementation strategies for an Early Childhood Education (ECE) curriculum grounded in deep learning pedagogy to improve young children's critical thinking skills. A qualitative approach was selected because the study focused on exploring the meanings, processes, and dynamics of curriculum implementation that cannot be adequately explained through quantitative measurement. The case study design enabled the researcher to examine the phenomenon of deep learning holistically within a real-life context in an Early Childhood Education institution that has implemented deep learning principles in its instructional practices (Creswell, 2003). The research participants included the school principal, classroom teachers, and young children. At the same time, informants were selected using purposive sampling for their direct involvement in curriculum planning and implementation.

Data were collected through participant observation, in-depth interviews, and a documentation study in order to obtain a comprehensive understanding of the implementation of deep learning. Observations were conducted by examining learning activities, teacher–child interactions, and classroom practices that reflected the implementation of deep learning principles and indicators of children's critical thinking skills. Interviews were conducted with the school principal and teachers to obtain information on learning planning, implementation, and evaluation, as well as on supporting and inhibiting factors in curriculum implementation. Documentation included the analysis of instructional materials, learning modules, children's developmental records, and children's work as authentic evidence of the learning process.

The data were analyzed using an interactive analysis model consisting of data reduction, data display, and continuous conclusion drawing (Miles et al., 2014). Thematic analysis was used to identify patterns and major themes related to curriculum implementation strategies and the development of young children's critical thinking skills. Data validity was ensured through source and method triangulation by comparing the results of observations, interviews, and documentation, as well as through systematic member checking and audit trails to ensure the credibility, dependability, and confirmability of the research findings.

RESULT AND DISCUSSION

The results of the study indicate that the implementation of a deep learning-based Early Childhood Education (ECE) curriculum was carried out in stages, comprising contextual learning planning, inquiry- and exploration-based learning, and evaluation oriented toward children's thinking processes. These strategies were designed to provide meaningful learning experiences so that children not only acquired basic knowledge but also developed critical thinking skills through exploratory activities. The deep learning approach emphasizes the connection between learning experiences and children's real-life contexts, making the acquired knowledge easier to understand and retain over the long term (Diputera et al., 2024). These findings indicate that deep learning can be implemented contextually within ECE environments through structured yet flexible activities. In line with the concept of deep learning pedagogy, learning processes centered on real-life experiences enable children to actively construct understanding through interaction with the learning environment (Fullan & Langworthy, 2014).

The consistency of findings was confirmed through data triangulation obtained from observations, interviews, and documentation analysis. Observational data showed that learning activities were designed to encourage children's active participation through exploration and discussion. Interview results with teachers indicated that learning activities were intentionally structured to connect learning themes with children's daily experiences. One teacher explained

that learning activities were designed so that *"children can observe objects directly and explain what they see based on their own experiences."* Documentation, including instructional modules and children's learning records, also included exploratory activities and guiding questions that reflected deep learning principles. The consistency of findings from these data sources indicates that deep learning principles were systematically integrated into learning practices.

At the planning stage, teachers formulated learning objectives that were oriented not only toward mastering basic knowledge but also toward developing children's critical thinking skills. This planning was reflected in the preparation of instructional modules that included exploratory activities, guiding questions, and simple problem-based activities, all designed to align with children's daily experiences. Learning themes were arranged contextually so that children could relate the concepts learned to real-life situations they encountered. Teachers also integrated various aspects of child development into a unified sequence of learning activities, thereby providing children with holistic learning experiences (Rahmawati et al., 2021). This approach demonstrates that learning planning functions not only as a guideline for instructional activities but also as a framework that directs the gradual construction of children's knowledge. Thus, the planning stage reflects the principles of deep learning that emphasize the meaning and relevance of learning experiences.

Interview data supported the observational findings regarding learning planning. Teachers explained that lesson plans were developed by considering children's real-life experiences in order to make learning activities more meaningful and understandable. One teacher stated that *"learning themes are selected based on children's daily experiences so that children can more easily understand the activities carried out in class."* Documentation analysis of instructional modules also indicated that lesson plans included exploratory tasks and open-ended questions designed to stimulate children's reasoning abilities. The alignment between planning documents, teachers' explanations, and classroom practices demonstrates the application of deep learning principles in instructional planning. These findings support the view that meaningful learning experiences constitute an essential component of deep learning pedagogy (Diputera et al., 2024).

Learning planning oriented toward children's real-life experiences aligns with the characteristics of early childhood pedagogy that emphasize meaningful, child-centered learning. Learning designed through exploratory activities and open-ended questions provides opportunities for children to construct understanding through direct experience actively. This approach is consistent with the concept of deep learning, which emphasizes the connection between knowledge and learners' life contexts (Fullan & Langworthy, 2014). In addition, the quality of early childhood learning is strongly influenced by the design of learning experiences that allow children to interact actively with their environment and obtain broad opportunities for exploration (Siraj et al., 2017). Therefore, contextual learning planning can be understood as an important foundation for implementing deep learning because it enables children to develop understanding in a more meaningful and sustainable manner.

At the implementation stage, learning activities included inquiry-based tasks, simple experiments, and group projects that encouraged children's active engagement in the learning process. Children were given opportunities to observe, ask questions, and express opinions about the phenomena being studied, making the learning process dialogic. Teachers acted as facilitators by providing open-ended questions and necessary guidance without dominating the learning process, allowing children to develop ideas independently. In several project activities, children worked collaboratively to complete simple tasks such as designing and building structures using blocks or planting seeds, demonstrating collaboration and negotiation in determining work procedures. Such learning practices indicate that the principles of deep learning can be effectively implemented in Early Childhood Education through experience-based learning activities (Caniglia et al., 2016). Furthermore, inquiry-based learning provides opportunities for children to discover concepts through simple investigation processes appropriate to their developmental stages (Bell et al., 2010).

Interview results further strengthened the findings regarding the implementation of deep learning-based activities. Teachers explained that children were encouraged to participate actively by asking questions and explaining their observations during learning activities. One teacher stated that *"children are encouraged to ask questions and explain their observations so that they become more confident in expressing their ideas."* Observational data showed that children participated actively in group activities and attempted to explain their ideas using simple reasoning. Documentation, including children's work and learning portfolios, also demonstrated exploratory learning activities. The consistency of these findings indicates the validity of the research data through triangulation. These findings support the view that exploratory learning experiences enable children to construct understanding through interaction with their environment (Siraj et al., 2017).

The implementation of dialogic and exploratory learning indicates that interaction between teachers and children plays an important role in supporting children's thinking development. Teachers did not provide answers directly but encouraged children to find solutions through guiding questions and simple discussions, allowing scaffolding processes to occur in learning. Social interactions during learning activities helped children develop a more complex understanding, supported by adults and peers. This condition reflects the sociocultural theory, which emphasizes that children's cognitive development occurs through social interaction within the learning environment (Vygotsky & Cole, 1978). These findings are also consistent with studies showing that scaffolding practices help children move from actual abilities toward higher developmental potential (Damanik et al., 2025). Therefore, the implementation of deep learning in Early Childhood Education functions not only as a means of delivering subject matter but also as a process of social interaction that gradually supports the development of children's thinking abilities.

Observational results indicate the emergence of critical thinking indicators among children during the learning process. Children actively asked questions about the causes and effects of simple events they observed and provided logical explanations when answering teachers' questions. However, their explanations remained within the level of concrete reasoning. Children were also able to compare two objects by identifying simple similarities and differences. During experimental activities, children attempted to predict outcomes before conducting experiments and drew conclusions based on their observations (Lestariningrum & Wijaya, 2020). Interview data confirmed that teachers observed gradual improvements in children's reasoning abilities during exploratory activities. Teachers reported that children increasingly demonstrated curiosity and confidence in expressing their ideas during classroom discussions. Documentation in the form of developmental records also showed evidence of children's progress in observing, comparing, and explaining simple phenomena. The emergence of these indicators demonstrates that deep learning offers children opportunities to develop thinking processes through direct experience, so that knowledge is not obtained solely through teacher explanations. Experience-based learning enables children to connect concepts with real-life situations, making the learning process more meaningful and sustainable (Prawesti et al., 2025).

The emergence of these reasoning abilities is consistent with cognitive development theory, which explains that young children are still in the stage of concrete thinking. At this stage, children develop understanding primarily through direct experiences and observable phenomena, so their reasoning appears in activities such as observing, comparing, and making simple predictions. According to Piaget and Inhelder (2008), children in the preoperational stage construct knowledge through interaction with concrete objects and experiences. The findings of this study indicate that deep learning activities provide opportunities for children to develop reasoning abilities appropriate to their developmental stage through meaningful and experience-based learning.

Interview data confirmed the observational findings regarding the development of children's reasoning abilities. Teachers explained that children gradually became more confident in expressing their ideas and explaining their observations during learning activities. One teacher stated that *"children are now more willing to explain what they observe and try to predict what will happen during activities."* Documentation, including children's developmental records and learning portfolios, also showed evidence of progress in children's abilities to observe, compare, and explain simple phenomena. Conceptually, critical thinking is a reflective process that involves analyzing information and making rational judgments (Facione, 2011; Ennis, 2018). The findings of this study indicate that deep learning provides a context that enables children to develop critical thinking skills through exploratory activities appropriate to their developmental stages. Therefore, deep learning can serve as an effective strategy for fostering critical thinking skills from an early age through structured learning experiences.

In addition to contributing to the development of children's thinking abilities, this study also identified several supporting factors for implementing a deep learning-based curriculum. Observational data indicated that teachers' creativity played an important role in designing varied, meaningful learning activities that aligned with the characteristics of early childhood learners. Teachers used various learning materials, such as blocks, natural objects, and simple experimental tools, to support exploration-based learning activities. The support of the school principal in the form of flexible policies provided opportunities for teachers to innovate in developing exploration- and experience-based learning. The availability of educational play materials and simple exploratory resources also supported the implementation of contextual learning processes. At the same time, parental involvement in home-based projects expanded children's learning experiences beyond the school environment. Collaboration among teachers in designing learning themes also improved the quality of curriculum implementation sustainably (Sari et al., 2024).

Interview findings strengthened the identification of supporting factors in implementing deep learning-based learning. Teachers explained that flexible school policies enabled them to design learning activities adapted to children's interests and daily experiences. One teacher stated that *"the school gives teachers the flexibility to develop learning activities that allow children to explore directly."* Documentation analysis of lesson plans and learning modules also indicated the integration of project-based and exploration-based activities, reflecting collaborative planning among teachers. These findings indicate that the successful implementation of deep learning is strongly influenced by supportive learning environments and effective school management (Sahra et al., 2025; Abdurrahman, 2025).

On the other hand, this study also identified several inhibiting factors affecting the optimization of deep learning-based curriculum implementation. Observational results indicated that some learning activities could not always be carried out optimally due to time limitations and differences in children's learning abilities within the same classroom. Some teachers still require a deeper understanding of deep learning to avoid superficial learning activities. Time limitations within the instructional schedule often restrict opportunities for reflection, which is an essential component of deep learning. In addition, variations in children's abilities within a single classroom required differentiated instructional strategies that had not yet been implemented optimally. Administrative demands also consumed teachers' time in preparing innovative learning activities, resulting in planning processes that were not always conducted optimally.

Interview data further confirmed the challenges teachers faced in implementing deep-learning-based activities. Teachers explained that limited instructional time often reduced opportunities for reflective discussion during learning activities. One teacher stated that *"sometimes learning activities must be completed within a limited time, so reflection activities cannot always be carried out optimally."* Teachers also reported that differences in children's abilities required additional instructional adjustments that were not always easy to implement. Documentation

analysis also showed that teachers needed to balance administrative requirements with instructional planning. These findings indicate that learning transformation requires policy support and teacher capacity development in order to ensure the sustainable implementation of deep learning (Pebri & Wati, 2025; Lestari, 2024).

This study provides both conceptual and practical contributions to the development of deep learning implementation in Early Childhood Education. The findings indicate that deep learning can be implemented through contextual planning, inquiry- and exploration-based learning implementation, and authentic assessment oriented toward children's thinking processes. This implementation structure demonstrates that deep learning is not only relevant at the primary and secondary education levels but also adaptable to early childhood education. These findings enrich the body of research on deep learning, which has primarily focused on higher levels of education, and provide a new perspective on the development of critical thinking skills from an early age (Sambonu & Hardi, 2024). Furthermore, experience-oriented learning strategies demonstrate alignment with learning models that enable learners to construct understanding more deeply and sustainably (Hattie & Donoghue, 2016; Adnyana et al., 2025).

Nevertheless, this study has several limitations that should be considered in interpreting the findings. The study was conducted in a single Early Childhood Education institution using a case study approach; therefore, the findings are contextual and are not intended for broad generalization. In addition, this study focused on analyzing deep learning-based curriculum implementation strategies without conducting quantitative measurements of improvements in children's critical thinking skills; therefore, interpretations of cognitive development were based on observational results and qualitative analysis. Despite these limitations, the study offers novelty in its analysis of deep learning-based curriculum implementation in Early Childhood Education by integrating contextual planning, inquiry-based learning, and authentic assessment within a unified implementation framework. This novelty provides an empirical contribution to the literature on the application of deep learning in Early Childhood Education. It opens opportunities for further studies to examine similar approaches in broader contexts.

CONCLUSION

This study shows that the implementation of a deep learning-based Early Childhood Education (ECE) curriculum was carried out through contextual learning planning, inquiry- and exploration-based learning activities, and authentic assessment oriented toward children's thinking processes. Learning planning was designed to integrate children's real-life experiences and various developmental aspects, creating meaningful learning experiences. In contrast, the implementation of learning positioned teachers as facilitators who encouraged children's active engagement through exploratory activities, simple discussions, and collaborative projects that fostered critical thinking indicators such as questioning, comparing, predicting, and drawing simple conclusions. The implementation of deep learning was supported by teacher creativity, school management support, the availability of learning resources, and parental involvement. However, it also faced challenges, including limited pedagogical understanding among teachers, limited instructional time, and administrative workload. The findings confirm that deep learning can be contextually adapted in Early Childhood Education and contributes to the development of children's critical thinking skills through meaningful and reflective learning experiences.

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