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Deep Learning in Indonesian Education: Conceptual Foundations, Policy Frameworks, and Implementation

T. Wisnu Warnia WR[1*], Dini Fitriani[2], Fadilla Oktaviana[3]
[1] Postgraduate Program of English Education, Universitas Islam Negeri Sultan Maulana Hasanuddin Banten, Indonesia
[2,3] English Education Department, Universitas Islam Negeri Sultan Maulana Hasanuddin Banten, Indonesia
Email: 252707110.wisnuwarnia@uinbanten.ac.id[1], dini.fitriani@uinbanten.ac.id[2], fadilla.oktaviana@uinbanten.ac.id[3]*

**Penulis korespondensi: 252707110.wisnuwarnia@uinbanten.ac.id*

Abstract. This study examines deep learning as an educational approach within the Indonesian education system by exploring its conceptual foundations, policy frameworks, and practical implementation. The background of the study arises from ongoing challenges in Indonesian classrooms, where teacher-centered instruction and surface learning practices remain dominant, limiting students' critical thinking, engagement, and real-world application of knowledge. The study aims to analyze how deep learning, characterized by mindful, meaningful, and joyful learning, is conceptualized in educational theory, reflected in national education policies, and implemented in classroom practices. Using a qualitative literature review method, data were collected from peer-reviewed national and international journal articles, academic books, and research reports related to deep learning in education. The data were analyzed through thematic synthesis to identify patterns concerning implementation strategies, learning outcomes, and implementation challenges. The findings indicate that deep learning contributes positively to students' cognitive development, motivation, engagement, and 21st-century skills, particularly critical thinking, collaboration, and creativity. However, its implementation in Indonesia faces several obstacles, including limited teacher competence, inadequate assessment systems, insufficient contextual learning materials, and unequal technological infrastructure. The study concludes that successful deep learning implementation requires integrated policy support, continuous teacher professional development, contextualized curriculum design, and equitable access to learning resources. These findings provide practical implications for educators, curriculum developers, and policymakers in strengthening sustainable and humanistic education in Indonesia.

Keywords: Deep Learning; Educational Policy; Indonesian Education; Learning Implementation; Meaningful Learning.

1. BACKGROUND

Indonesian education now focuses on improving literacy, numeracy, and writing skills as key elements for developing human resources (Anjarwati et al., 2022; Rahmawati et al., 2022). Schools serve as places for formal learning and as social spaces that teach community values (Nugroho et al., 2023; Ramawati et al., 2021). They play an important role in building students who are disciplined and independent (Pramesiana et al., 2020).

Today's world, with fast changes in technology and society (like Industry 4.0 and Society 5.0), requires education systems that can adapt. These systems should go beyond simple knowledge sharing to build skills in critical thinking, creativity, communication, and collaboration. Yet, many Indonesian schools still use teacher-led methods focused on memorizing facts. This reduces student interest and links to real life (Suharyanto, 2020; Maulana et al., 2022).

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To address these issues, the Ministry of Basic and Secondary Education (Kemdikdasmen) has promoted deep learning. Unlike AI-based deep learning, this method stresses learning that is meaningful, mindful, and joyful. It involves students' thinking, feelings, and social growth (Kadarismanto & Sari, 2025; Wahyudi, 2025). Combining these three pillars, mindful, meaningful, and joyful, helps develop character and 21st-century skills (Diputera & Zulpan, 2024; Otto et al., 2020; Putria et al., 2022).

Even with its benefits, applying deep learning in schools faces barriers in structure and teaching methods. Studies show teachers often lack clear understanding, training, and support from curriculum or administration (Rahmah & Sulaiman, 2021; Suwandi et al., 2024). As a result, its use in practice is not effective, calling for more practical research.

This study examines the theory, policies, and real-world use of deep learning in Indonesian education. It focuses on how the three pillars (mindful, meaningful, joyful) appear in national policies and school practices.

Building on this context, the study investigates four primary questions:

1). What defines deep learning within an educational setting?
2). How is deep learning currently applied in Indonesia's education system?
3). What positive outcomes result from deep learning?
4). What obstacles impede its successful implementation in Indonesia?

In response to these research questions, this study defines the theoretical framework of deep learning in a pedagogical context and examines its execution within the Indonesian school system. It further assesses the broader implications for the national education structure while scrutinizing the barriers that impede its comprehensive rollout.

2. THEORETICAL SUPPORT

The study's new approach bridges theory and practice with a full view that links teaching, policy, and classrooms (Nurhasanah et al., 2020; Astuti, 2023). Its results should add to knowledge and give useful advice for teachers, leaders, and curriculum planners. In the end, this work strengthens education to create thoughtful, teamwork-oriented, and strong learners for global issues. In Indonesia's varied culture, deep learning provides a base for fair and useful education. It aims to spark better 21st-century policies.

In education, deep learning is a teaching method that helps students build deep understanding, connect new ideas to past experiences, and use knowledge in real settings (Biggs & Tang, 2011; Mystakidis et al., 2021). It focuses on higher thinking skills like analyzing, combining, judging, and creating, not just remembering facts.

Learning styles fall into two main types: surface learning and deep learning. Surface learning involves little effort just to complete tasks (Marton & Säljö, 1976). Deep learning pushes students to find the true meaning of material, link it to what they know, and use it wisely. It fits constructivist theory, where people build knowledge through experiences and interactions (Bruner, 1966; Vygotsky, 1978). Teachers act as guides, creating spaces for making meaning.

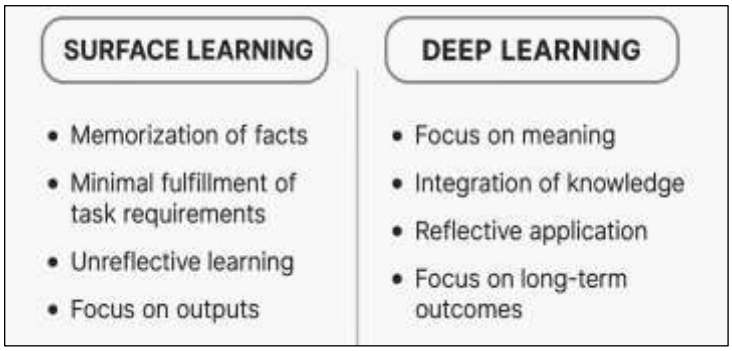

Figure 1. A comparison between Surface Learning and Deep Learning.

Use (see Table 1) or (Author, 2023, Table 1). The distinction between surface and deep learning paradigms is illustrated in Figure 1, providing a clear comparative overview of these two approaches that differ in orientation and have markedly different effects on students' learning processes. Surface learning involves shallow learning activities, including memorizing information without deeper understanding, completing tasks only at a basic level, and showing limited reflection on the learning material. This approach commonly arises within education systems that prioritize examinations and emphasize cognitive evaluation, leading students to focus more on achieving results than engaging in meaningful learning processes (Purwani et al., 2025).

Conversely, deep learning centers on constructing meaning, linking new knowledge to prior understanding, and applying insights reflectively in real-world contexts. Rather than merely absorbing data, students function as active agents who cultivate a nuanced understanding of their subjects. This engagement allows them to sharpen their analytical reasoning and develop the capacity for enduring, long-term problem solving. This approach corresponds with 21st-century education, which requires advanced cognitive skills and supports lifelong learning. Through this representation, readers can clearly understand the fundamental distinctions between surface and deep learning, as well as the pressing need to shift instructional practices toward a more reflective, relevant, and meaningful deep learning model capable of addressing contemporary educational demands.

In a classroom setting, the adoption of deep learning prompts students to scrutinize data rigorously and weave new insights into their foundational knowledge. By translating theoretical concepts into practical, real-world applications, this approach nurtures a persistent drive for self-improvement and adaptability in the face of rapid global changes. Rooted in active, collaborative, and ongoing learning practices, deep learning cultivates lifelong learner dispositions and aligns with educational policies aimed at preparing future generations to be analytical, creative, and responsive to change (Santiani, 2025). As a result, deep learning functions as a crucial foundation for a humanistic and transformative 21st-century education. The educational concept of deep learning is built upon three core pillars: A comprehensive educational journey is built upon the synergy of conscious awareness, conceptual relevance, and positive engagement. These three pillars are deeply intertwined, ensuring that the student's intellectual growth, emotional health, and interpersonal skills are developed in unison rather than in isolation. Recognizing these diverse aspects allows learning to become more inclusive while promoting emotional intelligence. Mindful learning, in particular, encourages learners to remain fully engaged and attentive throughout the learning process, increasing awareness of learning experiences and strengthening connections between academic content and social contexts (Diputera & Zulpan, 2024).

Joyful learning emphasizes the creation of engaging and enjoyable learning experiences. Learning environments that are positive, creative, and free from excessive pressure have been proven to enhance student engagement and academic achievement. When learners feel comfortable, secure, and emotionally supported, they become more receptive to new knowledge and more confident in sharing their ideas. In contrast, meaningful learning requires a deeper level of understanding by connecting learning content to real-life contexts, thereby increasing its relevance (Putria et al., 2022). By relating instructional materials to authentic situations, students are better able to recognize the usefulness of what they learn in their daily lives, resulting in more profound and lasting learning experiences. Table 1 presents a summary of the key conceptual pillars underlying the deep learning approach. In short, in Indonesia, deep learning often includes three linked principles: Mindful Learning: Learning with full awareness, focus, and reflection. Metacognition is key to it (Ritchhart et al., 2011). It respects students' different styles, backgrounds, and feelings to boost involvement (Diputera & Zulpan, 2024). Meaningful Learning: Connecting new topics to personal life and the real world. New ideas join existing knowledge [Ausubel, 1968]. Daily examples show why school matters. Joyful Learning: Teaching in a fun, positive setting that builds inner drive (Otto et al., 2020; Putria et al., 2022). It needs space for free talk, creativity, and discovery.

Table 1 below summarizes the conceptual pillars of the deep learning approach.

Table 1. Conceptual Pillars in the Deep Learning Approach.

Learning Approach	Definition	Main Objective	Implementation Characteristics
Mindful Learning	This methodology prioritizes an intentional and introspective engagement with knowledge acquisition, requiring the learner to remain profoundly present throughout every stage of the educational journey.	To cultivate self-awareness, metacognition, and empathy.	Learners are empowered to discern their individual cognitive preferences, enabling them to maintain sustained concentration and engage in a critical self-assessment of their conceptual grasp.
Meaningful Learning	A type of learning that connects the subject natter to real-life experiences or authentic contexts.	To enhance the relevance of the material for students	Rather than viewing subjects in isolation, students are capable of synthesizing course material with real-world occurrences, clarifying how educational themes manifest in day-to-day reality.
Joyful Learning	Learning that occurs in a positive and enjoyable emotional atmosphere	To foster intrinsic motivation and active engagement.	Learners experience a sense of psychological safety and genuine fascination, which allows them to immerse themselves fully in the educational journey.

Drawing upon the framework established by Puthut Prihantoro (2025), Table 1 delineates the triad of deep learning: mindful, meaningful, and joyful engagement. These core components synergize to facilitate a learner-centric environment that prioritizes not only intellectual rigor but also emotional and social maturity. By integrating self-reflection with real-world applicability, this model ensures that the educational experience transcends traditional cognitive boundaries, effectively nurturing the character traits and competencies essential for the 21st century.

The framework of deep learning finds a practical manifestation in the curriculum reforms spearheaded by Abdul Mu'ti, which place a premium on investigative, cooperative, and hands-on academic practices. Within this pedagogical model, the traditional view of students as dormant vessels for information is discarded; they are instead empowered to lead their own discovery through dialogue and research. Such a paradigm shift is instrumental in cultivating the multifaceted skills demanded by today's educational landscape (Muvid, 2024), encouraging students to become proactive, creative, and adaptable individuals capable of responding effectively to challenges and rapid changes in their environment. These three pillars function in an integrated manner, as deep learning can be fully realized only when mindful, meaningful, and joyful learning are implemented simultaneously to support comprehensive student development.

Figure 2. The Synergy of the Three Pillars of Deep Learning in Holistic Learning.

The connectivity between the three pillars of deep learning—namely mindful, meaningful, and joyful engagement—is depicted in Figure 2. Represented as a triangular framework, these elements converge to anchor the central premise of 'deep learning,' emphasizing that profound educational mastery is only possible through the harmonious integration of these three dimensions deep learning functions as an integrated and multidimensional approach rather than a standalone or isolated practice.

Mindful learning represents the significance of awareness and full engagement during the learning process. Learners who practice mindful learning are more capable of identifying their cognitive processes, engaging in reflection, and understanding their individual needs and learning characteristics. Meaningful learning emphasizes the linkage between academic content and students' real-life experiences (Jayanti et al., 2021), enabling learners to move beyond rote memorization toward a deeper comprehension of relevance and practical application. In contrast, joyful learning prioritizes the creation of a supportive and emotionally secure learning environment. When students feel interested, comfortable, and emotionally safe, their intrinsic motivation to learn is significantly enhanced.

This synergy aims to strengthen the idea that deep learning's success relies solely on the integrated interplay of these three key pillars. Therefore, the synergy illustrated in the figure goes beyond a mere conceptual framework; it also acts as a hands-on resource for educators and curriculum planners to create comprehensive, humane, and enduring learning experiences. Modern education requires 21st-century skills like critical thinking, collaboration, creativity, and communication (4Cs) (Partnership for 21st Century Skills, 2019). Deep learning suits this by engaging students actively and relevantly. New Pedagogies for Deep Learning (NPDL) adds character, global citizenship, and more (Langworthy, 2014). It is a full system for ready, goal-driven students.

In Indonesia, deep learning must fit local culture and values. Learning ties to social and cultural settings (Vygotsky, 1978). It should use real-life links to boost engagement (Rahmah & Sulaiman, 2021). Teachers must show subject knowledge, cultural care, and flexible teaching.

Teachers in deep learning do more than share facts; they design experiences. They create real challenges for thinking and reflection (Biggs & Tang, 2011). Helpful frameworks include:

1) Problem-Based Learning (PBL)
2) Project-Based Learning (PjBL)
3) Inquiry-Based Learning
4) Reflective Teaching

These put students at the center, engage them, and focus on real results (Hmelo-Silver, 2004; Bell, 2010). From these ideas, deep learning is a key change for 21st-century education. It builds mindful, meaningful, joyful experiences beyond thinking alone. Teachers guide actively, aware of culture, using problem-solving. Full understanding of it is needed to improve Indonesian teaching.

In summary, deep learning is a broad model blending thinking, feelings, social, and cultural parts. While PBL and others are well-studied, research on how teachers use mindful, meaningful, joyful ideas in Indonesia's diverse schools is limited (Anggarini et al., 2024). This sets a base and calls for more study on practice. The study uses these to check school practices and suggest fitting strategies.

3. RESEARCH METHODE

This research adopts a qualitative literature review methodology to scrutinize the theoretical foundations, practical implementation, and broader implications of deep learning within educational settings. Furthermore, it identifies the systemic barriers that impede its progress. A qualitative method allows for a detailed look at ideas from past studies, both in Indonesia and globally, helping to fully understand deep learning in schools (Snyder, 2019). This approach also helps combine results from many sources to find main trends and research gaps (Boell & Cecez-Kecmanovic, 2015).

The primary data for this investigation is derived from a rigorous selection of peer-reviewed scholarly journals, spanning both domestic and global publications, that talk about deep learning in education. Journals were chosen from databases like Mendeley, Google Scholar, Direct Science, and Eric. These databases have high standards to make sure the findings are trustworthy (Xiao & Watson, 2019). The articles reviewed cover how deep

learning is put into practice, how well it improves learning quality, and issues in using it. Information was gathered by analyzing journal articles, academic books, conference papers, and research reports. Searches used specific keywords like "deep learning in education," "educational technology," "deep learning implementation," and "challenges in deep learning education" to ensure all relevant information was found (Tranfield et al., 2003).

The analytical framework for this study is grounded in thematic synthesis, a method that facilitates the identification of recurring patterns and core motifs (Braun & Clarke, 2006). The systematic workflow involved: (a) categorizing literature into thematic clusters such as conceptual foundations, practical execution, and systemic hurdles; (b) performing a comparative assessment to discern convergences and divergences across the sources; (c) scrutinizing contextual variables—including institutional capacity, teacher proficiency, and regulatory frameworks—that influence deep learning outcomes (Zawacki-Richter et al., 2019); and (d) consolidating these findings to construct a comprehensive understanding of how deep learning can be optimally integrated into educational infrastructures

Several constraints characterize the scope of this research. Primarily, as a secondary study based on a literature review, it lacks fresh empirical data derived directly from field observations in schools. Additionally, the methodological heterogeneity and varying quality of the analyzed works may influence the generalizability of the conclusions. Finally, given the accelerated pace of innovation within deep learning, this review may not fully encapsulate the most recent, cutting-edge developments that have emerged since the data collection phase (Bozkurt, 2023).

4. RESULT AND DISCUSSION

Result

Table 1 shows the main findings of the study, grouped by its goals and themes. These findings summarize research evidence and proven best practices about what deep learning is, how it's put into action, its effects, problems in using it, and how it's used globally in education (Jeni Ambarita, 2025).

Table 2. Research Findings on Deep Learning in Education.

Category	Key findings	References
Concept of Deep Learning	1. Deep learning differs from surface learning by focusing on conceptual understanding and application across contexts. 2. Analytical inquiry and strategic problem-resolution are regarded as the cornerstone competencies for individuals striving to thrive in today's rapidly evolving society. 3. The capacity for cross-disciplinary information migration serves as a cornerstone for versatility, allowing individuals to navigate the complexities of both technology-driven and multifaceted academic landscapes. 4. The instructional underpinnings are primarily anchored in a triad of conscious engagement, substantive relevance, and the cultivation of a positive learning atmosphere.	1. Marton & Säljö, 1976 2. National Research Council, 2012 3. Chen et al., 2020; Shi, 2022; Warburton, 2003; Wu, 2024 4. Zeidan et al., 2010; Van den Beemt et al., 2023; Atkinson & Barker, 2023
Frameworks and Models of Implementation	1. The convergence of artificial intelligence with big data analytics serves as a catalyst for refining student evaluations and tailoring educational trajectories to meet individual learner needs 2. Intelligent learning platforms dynamically calibrate the level of instructional challenge in direct response to a student's real-time academic output. 3. The implementation of digital-rich cooperative spaces serves to bolster the level of active participation and academic commitment among learners.	1. Shi, 2022; Chen, 2022 2. Chen, 2022 3. OECD, 2019; Pan et al., 2023
Teaching Strategies in Deep Learning	1. The DBL framework is instrumental in nurturing students' capacity for authentic problem resolution and cognitive flexibility, enabling them to address complex challenges with inventive solutions. 2. The adoption of Project-Based Learning (PBL) acts as a catalyst for heightening student enthusiasm, ensuring the long-term preservation of knowledge, and fostering robust collaborative synergy. 3. The implementation of inquiry-driven methodologies empowers students to assume greater responsibility for their own educational trajectory, fostering a profound sense of agency. 4. The practical execution of these pedagogical frameworks is further	1. Weng et al., 2023 2. Thomas, 2000 3. Streicher & Bauer, 2024 4. Chen, 2022

	bolstered by the strategic integration of diverse digital resources and online infrastructures.	
Impact on Cognitive Development and Engagement	1. Cognitive impact: Evidence from a half-year longitudinal study suggests that the integration of STEAM within Project-Based Learning frameworks yields enduring educational benefits, particularly in deepening theoretical comprehension and refining analytical troubleshooting capabilities. 2. The implementation of mindfulness-based interventions has been shown to bolster sustained attention and mitigate academic stress, thereby providing a robust foundation for enhanced student achievement 3. Regarding student involvement, the deep learning paradigm has been shown to catalyze a heightened sense of learner agency. This shift transcends mere participation, manifesting as a vigorous enthusiasm and a steadfast dedication to the educational journey. 4. The synergy between emotionally positive and contextually relevant instructional practices acts as a powerful catalyst for bolstering students' internal drive and innovative capacities.	**1.** Salmi et al., 2023 **2.** Zeidan et al., 2010 **3.** Zhang et al., 2023; Salmi et al., 2023 **4.** Amaefule et al., 2023; Mielikäinen et al., 2024

Source: Author's Synthesis from Relevant Literature, 2025

Discussion

Expanded Concept of Deep Learning in Education

Deep learning serves as a pedagogical strategy that prioritizes thorough grasp of core ideas and the capacity to adapt knowledge to varied scenarios, moving beyond simple rote recall. As outlined by Marton and Säljö (1976), it sets itself apart from surface-level learning by empowering individuals to authentically internalize concepts and extend them to different applications. This method fosters the blending of novel insights with existing awareness, rather than depending on the retention of standalone details.

A key element of deep learning involves cultivating analytical reasoning and the skills to address challenges effectively. In today's intricate society, individuals must examine data, assess supporting facts, and combine concepts to reach well-reasoned conclusions (National Research Council, 2012). Additionally, this form of learning enhances the ability to apply insights between different fields, which proves especially important in interconnected and

technology-driven educational settings (Chen et al., 2020; Shi, 2022; Warburton, 2003; Wu, 2024).

Deep learning readies students for 21st-century issues by developing creativity, teamwork, communication, and digital skills needed in modern jobs and STEAM fields (National Research Council, 2012; Partnership for 21st Century Learning, 2019).

The three primary pedagogical foundations for deep learning encompass mindful, meaningful, and joyful educational strategies. Mindful learning focuses on cultivating presence and attentiveness during academic pursuits. Studies by Zeidan et al. (2010) revealed that mindfulness techniques enhance attention, alleviate anxiety, and elevate performance levels, outcomes that have been corroborated in more recent investigations (Lin, 2020; Sykes, 2024; Wang et al., 2023). Integrating mindfulness allows learners to participate more immersively and attain superior comprehension. Meaningful learning emerges when individuals link emerging concepts to their accumulated expertise and real-world encounters. Rooted in constructivist frameworks, this method bolsters retention and insight by promoting hands-on engagement (Van den Beemt et al., 2023; Wong, 2022). Joyful learning cultivates inherent drive, where uplifting emotions inspire persistence and innovative problem-solving among students. Enjoyable educational encounters motivate learners to fully immerse themselves and navigate obstacles effectively (Atkinson & Barker, 2023; Knoop, 2020). Emerging research underscores technology's contribution to deep learning, with artificial intelligence and adaptable platforms facilitating tailored educational trajectories (Chen, 2022), alongside multidisciplinary approaches that promote an integrated perspective (Pan et al., 2023).

Global views show deep learning works in different places. For instance, Finland and Singapore use methods focused on critical thinking and teamwork, leading to better student results (OECD, 2019). These cases highlight the need to adjust strategies for local culture and situations.

Expanded Implementation of Deep Learning Frameworks and Models

1) Frameworks and Models

Implementing deep learning within educational settings involves various structures and approaches that integrate technological innovations with contemporary instructional techniques. A significant progression includes incorporating artificial intelligence (AI) and extensive data analytics into evaluating student performance. Such technologies enable educators to examine learner outcomes, identify behavioral trends in studying, and adjust curricula to align with individual requirements (Shi, 2022). For example, a framework

employing deep learning in university-level English courses enhances instruction through real-time responses and personalized educational trajectories (Shi, 2022).

Personalized adaptive platforms contribute to deep learning by leveraging algorithms to modify the complexity or nature of the material presented, depending on a student's advancement. This ensures an appropriate degree of difficulty for each participant (Chen, 2022). Investigations indicate that these platforms substantially increase learner engagement and overall performance. Environments enriched with technology further facilitate deep learning. Virtual platforms and electronic resources promote collaborative efforts and novel interactions with content (Chen, 2022). Evidence suggests that such settings elevate enthusiasm and accomplishment rates. Globally, Finland emphasizes learner autonomy and cooperative activities, resulting in elevated participation and success levels (OECD, 2019). Singapore prioritizes analytical reasoning and issue resolution to advance deep learning (Pan et al., 2023). These instances provide adaptable strategies for incorporating deep learning across diverse contexts.

2) Teaching Strategies

Effective instructional strategies play a crucial role in fostering deep learning within educational institutions. Techniques such as Design-Based Learning (DBL), Project-Based Learning (PBL), and Inquiry-Based Learning prove highly beneficial in enhancing comprehension and engagement. DBL emphasizes addressing authentic challenges and innovation via practical initiatives that cultivate higher-order cognition and collaboration (Weng et al., 2023). It aligns with deep learning principles by enabling learners to investigate, experiment with concepts, and develop solutions. Investigations demonstrate that DBL enhances conceptual mastery, along with abilities in cooperation and analytical reasoning.

PBL engages participants in extended endeavors that require investigation and resolution of complex inquiries or problems. It encourages the practical application of information, thereby boosting drive and concentration (Thomas, 2000). Evidence connects PBL to improved retention of material and development in competencies such as communication and group dynamics. Inquiry-Based Learning prompts learners to pose queries, conduct explorations, and delve into subjects of personal interest. It empowers individuals to take ownership of their education, facilitating a more profound interaction with the subject matter (Streicher & Bauer, 2024). Findings indicate that it results in enhanced insight and sustained memory.

Emerging technologies amplify these approaches. Electronic resources and virtual collaboration systems offer opportunities for interactive, immersive learning experiences (Chen, 2022). This is evident in international educational frameworks, where deep learning adapts according to cultural and regional influences. Finland incorporates cooperative and exploratory methods to support deep learning (OECD, 2019). Singapore integrates analytical skills with technological integrations to promote greater involvement and outcomes (Pan et al., 2023). These examples illustrate that combining pedagogical tactics with digital elements is essential for creating environments conducive to deep learning.

3) Mindful, Meaningful, and Joyful Learning

Deep learning works best when it includes mindful, meaningful, and joyful learning. Mindful learning means students reflect on and check their own learning, becoming more aware of how they learn. When teachers encourage reflection and goal-setting, students connect more deeply with what they are learning (Zeidan et al., 2010). Studies show mindfulness improves focus, lowers stress, and makes overall learning better.

Meaningful education emphasizes connecting fresh concepts to learners' existing knowledge base and personal backgrounds. This is achieved via practical illustrations, interdisciplinary initiatives, and collaborative activities (Zaka, 2023). Studies suggest that individuals immerse themselves more profoundly in material when they recognize its relevance (Bryce & Blown, 2024). Joyful education further boosts participation by fostering encouraging and nurturing atmospheres. When learners find pleasure in the process, they become more driven to exert effort and maintain inquisitiveness (Widayanti, 2020). Educators can promote joy in learning by incorporating elements of fun, imagination, and discovery.

Integrating these principles aligns with prominent international educational movements, such as Finland's priority on learner self-reliance and Singapore's dedication to innovation and challenge resolution (OECD, 2019; Pan et al., 2023). Technological advancements, particularly those driven by AI, bolster mindful, meaningful, and joyful approaches by delivering flexible, introspective, and captivating opportunities (Chen, 2022).

Merging diverse structures, instructional techniques, and educational philosophies forms a holistic strategy for deep learning. The synergy of digital tools, pedagogical methods, and intellectual involvement guarantees that learners acquire not just information but also hone analytical abilities, resolution skills, and an enduring passion for education.

Expanded Impact of Deep Learning in Education

Deep learning positively affects how students think, their motivation, and their involvement by encouraging higher-level thinking skills, like analyzing, combining, and judging, and by helping students build *understanding and link new ideas to old ones (Salmi et al., 2023).*

1) Cognitive Impact

One significant impact of deep learning lies in enhancing cognitive capabilities. Research by Salmi et al. (2023) demonstrated that a STEAM program incorporating project-based activities led to notable advancements in mental performance across a half-year period. This approach enabled learners to tackle complex issues and collaborate on resolutions, thereby sharpening their analytical and resolution-oriented competencies. Engagement in such hands-on projects also supported better retention and grasp of ideas. Furthermore, mindful approaches contribute to intellectual growth by encouraging complete attentiveness throughout education (Zeidan et al., 2010). By maintaining presence in their activities, individuals can contemplate and integrate fresh insights with prior information, resulting in more profound insights.

2) Student Engagement

Deep learning has a strong link to heightened learner involvement and drive, particularly within non-traditional educational contexts. Participants engaged in this approach frequently assume greater ownership of their studies, resulting in superior scholastic achievements and favorable views on schooling (Zhang et al., 2023). As an illustration, those taking part in scientific displays that employed deep learning tactics exhibited elevated excitement and dedication (Salmi et al., 2023). Meaningful education, by associating novel data with pre-existing insights, further amplifies participation through increased pertinence and significance (Zhang et al., 2023). Joyful education introduces an additional dimension by merging pleasure with intrinsic encouragement. Techniques like project-oriented and exploratory learning enable individuals to pursue their curiosities and inventive ideas, rendering the process more pleasurable and rewarding (Amaefule et al., 2023; Mielikäinen et al., 2024). Consequently, deep learning not only elevates academic comprehension among students but also cultivates an atmosphere that promotes discovery, originality, and sustained commitment.

Expanded Challenges in Deep Learning

While the benefits of the deep learning paradigm are compelling, its practical integration is often hindered by systemic hurdles, including complex evaluation metrics, localized constraints, and a deficit in professional educator development. Addressing these

inequities is fundamental to ensuring a just and productive educational ecosystem. As delineated in the accompanying table, these obstacles are multifaceted—encompassing human capital, pedagogical resources, and the underlying technological framework (Puthut Prihantoro,2025).

Table 3. Challenges in Implementing Deep Learning in Indonesian Schools.

Aspect	Main Challenges	Impact on Implementation	Suggested Solutions
Teacher Competence	Lack of training on project-based, reflective, and collaborative pedagogical strategies	Teachers tend to revert to traditional lecture methods	Intensive training, mentoring, and teacher learning communities
Resources and Materials	The prevalence of abstract instructional resources that lack real-world relevance, coupled with a deficit in technologically-mediated pedagogical instruments.	The instructional process loses its substantive depth, which consequently leads to a pervasive state of student passivity within the classroom	Development of contextual learning media
Technology Infrastructure	Significant digital disparities persist in the marginalized 3T regions comprising frontier, outermost, and socio-economically disadvantaged areas where inadequate network infrastructure and a scarcity of hardware continue to impede educational progress.	Serves as a significant impediment to the seamless deployment of technology-mediated instructional frameworks.	Gradual and inclusive provision of technology

The data provided in the table highlights that the hurdles to adopting a deep learning framework are layered, cutting across the domains of personnel, instructional content, and physical infrastructure. Chief among these is a noticeable gap in educator proficiency, especially regarding the creation of investigative or contemplative curricula where the instructor acts as a guide rather than a lecturer. Furthermore, the scarcity of culturally aligned teaching aids and digital hardware often stymies the shift toward active pedagogy. These

systemic inequities are most acute in geographically isolated (3T) zones, where the lack of connectivity remains a significant barrier to educational modernization

To address these barriers, policies must systematically promote teacher professional development, supply of context-specific learning resources, and fair investment in technology. Through proactive strategies to anticipate these issues, deep learning implementation in Indonesia can advance effectively and sustainably.

The following are the detailed explanation of the challenges in implementing a deep learning program.

1) Assessment Difficulties

To truly capture the essence of deep learning, education systems must move past traditional assessments that favor surface-level memorization at the expense of higher-order thinking (Jiang, 2022). The current reliance on these outdated models often leads to an inaccurate appraisal of a student's actual capabilities. Instead, the integration of portfolio-based and task-specific evaluations provides the nuanced insights necessary to see how knowledge is utilized in practical situations (Šimić Šašić et al., 2023). Transitioning from a focus on 'what' students know to 'how' they apply it is crucial for a fair assessment process. In the realm of EFL instruction, this shift toward formative evaluation has proven to be an indispensable factor in enhancing classroom dynamics and learning efficacy.

2) Cultural and Contextual Factors

Deep learning is not a culturally neutral process; its success depends heavily on its alignment with local values and student experiences (Jiang, 2022). For educators, particularly those in EFL settings, the challenge lies in creating deep learning opportunities that resonate with the learners' specific cultural identities. However, cultural sensitivity alone is insufficient if not backed by material support. As Pan et al. (2023) highlight, the stark contrast in access to technology and expert teaching between wealthy and impoverished schools creates a self-perpetuating cycle of inequality. To dismantle these barriers, policy interventions must prioritize the fair distribution of educational assets and encourage the use of strategies that are sensitive to the socio-economic realities of each school

3) Teacher Training and Professional Development

Professional readiness remains a critical variable; without targeted training, the principles of deep learning often remain elusive to many classroom practitioners (Kilag et al., 2023). To bridge this gap, training programs must shift their focus toward practical strategies and culturally sensitive engagement. However, individual workshops are only part of the solution; as Berikkhanova (2022) highlights, it is through collaborative networks and peer-to-

peer mentoring that teachers truly refine their craft and foster a culture of continuous growth. This strategic emphasis on teacher capacity is currently exemplified by the Kemendikdasmen training sessions in Bandung, which aim to equip school principals and basic education staff with the tools necessary for modernizing the classroom experience.

Expanded International Applications of Deep Learning in Education

Around the world, education systems are increasingly using deep learning to prepare students for the challenges of the 21st century. This approach helps develop critical thinking, creativity, teamwork, and digital literacy. For example, Canada's New Pedagogies for Deep Learning (NPDL) project focuses on student-centered learning and key skills like critical thinking, communication, and collaboration (Sims et al., 2021). This framework, used across Canadian provinces, supports learning based on questions and real-world experiences, which makes students more engaged and improves learning results (Chénier et al., 2020; Fullan & Langworthy, 2014). The NPDL framework uses six global competencies, and teachers assess students' progress in each of these.

In the United States, deep learning is part of the Partnership for 21st Century Skills (P21) framework, which highlights problem-solving, communication, and digital literacy (Partnership for 21st Century Learning, 2019). Schools use project-based learning to encourage active and meaningful engagement that connects to solving real-life problems. The P21 framework defines the skills, knowledge, and expertise students need to succeed in work and life [eric.ed.gov]. Similarly, the European Union's Digital Education Action Plan (2021–2027) promotes digital literacy and new teaching methods by using technology to help with learning across different subjects and cultures (Sounoglou, 2023). This plan is a key part of achieving a European Education Area by 2025 [eilm.edu.eu]. These efforts aim to provide all students with fair access to deep learning opportunities.

Building on these regional initiatives, learning across different subjects is seen as a key factor in deep learning. Combining multiple subjects helps students understand and engage more deeply [Pan et al., 2023]. For example, the STEAM model, which mixes science, technology, engineering, arts, and mathematics, boosts innovation and problem-solving (Yakman & Lee, 2012). This interdisciplinary approach strengthens critical thinking and creativity

Adapting to different cultures is also very important. Jiang (2022) stresses that deep learning must fit students' cultural backgrounds and learning styles. In many Asian settings, group problem-solving works better than individual learning, showing the need for solutions

designed for specific contexts. Research indicates that integrating cultural adaptation into deep learning frameworks can significantly improve academic performance and classroom participation. This cultural integration is vital for AI tools to be effective in diverse classrooms.

Technological advancements further improve deep learning. Artificial intelligence (AI) and big data analysis allow for personalized learning, while adaptive platforms give immediate feedback, support various learning needs, and offer more complete assessments than traditional exams (Chen, 2022). In Indonesia, AI is transforming education by personalizing learning and improving student engagement. Indonesia is rapidly implementing AI and coding in schools, aiming to create 100,000 AI talents per year by 2025.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Deep learning significantly enhances students' thinking skills, critical analysis, motivation, and involvement by fostering advanced abilities such as information synthesis and cross-disciplinary application, which are vital for the 21st century. Methods focused on mindful, meaningful, and joyful learning support student-centered teaching, making education personal and naturally motivating, while technological advancements like AI platforms have further widened its global impact (Jiang, 2022; Chen, 2022). However, important challenges persist, as traditional assessments often fail to measure advanced thinking, and cultural differences, alongside a lack of teacher training, continue to block effective implementation. Without focused solutions, these issues could limit the benefits of deep learning and increase existing education gaps (Pan & Chen, 2023; Kilag et al., 2023).

From this study's findings, fully adopting deep learning requires combined changes in both structure and teaching through several integrated policy steps. Governments and policymakers should first develop comprehensive assessment systems that shift from standard tests to authentic evaluations, such as portfolios and performance tasks that demonstrate critical thinking and problem-solving (Jiang, 2022; Šimić Šašić et al., 2023). Simultaneously, providing continuous support for teacher professional training is essential to build skills in new methods like project-based and inquiry-based learning, supplemented by peer support networks and reflection practices (Berikkhanova, 2022; Kilag et al., 2023). Furthermore, ensuring equal and fair access to digital tools and learning resources is necessary to bridge the gap between well-funded and underserved schools (Pan & Chen, 2023).

To ensure sustainability, deep learning methods must be adapted to local contexts and cultures, particularly in multilingual settings where teaching should connect to students' real lives (Jiang, 2022). This should be accompanied by the increased use of ethical, pedagogy-

focused technology and AI to provide customized learning and instant feedback (Chen, 2022). Moreover, curricula should promote interdisciplinary activities and collaborative projects, such as STEAM models, to build real-world problem-solving skills (Pan et al., 2023; Yakman & Lee, 2012). By adapting best practices from global leaders like Finland, Singapore, and Canada to fit local conditions, these policy steps can establish deep learning as the foundation for future-ready education, equipping students with the knowledge and attitudes to succeed in a connected world (OECD, 2019; Sims et al., 2021).

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