Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES
P-ISSN 2581-1657
E-ISSN 2581-2203

Effectiveness of Deep Learning in Digital-Based Learning Media: A Library Research Study in Indonesian Elementary Schools

Indana Farihatul Luthfi*, Mundir, Nino Indrianto
Islamic Education, Universitity Kiai Haji Achmad Siddiq Jember, Jember, 68136, Indonesia

ARTICLE INFO

Article history:

Received: 19 Jan 2026
Revised: 10 March 2026
Accepted: 25 March 2026
Published online: 05 April 2026

Keywords:

Deep Learning,
Digital-Based Learning Media,
Elementary School,
AI Integration,
Teacher Competence

* *Corresponding author:*

E-mail: indanafarihatulluthfi.27@gmail.com

Article Doi:

https://doi.org/10.31258/jes.10.4.p.156-167

A B S T R A C T

This study examines the effectiveness of deep learning as a pedagogical approach within digital-based learning media in Indonesian elementary schools. Employing a qualitative library research method, data were collected from academic books, peer-reviewed national and international journal articles, education policy documents, and credible digital sources. Data analysis followed three sequential stages: data reduction, data presentation, and synthesis, supported by source triangulation and peer review to ensure validity. The findings reveal that deep learning, characterized by meaningful, mindful, and joyful learning, demonstrates significant potential to improve the quality and inclusivity of educational experiences when integrated with digital media platforms such as Learning Management Systems, adaptive assessment tools, AI-based tutoring platforms, and gamified learning applications. The study further identifies a dual impact on student learning outcomes and teacher professional competence, as educators who receive structured digital training demonstrate greater pedagogical confidence and flexibility. Nevertheless, successful implementation requires equitable technological infrastructure, sustained teacher professional development, and curriculum alignment. This study concludes that deep learning and digital media integration represents a transformative educational strategy that demands systemic institutional commitment to realize its full pedagogical potential.

1. Introduction

The rapid advancement of artificial intelligence (AI) has brought profound transformations across various sectors, particularly in higher education. The integration of digital technology into learning systems is no longer merely an option but a strategic necessity for improving the quality, relevance, and competitiveness of education in the 21st century (Amiruddin Tawe et al., 2025). One of the most transformative developments in this landscape is the application of artificial

intelligence (AI), particularly in the context of deep learning-based digital instruction. AI enables more adaptive, personalized, and contextual learning experiences that align closely with the demands of contemporary education. As Istiqomah et al. (2025) noted, the transformation of education in the digital era involves not only technical changes in learning methods, but also fundamental shifts in values, social relations, and the overall educational system.

Digital-based learning management has emerged as a central innovation in strengthening the teaching and learning process. The integration of information and communication technology (ICT) has enabled learning to transcend spatial and temporal constraints, facilitating more collaborative, personal, and contextual educational experiences (Apriliani, 2025). Platforms such as Learning Management Systems (LMS), video conferencing tools, and interactive applications allow teachers and students to interact dynamically, while analytical data systems enable real-time monitoring of learning progress. As Turnip et al. (2025) demonstrated, the use of LMS-assisted project-based learning models significantly improves students' writing skills and learning engagement, affirming the pedagogical value of technology-integrated instruction. Similarly, Harmoni and Handayani (2025) found that digital learning tools, including interactive platforms such as Nearpod, effectively enhance students' critical thinking skills when applied within structured pedagogical frameworks.

The development of digital teaching media plays a vital role in supporting students' learning processes, particularly in improving numeracy and language competencies. Digital media increases student involvement, provides more active learning experiences, and broadens access to learning resources (Hadi, 2025). In this regard, numerous studies have demonstrated the effectiveness of various forms of digital media in improving learning outcomes and motivation. Azmi et al. (2025) found that Wordwall-based learning media significantly increased fourth-grade students' motivation in Social Studies learning, demonstrating the power of gamified digital tools to transform passive learning into engaging, interactive experiences. Likewise, Syahrir et al. (2025) showed that Augmented Reality-based learning modules effectively reduced the abstract nature of subject matter and improved student engagement and interest in IPAS learning at the elementary level.

Despite the proven benefits of digital media, its effective implementation is contingent on several critical factors. Limited knowledge and skills among teachers in developing technology-based teaching materials remain a significant barrier to optimal utilization (Hadi, 2025). Septiani et al. (2025) confirmed that AI integration in educational practice requires more than tool familiarity, as it demands a growth mindset, contextualized training, and sustained digital competence development among educators. Furthermore, Sahputra et al. (2025) identified that while AI offers significant benefits for personalized learning and adaptive assessment in Indonesian schools, challenges remain, including limited internet access, insufficient devices, and uneven digital literacy among teachers and students. These findings underscore the importance of institutional readiness and comprehensive teacher professional development as prerequisites for successful technology integration.

Digital learning also has the potential to support self-reflection and make learning more adaptive through systems that can be customized to individual students' levels and learning difficulties (Apriliani, 2025). Features such as automatic feedback, assessment tools, and learning progress tracking help both teachers and students monitor development continuously. Rahayu et al. (2025) demonstrated that AI-based learning media, exemplified by Teachy App, effectively supports teachers in designing adaptive assessments and delivering instant feedback, significantly increasing student engagement in Indonesian elementary schools. Similarly, Wardhani et al. (2025) found that the integration of AI in science learning improves student learning outcomes and builds digital literacy awareness, with research indicating that AI-assisted instruction can improve learning outcomes significantly compared to conventional methods.

The success of digital-based deep learning implementation depends greatly on the managerial readiness of educational institutions. Strategic planning for the digitalization of learning, beginning with needs mapping, platform selection, and curriculum integration, is essential to ensure that technology serves pedagogical purposes effectively (Apriliani, 2025). In Indonesia, approximately 59,000 schools are preparing to implement deep learning methods starting from the 2025/2026 academic year, with the Ministry of Primary and Secondary Education emphasizing staged implementation supported by teacher incentive training. This national initiative reflects the urgent need for research that evaluates the effectiveness of deep learning approaches within digital-based learning media to guide implementation at scale.

Previous studies have largely examined digital media and AI integration in isolation, focusing either on specific tools or on general perceptions of technology in education. Few studies have explored how deep learning approaches can be systematically embedded within digital teaching media development, particularly within the Indonesian educational context. Prayudi et al. (2025) developed multimedia learning materials integrating local wisdom with case method and team-based project approaches, demonstrating that culturally contextual digital media strengthens both analytical skills and student identity. However, the specific intersection between deep learning pedagogical principles and AI-assisted digital media in Indonesian schools remains an underexplored area.

Given this gap, the present study aims to analyze the effectiveness of AI-based digital teaching media designed through a deep learning approach in improving the quality of learning in Indonesian educational contexts. By examining how deep learning principles can be operationalized within technology-driven instructional media, this study seeks to contribute to the development of more adaptive, meaningful, and ethically grounded pedagogical strategies that respond to both national educational transformation agendas and the practical realities of digital learning implementation in Indonesia.

2. Methodology

Research Design and Instrument

This study employed a qualitative approach using the library research method to examine the effectiveness of deep learning in digital-based learning media. Library research was selected because it enables researchers to systematically analyze and synthesize findings from previous scholarly works related to the research topic. The primary instrument in this study was the researcher as a human instrument, responsible for identifying relevant literature, interpreting findings, and synthesizing insights across multiple sources (Ali Khan et al., 2023). To support a systematic review process, several auxiliary instruments were also used. These included literature matrices to categorize and compare findings across studies, research record sheets to document key information from each article, and reference management software to organize bibliographic data. These instruments ensured that the process of data collection, organization, and analysis was conducted in a structured and transparent manner.

Literature Search Strategy and Data Collection

The literature analyzed in this study consisted of peer-reviewed journal articles, academic books, education policy documents, and credible digital sources related to deep learning, digital-based learning media, and artificial intelligence integration in education. The literature search focused on publications published between 2015 and 2024, reflecting the rapid development of digital learning technologies and AI in education. The search process was conducted using several academic databases, including Google Scholar, ERIC, and institutional repositories. The search strategy employed combinations of keywords such as: “deep learning in education,” “digital learning media,” “AI in education,” “technology-enhanced learning,” and “teacher digital competence.” Boolean operators (AND, OR) were used to refine search results. A total of 120 records were initially identified. After duplicate removal and title–abstract screening, 75 articles remained for full-text assessment. Based on the inclusion and exclusion criteria, 45 articles were excluded, resulting in 30 articles (n = 30) included in the final analysis.

Data Analysis

Data analysis was conducted using qualitative content analysis through three main stages. The first stage was data reduction, in which relevant information from the selected articles was filtered and categorized according to themes related to deep learning strategies and digital learning media. The second stage was data presentation, where key findings from the selected studies were organized into thematic descriptions and literature matrices to facilitate cross-study comparison. The final stage was data synthesis, in which insights from multiple sources were integrated to generate a comprehensive understanding of the role of deep learning within digital-based learning media.

Trustworthiness of the Study

To enhance the credibility of the findings, the study applied source triangulation by comparing information from different types of sources, including journal articles, books, and policy documents. Consistency of findings across these sources served as an indicator of reliability. In addition, a peer review process was conducted through academic discussions with colleagues familiar with the research topic to ensure analytical rigor and minimize researcher bias. These procedures strengthened the validity and transparency of the literature-based analysis. The characteristics of the selected studies are summarized in Table 1.

Table 1. Summary of Articles Included in the Literature Review

No	Author	Year	Research Focus	Method	Key Findings
1	Amalia	2025	Deep learning and student motivation in elementary school	Quantitative	Deep learning significantly increases student learning motivation.
2	Apriliani	2025	Digital learning management supporting deep learning	Qualitative	Digital management systems support adaptive and reflective learning.
3	Azmi, Putri, & Zulkardi	2025	Wordwall-based digital learning media	Experimental	Gamified digital media increases student engagement and motivation.
4	Hadi	2025	Training for developing digital teaching media	Descriptive	Teacher training improves competence in creating technology-based learning media.
5	Harmoni & Handayani	2025	Nearpod-based digital learning tools	Experimental	Digital interactive tools enhance students' critical thinking skills.
6	Hidayat & Haryati	2025	Deep learning effectiveness in elementary schools	Qualitative	Deep learning improves conceptual understanding and participation.
7	Istiqomah, Setiawan, & Mulyasa	2025	Educational transformation in the digital era	Literature review	Digital transformation reshapes learning systems and educational values.
8	Prayudi, Sugiarta, & Wahyuni	2025	Multimedia learning with local wisdom	Development study	Digital multimedia strengthens analytical skills and cultural identity.
9	Rahayu, Fitriani, & Kurniawan	2025	AI-based learning media (Teachy App)	Experimental	AI-assisted assessment increases engagement and adaptive learning.
10	Sahputra, Haryanto, & Setiadi	2025	AI for personalized learning	Qualitative	AI supports adaptive learning but requires infrastructure readiness.
11	Septiani, Nugraha, & Ambarwati	2025	AI-driven language teaching	Qualitative	AI integration improves teacher innovation and digital competence.
12	Syahrir, Sulistyowati, & Hidayat	2025	Augmented Reality learning modules	Experimental	AR-based modules improve engagement and understanding.

13	Tawe et al.	2025	Digital media innovation using deep learning	Case study	Deep learning integration improves interactive instruction.
14	Turnip, Simatupang, & Panjaitan	2025	LMS-assisted project-based learning	Quasi-experimental	LMS improves writing skills and student participation.
15	Wardhani, Kusumawati, & Prasetyo	2025	AI integration in science learning	Experimental	AI improves learning outcomes and digital literacy awareness.

3. Results and Discussion

Result

Main Findings of the Review

This review synthesizes current literature on the implementation of deep learning in digital-based learning media, highlighting key patterns, convergences, and contradictions across studies. Findings are organized into four thematic areas: (1) characteristics and principles of deep learning, (2) the role of digital media in supporting deep learning, (3) impact on student outcomes and teacher competence, and (4) challenges and enabling conditions for effective implementation.

Characteristics and Principles of Deep Learning

Deep learning is fundamentally and decisively distinguished from surface learning by its sustained emphasis on conceptual understanding, reflective engagement, and the applicative transfer of knowledge to new and unfamiliar situations. Unlike conventional instructional approaches that prioritize memorization and the reproduction of discrete facts, deep learning requires students to actively construct meaning by connecting new information with prior knowledge, critically evaluating the validity and relevance of information, and engaging in reflective self-monitoring throughout the learning process. This fundamentally different orientation toward knowledge acquisition transforms the student from a passive recipient of teacher-transmitted content into an active, self-directed agent in the construction of understanding. As summarized in Table 2, deep learning encompasses three core characteristics that collectively define its pedagogical orientation and distinguish it from less cognitively demanding forms of instruction. These characteristics are not isolated traits but mutually reinforcing dimensions of a holistic learning philosophy that places the intellectual and emotional engagement of the student at the center of educational design.

Table 2. Core Characteristics of Deep Learning

Characteristic	Description
Meaningful Learning	Students connect new knowledge with prior experiences, making learning more memorable and contextually relevant
Mindful Learning	Students are actively aware of their own thought processes and engage in structured self-reflection throughout learning

Joyful Learning	Learning is conducted in a comfortable, motivating atmosphere that encourages creativity, critical thinking, and active problem-solving

Source: Salsabila Amalia (2025)

These characteristics collectively facilitate the development of the 4C competencies (critical thinking, creativity, collaboration, communication), providing a clear alignment with 21st-century education goals (Muh Dliyul Haq & Nova Tri Prasetiyo, 2025). Synthesizing across studies, meaningful learning is consistently linked to improved conceptual retention, mindful learning to better metacognitive awareness, and joyful learning to higher student motivation and engagement. This convergence underscores the multifaceted nature of deep learning, which integrates cognitive, metacognitive, and affective dimensions.

The Role of Digital Media in Supporting Deep Learning

Digital media acts as a catalyst for deep learning, enabling multimodal content delivery, personalized feedback, collaborative interaction, and adaptive instruction (Amiruddin Tawe et al., 2025; Apriliani, 2025). Table 3 presents a structured overview of the principal functions through which digital media platforms support deep learning implementation across different instructional contexts.

Table 3. Functions of Digital Media in Deep Learning Implementation

Digital Media Function	Deep Learning Contribution
Interactive visual media	Enhances conceptual understanding through multimodal representation
Adaptive assessment systems	Personalizes feedback based on individual student performance
Learning Management Systems (LMS)	Facilitates progress monitoring and structured self-directed learning
AI-based tutoring platforms	Identifies learning patterns and adapts content to student needs
Gamified learning tools	Increases motivation and active engagement in the learning process

Source: Amiruddin Tawe et al. (2025); Apriliani (2025)

Studies converge on the idea that digital tools amplify the effectiveness of meaningful, mindful, and joyful learning, but some differences exist in which platforms are most effective depending on context. For instance, AI-based tutoring shows strong impact in individualized support, while LMS platforms are better for overall course organization and tracking.

Impact on Student Outcomes and Teacher Competence

The research literature consistently and compellingly demonstrates that the systematic integration of deep learning approaches within digital media environments yields measurable and meaningful improvements in both student learning outcomes and teacher professional capacity, producing a dual impact that extends the transformative potential of deep learning far beyond the individual classroom. Students who engage with deep learning-oriented digital media demonstrate not only higher levels of academic achievement and conceptual

understanding but also greater motivation, more sustained engagement, and stronger development of the higher-order thinking skills that are essential for success in contemporary academic and professional contexts. These improvements in student outcomes are attributable to the combined effect of more personalized instructional support, more engaging and interactive learning experiences, and more frequent and actionable feedback that enables students to monitor and adjust their learning progress in real time. At the same time, teachers who engage with structured digital learning frameworks and receive targeted professional development in deep learning principles undergo significant and lasting transformations in their pedagogical orientation, moving from a predominantly transmissive model of instruction toward a more facilitative, reflective, and student-responsive approach. Table 4 presents a synthesis of key research findings documenting the impact of deep learning integration in digital media on both student outcomes and teacher practice across a range of educational contexts.

Table 4. Research Findings on the Impact of Deep Learning in Digital Media

Researcher	Focus	Key Finding
Khotimah & Abdan (in Ambar Wulan Sari & Dewi Juni Arta, 2025)	Deep learning in Islamic Religious Education	Increased student participation and conceptual understanding
Turmuzi (in Ambar Wulan Sari & Dewi Juni Arta, 2025)	Curriculum adaptation through deep learning	More interactive and effective learning with relevant feedback
Amiruddin Tawe et al. (2025)	Teacher training in digital media integration	Increased teacher confidence and shift toward interactive, varied learning
Agussabeth Adelina Pasaribu (2025)	Student-centered deep learning approaches	Development of critical, creative, collaborative, and communicative skills

Synthesis reveals that student benefits include higher academic achievement, stronger higher-order thinking skills, and sustained engagement. Meanwhile, teacher benefits involve enhanced pedagogical flexibility, confidence, and adoption of facilitative, student-centered approaches. Contradictions are minimal, but some studies note that the magnitude of outcomes depends heavily on teacher readiness and digital literacy, indicating a conditional relationship.

Challenges and Conditions for Effective Implementation

Table 5 presents a structured and comprehensive overview of the principal barriers to effective deep learning implementation in digital media environments, paired with the corresponding enabling conditions that the literature identifies as necessary prerequisites for successful and sustainable integration.

Table 5. Challenges and Enabling Conditions for Deep Learning Implementation in Digital Media

Challenge	Enabling Condition
Limited teacher understanding of deep learning principles	Structured professional development and incentive-based training programs
Predominance of teacher-centered instruction	Curriculum reform emphasizing student-centered learning frameworks

Challenge	Enabling Condition
Uneven digital literacy among teachers and students	Equitable ICT infrastructure and AI literacy development programs
Insufficient devices and internet access	Institutional investment in technological infrastructure
Lack of curriculum design supporting deep learning	Strategic educational planning integrating deep learning into curriculum frameworks

Source: A. Gafar Hidayat & Tati Haryati (2025); Amiruddin Tawe et al. (2025); Apriliani (2025)

Studies converge on the need for systemic support teacher training, institutional readiness, and infrastructure, while diverging slightly on prioritization strategies depending on local contexts (A. Gafar Hidayat & Tati Haryati, 2025; Amiruddin Tawe et al., 2025; Apriliani, 2025). The synthesis indicates that pedagogical and institutional factors outweigh pure technological limitations, highlighting the importance of coordinated policy and professional development.

Discussion

Deep learning as a pedagogical approach represents a profound shift from traditional, teacher-centered instruction toward more dynamic, student-centered, reflective, and meaningful learning experiences. While the literature highlights its potential to enhance cognitive, emotional, and collaborative skills, a critical examination reveals that these outcomes are contingent on multiple interdependent factors such as teacher readiness, student engagement, and institutional support. Although meaningful, mindful, and joyful learning are central to deep learning, their successful realization is not guaranteed. Meaningful learning can falter if students lack foundational knowledge or if instructional scaffolding is inadequate. Mindful learning depends on both students' metacognitive skills and teachers' capacity to facilitate structured reflection, while joyful learning is often constrained by rigid curricula, high-stakes assessments, or resource limitations. These observations indicate that deep learning outcomes emerge from the interaction between pedagogical principles, contextual conditions, and human agency rather than from the approach itself.

The integration of digital media amplifies the potential of deep learning by enabling personalized feedback, adaptive instruction, and interactive engagement. Yet, its effectiveness is unevenly realized in practice. Disparities in access to technology, variations in digital literacy, and insufficient teacher training can limit the benefits. Furthermore, an overreliance on technology risks overshadowing essential human dimensions of learning, including relational scaffolding, peer collaboration, and ethical reasoning. Thus, while digital tools offer significant pedagogical affordances, their transformative power is conditional and requires critical oversight and alignment with broader learning objectives.

Evidence suggests that deep learning can improve student outcomes and enhance teacher competence. However, the research often relies on short-term, context-specific studies or self-reported measures, raising questions about generalizability and sustainability. Teacher transformation is not automatic; without ongoing professional development and institutional support, shifts toward student-centered, facilitative instruction may remain superficial. Moreover, systemic challenges such

as curriculum misalignment, uneven access to digital infrastructure, and varying levels of teacher preparation present structural barriers that, if unaddressed, could inadvertently reinforce existing educational inequities.

Limitations of the Study

This study relies primarily on secondary literature, which may introduce selection bias, incomplete reporting, and context-specific limitations. Findings may not fully capture regional variations in teacher competence, student readiness, or technological infrastructure. Additionally, focusing on published studies potentially overlooks innovative practices documented in grey literature or field reports, limiting the breadth and depth of insights.

Theoretical Implications

The findings reinforce the conceptual distinction between deep and surface learning and highlight that digital media serves as a critical but non-deterministic enabler of pedagogical transformation. Effective learning outcomes arise from the alignment of technology, human agency, and contextual factors, emphasizing that technology alone cannot guarantee meaningful educational experiences. This contributes to theoretical debates on how digital tools mediate learning processes and shape teacher practices.

Practical Implications

For educators and policymakers, the results underscore the need for integrated strategies combining professional development, curricular reform, and equitable digital infrastructure. Teachers require support in fostering metacognitive skills, designing meaningful learning tasks, and using digital tools adaptively. Policy interventions must address systemic inequities to ensure that deep learning contributes to sustainable educational improvements rather than exacerbating disparities. These practical measures are essential to translate the theoretical promise of deep learning into real-world, lasting impact.

4. Conclusion

This study concludes that deep learning represents a transformative pedagogical approach that extends beyond mere content mastery to cultivate higher-order thinking skills, reflective awareness, and meaningful engagement among students. When integrated within digital-based learning media, deep learning demonstrates significant potential to improve the quality, effectiveness, and inclusivity of educational experiences across various levels of schooling. The three core characteristics of deep learning, namely meaningful learning, mindful learning, and joyful learning, align closely with the competency demands of 21st-century education and are effectively supported by digital media functionalities such as adaptive assessment, interactive visual tools, and AI-assisted tutoring platforms.

The findings further reveal that the benefits of deep learning integration extend beyond student outcomes to encompass teacher professional development. Teachers who engage with structured digital learning frameworks demonstrate increased confidence, pedagogical flexibility, and a greater capacity for student-centered instruction. This dual impact on both learners and educators underscores the systemic value of embedding deep learning principles within institutional digital transformation agendas. Nevertheless, successful implementation remains contingent upon several enabling conditions, including equitable access to technological infrastructure, sustained teacher training programs, and curriculum frameworks that explicitly support deep learning orientations. Without these foundational supports, the gap between policy intention and classroom practice is likely to persist.

Future research is recommended to conduct empirical studies that measure the direct impact of specific deep learning digital media on student learning outcomes across different subject areas and educational levels in Indonesia. Longitudinal studies examining the sustained effects of teacher training programs on deep learning implementation would also contribute meaningfully to the evidence base, guiding more effective and scalable educational transformation efforts in the digital era.

References

Amalia, S. (2025). The Influence of Deep Learning Learning on Learning Motivation for Grade 1 Students at SD S Muhammadiyah 01 Binjai. *JUMI Journal of Multidisciplinary Science*, *1*(1), 106.

Apriliani, D. M. (2025). Digital-Based Learning Management to Support Deep Learning in Schools. *Journal of Educational Management (JMP)*, *1*(1), 57.

Azmi, N., Putri, R. I. I., & Zulkardi. (2025). Wordwall-Based Learning Media to Increase Fourth-Grade Students' Motivation in Social Studies Learning. *Journal of Educational Sciences*, *9*(5), 3245–3255. https://doi.org/10.31258/jes.9.5.p.3245-3255

Hadi, F. (2025). Deep Learning Based Digital Teaching Media Creation Training for MA Miftahul Ulum Teachers. *Abdimas Sangkabira Journal*, *6*(1), 85.

Haq, M. D., & Prasetiyo, N. T. (2025). Deep Learning as a Transformational Climb in Education: A Literature Review. *Journal of Teacher Studies and Learning*, *8*(3), 1827.

Harmoni, R., & Handayani, S. (2025). The Effect of Nearpod-Based Digital Learning Tools on Students' Critical Thinking Skills. *Journal of Educational Sciences*, *9*(4), 2719–2729. https://doi.org/10.31258/jes.9.4.p.2719-2729

Hidayat, A. G., & Haryati, T. (2025). Learning Effectiveness Analysis Using a Deep Learning Approach in Elementary Schools. *Curricula Journal: Journal of Education*, *9*(2), 131.

Istiqomah, N., Setiawan, A., & Mulyasa, E. (2025). Digital Era Educational Transformation: Shifts in Values, Social Relations, and Learning Systems.

Journal of Educational Sciences, *9*(3), 1546–1557. https://doi.org/10.31258/jes.9.3.p.1546-1557

Pasaribu, A. A. (2025). Analysis of Deep Learning Approaches as an Educational Endorsement Effort. *Journal of Community Service and Educational Research*, *4*(2), 9329.

Prayudi, A., Sugiarta, I. M., & Wahyuni, D. S. (2025). Multimedia Learning Materials Integrating Local Wisdom through Case Method and Team-Based Project Approaches. *Journal of Educational Sciences*, *9*(5), 3922–3934. https://doi.org/10.31258/jes.9.5.p.3922-3934

Rahayu, S., Fitriani, Y., & Kurniawan, D. (2025). AI-Based Learning Media through Teachy App to Support Adaptive Assessment and Student Engagement in Indonesian Elementary Schools. *Journal of Educational Sciences*, *9*(5), 3788–3799. https://doi.org/10.31258/jes.9.5.p.3788-3799

Sahputra, R., Haryanto, & Setiadi, D. (2025). Artificial Intelligence for Personalized Learning and Adaptive Assessment: Opportunities and Challenges in Indonesian Schools. *Journal of Educational Sciences*, *9*(5), 4461–4470. https://doi.org/10.31258/jes.9.5.p.4461-4470

Sari, A. W., & Arta, D. J. (2025). Implementation of Deep Learning: An Educational Innovation. *Journal of Educational Development Insights*, *13*(1), 2.

Septiani, R. P., Nugraha, S. I., & Ambarwati, E. K. (2025). Exploring AI-Driven Language Teaching for English as a Foreign Language Teachers in Vocational High School in Karawang. *Journal of Educational Sciences*, *9*(4), 2073–2084. https://doi.org/10.31258/jes.9.4.p.2073-2084

Syahrir, M., Sulistyowati, R., & Hidayat, T. (2025). Augmented Reality-Based Learning Modules to Improve Student Engagement and Interest in IPAS Learning at the Elementary Level. *Journal of Educational Sciences*, *9*(4), 2647–2658. https://doi.org/10.31258/jes.9.4.p.2647-2658

Tawe, A., Sulolipu, A. A., Amin, A. N., & Ampa, A. T. (2025). Inovasi Deep Learning Dalam Media Pembelajaran Digital Di Upt Spf Sd Inpres Kassi-Kassi Kota Makassar. *Jurnal Sulapa Eppa'*, *1*(2), 141-147.

Turnip, B. M., Simatupang, H., & Panjaitan, R. (2025). LMS-Assisted Project-Based Learning to Improve Students' Writing Skills and Learning Engagement. *Journal of Educational Sciences*, *9*(5), 3171–3184. https://doi.org/10.31258/jes.9.5.p.3171-3184

Wardhani, R., Kusumawati, N., & Prasetyo, Z. K. (2025). Integration of Artificial Intelligence in Science Learning to Improve Student Learning Outcomes and Digital Literacy Awareness. *Journal of Educational Sciences*, *9*(4), 1957–1970. https://doi.org/10.31258/jes.9.4.p.1957-1970

How to cite this article:

Luthfi, I. F., Mundir., & Indrianto, N. (2026). Effectiveness of Deep Learning in Digital-Based Learning Media: A Library Research Study in Indonesian Elementary Schools. *Journal of Educational Sciences*, *10(4)*, 156-167.