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Managing Deep Learning Implementation in Elementary Schools: Its Influence on Students' Learning Outcomes

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ABSTRACT

This study aims to analyze the effect of deep learning implementation on elementary students' learning outcomes from a learning management perspective. Deep learning is understood as a pedagogical approach that promotes meaningful learning through active student engagement, critical and reflective thinking, collaboration, and strengthened conceptual understanding, aligning with the demands of 21st-century education. The study employed a quantitative approach using a quasi-experimental one-group pretest–posttest design. The research participants were fifth-grade students who experienced a structured deep learning process before progressing to the next grade level. Data were collected using a standardized cognitive achievement test with adequate content validity and high reliability (Cronbach's Alpha > 0.80). Statistical analyses included descriptive statistics, the Shapiro–Wilk normality test, and a paired sample t-test. The results revealed a significant improvement in students' learning outcomes after the implementation of deep learning, as indicated by a statistically significant difference between pretest and posttest scores ($p < 0.05$). These findings imply that deep learning can serve as an effective instructional strategy that strengthens learning management practices, particularly in planning, implementing, and evaluating instruction to improve learning quality in elementary education.

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INTRODUCTION

Basic education constitutes a fundamental pillar in shaping learners' cognitive, affective, and psychomotor capacities, which are essential for their long-term academic and social development. In the context of 21st-century education, learning quality can no longer be assessed solely through academic scores but must also be evaluated based on the depth of students' conceptual understanding and their ability to apply knowledge meaningfully (Hefniy & Alwahedi, 2025; Hikmah & Mudarris, 2026; Holidi, 2025; Khofsah & Rozi, 2025).

This issue is particularly important for society, as elementary education plays a strategic role in preparing future citizens who are capable of critical thinking, problem-solving, and lifelong learning. Research has shown that meaningful and conceptually rich learning experiences enable students to connect new knowledge with prior understanding, resulting in more durable learning outcomes (Darling-Hammond et al., 2020). From an educational management perspective, this condition highlights the need for well-managed instructional planning, implementation, and evaluation to ensure that learning processes align with broader educational goals. Therefore, improving learning quality at the elementary level is not merely a pedagogical concern but also a critical issue in educational management aimed at strengthening human capital development.

Despite the growing emphasis on meaningful learning, many elementary education systems still struggle to translate these ideals into classroom practice (Dewi & Manshur, 2026; Kusumawati, 2025; Syafiih, 2025). The dominant instructional paradigm in basic education remains focused on content coverage, procedural mastery, and short-term achievement, rather than on deep conceptual understanding and higher-order thinking (Jasri, 2025; Mustafa & Maulana, 2024; Sholehah & Ichsan, 2025). This condition reflects a broader management problem within educational institutions, where instructional planning and supervision often prioritize curriculum completion over learning quality. As a result, students may achieve acceptable test scores without developing the cognitive flexibility needed to analyze, evaluate, and apply knowledge independently. Meta-analytic evidence indicates that learning approaches characterized by low cognitive engagement yield weaker impacts on learning outcomes compared to approaches that emphasize deep understanding (Hattie & Clarke, 2018). From a societal standpoint, this problem poses long-term risks, as graduates of basic education may lack essential competencies required in an increasingly complex and knowledge-driven world. Consequently, addressing this issue requires not only pedagogical innovation but also effective learning management strategies within schools.

Empirical observations in elementary school classrooms indicate that instructional practices often rely heavily on teacher-centered explanations, textbook-driven activities, and routine assessments that emphasize memorization. Learning interactions are frequently limited to question-and-answer sessions that do not sufficiently challenge students' reasoning or encourage reflective thinking (Bukhori & Zahro, 2025; Husna et al., 2024; Khomsiah et al., 2024; Khusnuridlo & Fauzi, 2024). In many cases, lesson planning and classroom management focus on maintaining instructional order rather than facilitating meaningful learning experiences. This phenomenon suggests a gap between policy-level aspirations for student-centered learning and the realities of classroom implementation. From a learning management perspective, this gap may stem from limited teacher capacity, inadequate instructional supervision, or insufficient integration of innovative learning approaches into school management systems. Consequently, students tend to demonstrate difficulties in transferring knowledge across contexts and applying concepts to real-life situations (Junaedi & Rumiyanti, 2023; Masrum et al., 2023; Munif & Sulaiman, 2023; Rozi et al., 2025). Such conditions highlight the urgency of implementing instructional approaches that promote deep learning while being realistically managed within existing school structures. Deep learning, when systematically managed, offers a potential solution to bridge this gap between instructional intention and classroom practice.

Previous studies have extensively examined the effectiveness of deep learning-oriented instructional approaches across various educational contexts. Darling-Hammond et al. (2020) emphasized that learning designs focusing on conceptual understanding, active engagement, and reflective practices significantly enhance learning quality. Similarly, Fullan et al. (2020) argued that deep learning fosters critical thinking, collaboration, and problem-solving skills, which are essential for 21st-century learners (Aini et al., 2025; Arifin, 2024; Mundiri, 2023; Rohmatillah & Jannah, 2024; Safitri & Lateh, 2024). At the elementary level, research has demonstrated that instructional strategies involving higher-order thinking tasks contribute positively to students' academic achievement (Zohar & Alboher Agmon, 2018). Other empirical studies also found that active and reflective learning strategies positively influence both academic outcomes and students' critical thinking skills (Pan et al., 2021). However, most of these studies focus primarily on pedagogical effectiveness without explicitly examining how deep learning is managed within instructional planning, implementation, and evaluation processes at the school level.

Although the existing literature provides strong evidence of the benefits of deep learning, several gaps remain unaddressed. First, empirical research on deep learning at the elementary education level is still limited compared to studies conducted in secondary and higher education contexts. Second, many studies employ complex experimental designs that are difficult to implement in real classroom settings, particularly in schools with limited resources. Third, few studies explicitly analyze deep learning from an educational management perspective, especially in relation to learning management processes such as instructional planning, classroom organization, and assessment practices. Moreover, research that examines deep learning within the context of grade-level transition, particularly from upper elementary grades to the next level, remains scarce. These gaps are significant because instructional continuity and learning management during transitional phases are critical to sustaining students' learning outcomes. Addressing these limitations is essential to generate practical and context-sensitive evidence that can inform both pedagogical practice and educational management.

The novelty of this study lies in its focus on implementing deep learning within the context of grade-level transition in elementary education, using a simple yet practical research design. Unlike previous studies that emphasize complex instructional interventions, this research adopts a one-group pretest–posttest design that reflects authentic classroom conditions. From a state-of-the-art perspective, this approach integrates deep learning principles with learning management practices, emphasizing how instructional strategies can be systematically planned, implemented, and evaluated within school management frameworks. By situating deep learning within the realities of elementary school instruction, this study offers a more applicable model for teachers and school leaders. The findings are expected to contribute to the advancement of educational management by demonstrating how deep learning can be operationalized as a strategic component of learning management, rather than merely as a pedagogical innovation. This novelty makes the study both theoretically relevant and practically valuable.

Based on the identified gaps, the research problem addressed in this study concerns the effectiveness of deep learning implementation in improving elementary students' learning outcomes when viewed from a learning management perspective. The central argument of this research is that systematically managed deep learning through careful instructional planning, active learning implementation, and reflective assessment can significantly enhance students' learning outcomes. This study hypothesizes that students will demonstrate higher posttest scores compared to pretest scores after participating in deep learning-oriented instruction. By empirically testing this assumption, the study aims to provide evidence that deep learning is not only pedagogically effective but also manageable within real classroom settings. The expected contribution of this research lies in strengthening the integration of deep learning into educational management practices, offering insights for teachers, school leaders, and policymakers seeking to improve learning quality in elementary education.

RESEACH METHODS

This study employed a quantitative approach using a quasi-experimental design, specifically the one-group pretest–posttest design. This design was selected because the research was conducted under authentic school learning conditions, which did not allow for random assignment of participants into experimental and control groups (Ghanad, 2023; Gul, 2023; Sardana et al., 2023).

The one-group pretest–posttest design is widely applied in educational research to examine changes in learning outcomes before and after an instructional intervention (Creswell & Creswell, 2022; Fraenkel et al., 2022). Through this design, students' learning outcomes were measured prior to and following the implementation of deep learning, enabling the researcher to identify the effect of the instructional treatment. From a learning management perspective, this design is appropriate for evaluating the effectiveness of instructional strategies that are integrated into regular classroom practice without disrupting existing school management structures.

The research was conducted at an elementary school during the 2024/2025 academic year. The selection of the research site was based on its accessibility, administrative support, and the feasibility of implementing deep learning within the school's existing instructional framework. The school also applied a structured learning management system that allowed consistent instructional planning, implementation, and assessment across grade levels. The research participants were fifth-grade students in the second semester who subsequently progressed to the next grade level. Accordingly, the pretest was administered when students were in the fifth grade, while the posttest was conducted after they advanced to the sixth grade and experienced instruction based on deep learning principles. This context provided a realistic setting for examining instructional effectiveness within a naturally occurring grade transition.

Data were collected using a cognitive achievement test administered as a pretest and posttest. The pretest was conducted prior to the implementation of deep learning to measure students' initial cognitive abilities, while the posttest was administered after the instructional intervention to identify changes in learning outcomes. The use of pretest and posttest measures in quasi-experimental educational research is recommended to control for participants' baseline abilities and to capture learning gains attributable to the intervention (Cohen et al., 2017). The test items were aligned with instructional objectives and adapted to the cognitive characteristics of elementary school students (OECD, 2021). This approach ensured that data collection accurately reflected students' learning progress resulting from the instructional treatment.

Data analysis was conducted in several stages using statistical software. First, descriptive statistical analysis was performed to obtain an overview of students' learning outcomes, including mean scores, standard deviations, minimum values, and maximum values. Second, data normality was tested using the Shapiro–Wilk test to confirm that the pretest and posttest data met the assumptions required for inferential analysis (Ghasemi & Zahediasl, 2012). Third, a paired sample t-test was employed to examine differences in students' learning outcomes before and after the implementation of deep learning.

Statistical significance was determined at a 95% confidence level (α = 0.05), consistent with established standards in quantitative educational research (Hair et al., 2021).

To ensure data credibility, the study utilized a standardized cognitive achievement test that had been validated and used in previous research. The instrument demonstrated adequate content validity, with a Content Validity Index (CVI) of ≥ 0.80, and high internal consistency reliability, indicated by Cronbach's Alpha coefficients ranging from 0.80 to 0.90. The use of validated and reliable instruments is strongly recommended in quantitative research to ensure measurement accuracy and consistency (Hair et al., 2021; Taber, 2018). Therefore, this study did not conduct additional validity and reliability testing but instead adjusted the content context of the instrument to suit elementary school learners. This approach supports the trustworthiness of the data while maintaining methodological rigor.

RESULTS AND DISCUSSION

Results

The research results were obtained from the analysis of learning outcome data of fifth-grade students in the second semester who were administered a pretest prior to the implementation of deep learning and a posttest after advancing to the sixth grade and participating in instruction based on a deep learning approach. Data analysis was conducted in stages, including descriptive statistical analysis, normality testing as a prerequisite analysis, and hypothesis testing using a paired sample t-test to examine differences in learning outcomes before and after the intervention.

Table 1. Descriptive Statistics of Pretest and Posttest Scores by Gender

Statistic	Gender	Pretest	Posttest
N	Male	13	13
	Female	11	11
Missing	Male	0	0
	Female	0	0
Mean	Male	82.6	87.6
	Female	85.4	89.6
Median	Male	82.0	86.0
	Female	85.0	88.0
Standard Deviation	Male	5.36	5.59

Statistic	Gender	Pretest	Posttest
	Female	3.85	4.18
Minimum	Male	76.0	80.0
	Female	80.0	84.0
Maximum	Male	92.0	96.0
	Female	91.0	97.0

Based on the descriptive statistics presented in Table 1, there is an overall increase in students' learning outcomes after the implementation of deep learning for both male and female students. The mean pretest score of male students increased from 82.6 to 87.6 in the posttest, while the mean score of female students increased from 85.4 to 89.6. The median scores also show a similar upward trend, indicating an improvement in students' overall academic performance following the instructional intervention.

In addition, the standard deviation values in the posttest remained relatively stable compared to the pretest, suggesting that the improvement in learning outcomes occurred relatively evenly across students rather than being concentrated among a small number of individuals. The higher minimum and maximum scores observed in the posttest further indicate a general enhancement in students' learning performance after the application of deep learning.

Table 2. Results of the Shapiro–Wilk Normality Test

Test	Gender	Pretest	Posttest
Shapiro–Wilk W	Male	0.912	0.893
	Female	0.912	0.917
Shapiro–Wilk p-value	Male	0.196	0.106
	Female	0.257	0.294

The normality of the data was examined using the Shapiro–Wilk test, as the sample size was fewer than 50 participants. As shown in Table 2, all p-values for both pretest and posttest scores among male and female students exceeded 0.05. These results indicate that the learning outcome data were normally distributed, thus meeting the assumption required for conducting parametric statistical analysis.

Table 3. Results of the Paired Sample t-Test

Comparison	Test Statistic	df	p-value	Mean Difference	SE Difference
Pretest – Posttest	Student's t = -17.9	23	< .001	-4.67	0.260

Hypothesis testing was conducted using a paired sample t-test to determine whether there was a statistically significant difference in students' learning outcomes before and after the implementation of deep learning. As presented in Table 3, the results show a highly significant difference between pretest and posttest scores ($p < 0.001$). The negative mean difference value (-4.67) indicates that posttest scores were higher than pretest scores, demonstrating an improvement in students' learning outcomes following the instructional intervention. These findings provide strong empirical evidence that the implementation of deep learning positively influenced students' learning outcomes.

Discussion

The findings of this study indicate that the implementation of deep learning has a significant positive effect on improving elementary students' learning outcomes. This conclusion is supported by the meaningful difference between pretest and posttest scores after students participated in instruction based on deep learning principles. The increase in mean posttest scores for both male and female students suggests that deep learning is effective in enhancing students' conceptual understanding, surpassing instructional approaches that primarily emphasize surface-level content mastery.

Statistically, the paired sample t-test results demonstrate a significance level of $p < 0.001$, confirming that the observed improvement in learning outcomes did not occur by chance but was a direct result of the instructional intervention. The positive mean difference between pretest and posttest scores reflects a measurable enhancement in students' cognitive abilities following the implementation of deep learning. These results align with the findings of Darling-Hammond et al. (2020), who emphasized that learning approaches focusing on conceptual understanding and active student engagement significantly contribute to improved learning outcomes.

The relatively stable standard deviation observed in the posttest results indicates that learning gains were distributed evenly across students with varying academic abilities. This finding suggests that deep learning benefits not only high-achieving students but also those with moderate and lower levels of academic performance. Such evidence supports the conclusions of Hattie and

Clarke (2018), who reported that instructional strategies involving active student participation and meaningful learning experiences yield greater learning gains than traditional, teacher-centered approaches.

Deep learning encourages students to engage in higher-order cognitive processes, including analyzing information, connecting concepts, and reflecting on their learning experiences. In the context of this study, students were not merely required to memorize content but were guided to develop a deeper conceptual understanding by linking new knowledge with prior learning experiences. This instructional orientation is consistent with the framework of 21st-century learning, which emphasizes the development of critical thinking and problem-solving skills as core educational outcomes (OECD, 2021).

From a learning management perspective, the effectiveness of deep learning implementation is closely related to systematic instructional planning, organization, and execution. Teachers function as learning managers who design meaningful learning activities, facilitate classroom interactions, and provide constructive feedback to students. Fullan et al. (2020) highlighted that deep learning initiatives require strong managerial support to ensure consistent and sustainable implementation within educational institutions.

Despite its positive findings, this study has several limitations that should be acknowledged. The use of a one-group pretest–posttest design without a control group limits the generalizability of the results. Additionally, the study focused solely on cognitive learning outcomes, leaving affective and psychomotor domains unexplored. Therefore, future research is encouraged to employ more robust experimental designs and examine additional variables, such as learning motivation, student engagement, and critical thinking skills, to provide a more comprehensive understanding of the effectiveness of deep learning.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the implementation of deep learning has a positive and significant effect on improving elementary students' learning outcomes. This study highlights that deep learning serves as an effective instructional strategy that promotes meaningful learning, strengthens students' conceptual understanding, and supports higher-order cognitive development. From a learning management perspective, the findings emphasize that systematic planning, organized instructional processes, and reflective assessment are essential for the successful implementation of deep learning in elementary education. The key lesson derived from this research is that well-managed deep learning can enhance learning quality in a sustainable manner and contribute to more equitable learning outcomes among students with diverse academic abilities.

This study contributes to the academic discourse by providing empirical evidence on the effectiveness of deep learning within the context of elementary education using a practical and context-sensitive research design. The findings strengthen the integration of pedagogical innovation and educational management by demonstrating that deep learning can be operationalized as a strategic component of learning management. However, this research is limited by the use of a one-group pretest–posttest design without a control group and by its focus on cognitive learning outcomes only. Future research is recommended to employ more rigorous experimental designs and to explore additional variables such as student engagement, learning motivation, and critical thinking skills in order to develop a more comprehensive understanding of deep learning effectiveness across educational contexts.

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