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The Effect of Deep Learning Instruction on the Motivation and Learning Outcomes of Grade 11 Students at SMA IT Nur Hidayah

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Abstract: This study aimed to investigate the effects of a deep learning–oriented instructional approach on the learning motivation and academic achievement of Grade 11 high school students. A quantitative quasi-experimental method was employed using a pretest–posttest control group design. The participants comprised 49 Grade 11 students, including 27 students in the experimental group and 22 students in the control group. Both groups received instruction on the human excretory system; however, the experimental group was taught using a deep learning approach, whereas the control group received instruction using a non-deep-learning approach. Data were collected using a learning motivation questionnaire, a 10-item pretest, and a 20-item posttest. The data were analyzed using the nonparametric Mann–Whitney U test and Wilcoxon signed-rank test. The findings demonstrated that the deep learning approach significantly improved the cognitive learning outcomes of Grade 11 students at SMA IT Nur Hidayah (Mann–Whitney U test, $p = 0.045$), with the Wilcoxon signed-rank test indicating a more consistent pattern of improvement. In contrast, no substantive difference was observed in learning motivation, with an increase of only 0.11%, which may be attributed to a ceiling effect resulting from the students' initially high motivation levels. Empirically, this instructional approach was particularly effective in restructuring students' cognitive understanding of complex subject matter, although it did not produce a substantial affective impact.
Keywords: Deep learning; learning motivation; learning outcomes; excretory system; biology education

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INTRODUCTION

Biology learning is often perceived as an activity that primarily involves memorizing factual information (Fitri et al., 2025). However, meaningful biology instruction requires students to participate actively in investigating, interpreting, and explaining natural phenomena. Such engagement is consistent with the nature of biology as a scientific discipline that examines living systems and addresses biological problems through systematic inquiry (Harita, 2024). As a branch of science, biology encompasses scientific concepts, principles, and processes that require students to apply critical thinking and problem-solving skills (Hulu et al., 2024). At the senior high school level, particularly within the Phase F curriculum framework, biology instruction therefore requires a shift from rote memorization toward comprehensive conceptual understanding (Hamidah et al., 2025).

Despite this expectation, evidence from the literature indicates that conventional teacher-centered instruction remains common across different levels of education. These instructional practices often position students as passive recipients of information and encourage them to adopt surface-learning strategies rather than construct a meaningful understanding of biological concepts (Fatihah & Wiji, 2026; Mustika et al., 2025; Renoat et al., 2025; Ulzana et al., 2025). Surface learning is generally characterized by memorization, repetition, and limited engagement with the underlying meaning of the learning material. Consequently, students who rely on this approach may experience difficulty applying their knowledge to unfamiliar situations and completing tasks that require higher-order thinking skills (HOTS), particularly analysis, evaluation, and creation at cognitive levels C4–C6. In contrast, a pedagogical deep-learning approach emphasizes conceptual understanding, higher-order thinking, and meaningful classroom interaction (Komara et al., 2026). Its implementation may therefore support the scientific nature of biology learning while simultaneously improving students' motivation and cognitive learning outcomes.

Preliminary observations conducted in the target classroom identified two interrelated problems: low intrinsic learning motivation and limited achievement of higher-order cognitive outcomes among Grade XI students. Students tended to participate passively and encountered difficulties when responding to problem-solving and HOTS-oriented questions. These conditions suggest that students had not yet developed sufficient conceptual understanding or the ability to transfer their knowledge to analytically demanding learning tasks. Similar problems have been reported in previous studies. Faiziyah & Priyambodho (2022), for example, found that Grade XI students at SMK Negeri 2 Sragen had not achieved satisfactory performance in answering HOTS questions. Adi et al. (2025) likewise reported that students' difficulties in completing HOTS assessments were associated with several factors, including inadequate conceptual knowledge. Insufficient conceptual understanding may lead to frustration, which can subsequently weaken students' motivation and persistence during learning. This explanation is consistent with the findings of Hidayati et al. (2022), who identified monotonous and insufficiently varied instructional methods as factors contributing to boredom and declining student motivation.

Previous research in science education has largely focused on diagnosing surface-learning behavior and students' difficulties in completing HOTS tasks. These studies indicate that students frequently rely on memorization without developing an adequate understanding of the concepts being studied (Stivani et al., 2025). However, identifying the causes of surface learning does not, by itself, provide sufficient evidence regarding which instructional approach can simultaneously improve conceptual understanding, higher-order cognitive performance, and learning motivation. Some interventions, including direct instruction, may help teachers deliver content systematically, but they often provide limited opportunities for active student engagement and the development of critical-thinking skills (Asyva et al., 2025). Thus, an important pedagogical gap remains concerning the need for an instructional approach that actively engages students, promotes meaningful knowledge construction, and addresses cognitive and motivational outcomes simultaneously.

To address this gap, the present study applies deep learning as a pedagogical approach rather than as a concept associated with artificial intelligence. In educational contexts, deep learning refers to an approach that encourages students to develop a comprehensive understanding of learning material, connect new knowledge with prior experience, and apply their understanding in authentic situations. Accordingly, students are expected not merely to memorize information but also to interpret, evaluate, and use it in real-world contexts (Fitriani & Santiani, 2025). The approach is interactive and student-centered and integrates three interrelated components: meaningful learning, mindful learning, and joyful learning (Andayanie et al., 2025). Meaningful learning helps students connect new concepts with existing knowledge and relevant experiences; mindful learning promotes awareness, reflection, and active cognitive engagement; and joyful learning fosters a positive learning environment that may strengthen interest and participation.

Compared with surface learning, which is associated with limited task engagement, memorization, and the reproduction of isolated information, deep learning involves sustained efforts to understand topics that students consider meaningful or relevant to their educational goals (Aguiar-Castillo et al., 2021). This approach is therefore expected to address conceptual difficulties while also strengthening students' emotional and intellectual engagement in learning. Nevertheless, empirical evidence regarding the simultaneous effects of pedagogical deep learning on learning motivation and higher-order cognitive outcomes in senior high school biology remains limited, particularly within the context of Indonesian secondary education. This limitation establishes the specific research gap addressed in the present study.

Based on this rationale, this study aims to examine the effect of a pedagogical deep-learning approach on the learning motivation and cognitive learning outcomes of Grade XI students at SMA IT Nur Hidayah during the 2025/2026 academic year. The study focuses on learning outcomes that require higher-order cognitive processes, particularly analysis, evaluation, and creation within the C4–C6 range. It was hypothesized that students would demonstrate significantly higher learning motivation and cognitive learning outcomes after participating in biology instruction based on the deep-learning approach.

This study is expected to contribute empirical evidence to the field of biology education regarding the effectiveness of integrating meaningful, mindful, and joyful learning at the senior high school level. In practical terms, the findings may provide biology teachers with an alternative instructional framework for reducing students' dependence on surface learning and promoting more active, conceptually oriented, and motivating learning experiences.

METHOD

This study employed a quantitative approach to collect data and examine the causal relationship between the independent variable, namely deep learning–based instruction, and the dependent variables, namely students' learning motivation and academic achievement. A quasi-experimental design was adopted, specifically a non-equivalent control group design involving one experimental class and one control class. Both groups completed a pretest and a posttest. The test items were developed based on Bloom's revised taxonomy and targeted higher-order cognitive skills at levels C4, C5, and C6. The pretest consisted of 10 items, whereas the posttest consisted of 20 items.

Table 1. Non-equivalent control group design

Group	Pretest	Treatment	Posttest
Experimental class (E)	O_1	X	O_2
Control class (C)	O_3	—	O_4

The study was conducted at SMA IT Nur Hidayah, located at Jl. Pandawa No. 13, Pucangan, Kartasura, Sukoharjo Regency, Central Java, during the second semester of the 2025/2026 academic year. To evaluate the effectiveness of the intervention, two Grade XI classes were selected through purposive sampling. This method was used to obtain experimental and control groups that appropriately represented the characteristics of the available classes. Class XI-7 was assigned as the experimental group and received deep learning–based instruction. Class XI-6 served as the control group and participated in instruction without the deep learning approach.

The research procedure consisted of four operational stages: preparation, implementation, data collection, and data analysis. During the preparation stage, the researchers coordinated with school administrative staff and the biology teacher to determine the research schedule. Teaching materials, lesson plans, and data collection instruments were also prepared at this stage. During the implementation stage, both groups received instruction on the human excretory system. The experimental group participated in student-centered, deep learning–based instruction using discovery learning and problem-based learning models. In contrast, the control group received teacher-centered instruction using the direct instruction model.

Data were collected in several stages using an academic achievement test and a learning motivation questionnaire. At the beginning of the study, a Likert-scale questionnaire was administered to measure students' learning motivation. The scale ranged from 1, representing "Strongly Disagree," to 4, representing "Strongly Agree," allowing students' attitudinal tendencies to be measured more specifically. Subsequently, a pretest was administered to assess students' initial cognitive abilities before the intervention. After the instructional activities had been completed, a posttest was administered to evaluate students' cognitive learning outcomes following the intervention.

The learning motivation questionnaire was developed based on six main indicators adapted from Listiani (2014): (1) the desire and determination to succeed, (2) intrinsic encouragement and the need to learn, (3) future expectations and aspirations, (4) expectations of recognition or rewards in learning, (5) interest in learning activities, and (6) support from a conducive learning environment. Before classroom implementation, both the achievement test and the questionnaire underwent expert validation involving two biology education lecturers. This process was conducted to ensure the content validity and feasibility of the instruments. Based on the validation results, both instruments were considered suitable for use in the study.

Quantitative data analysis was conducted to interpret the learning motivation questionnaire scores and cognitive learning outcome data obtained from the pretest and posttest. The analysis aimed to evaluate the extent to which the research objectives were achieved. Before hypothesis testing, the data were subjected to prerequisite analyses, including tests of distribution normality and variance homogeneity, to determine their suitability for parametric statistical procedures. Because the data did not meet the assumption of normality, subsequent analyses were conducted using non-parametric statistical methods.

Hypothesis testing involved two statistical procedures. First, the Wilcoxon signed-rank test was used to examine significant differences in students' learning outcomes before and after the intervention within each group. Second, the Mann–Whitney U test was used to compare the effectiveness of the instructional approaches between the experimental and control groups based on their posttest scores and learning motivation questionnaire scores. The results were interpreted using an empirical probability criterion, with a significance level of $p < 0.05$ indicating a statistically significant difference or treatment effect on students' learning outcomes or learning motivation.

RESULTS AND DISCUSSION

The analysis included data from 49 students who completed all stages of the study. The participants consisted of 27 students in the experimental class (XI-7) and

22 students in the control class (XI-6). Students' learning motivation was measured using a questionnaire, whereas cognitive learning outcomes were assessed through a pretest and a posttest. All data were analyzed using IBM SPSS Statistics.

Table 2. Descriptive statistics of students' learning motivation

Class	N	Mean (%)	Standard Deviation
XI-6	22	81.19%	3.99
XI-7	27	81.37%	5.35

Table 2 shows that both classes had very high levels of learning motivation. The control class (XI-6) obtained a mean motivation score of 81.19% with a standard deviation of 3.99, whereas the experimental class (XI-7) obtained a mean score of 81.37% with a standard deviation of 5.35. The difference between the two mean scores was 0.18 percentage points, indicating that the experimental class had a slightly higher average motivation score. However, the experimental class also showed greater variation in motivation scores than the control class, as indicated by its higher standard deviation.

Table 3. Shapiro–Wilk normality test

Variable	Class	Sig.	Distribution
Learning motivation	XI-6	0.828	Normal
	XI-7	0.554	Normal
Pretest	XI-6	0.014	Non-normal
	XI-7	0.019	Non-normal
Posttest	XI-6	0.060	Normal
	XI-7	0.005	Non-normal

Table 3 presents the results of the Shapiro–Wilk normality test. The learning-motivation data were normally distributed in both the control class ($p = 0.828$) and the experimental class ($p = 0.554$). In contrast, the pretest scores were not normally distributed in either the control class ($p = 0.014$) or the experimental class ($p = 0.019$). For the posttest scores, the control-class data were normally distributed ($p = 0.060$), whereas the experimental-class data were not normally distributed ($p = 0.005$). Because several cognitive-achievement datasets did not meet the normality assumption, non-parametric statistical tests were used in the subsequent analyses. The Wilcoxon signed-rank test was used to examine changes between pretest and posttest scores within each class, while the Mann–Whitney U test was used to compare posttest scores between the two classes.

Table 4. Wilcoxon signed-rank test

Class	Positive Ranks	Negative Ranks	Ties	Z	Sig.
XI-6	17	4	1	−3.329	0.001
XI-7	24	1	2	−4.315	<0.001

Table 4 shows statistically significant differences between the pretest and posttest scores in both classes. The control class obtained a significance value of $p = 0.001$, whereas the experimental class obtained a significance value of $p < 0.001$. Both values were below the significance threshold of 0.05.

In the control class, 17 students obtained higher posttest scores than pretest scores, four students obtained lower scores, and one student obtained the same score. In the experimental class, 24 students obtained higher posttest scores, one student obtained a lower score, and two students obtained the same score. Thus, the experimental class had a larger number and proportion of students whose scores improved after instruction.

Table 5. Mann–Whitney U test

Variable	Class	Mean Rank	Sig.
Posttest	XI-6	20.50	0.045
	XI-7	28.67	

Table 5 shows a statistically significant difference in posttest scores between the control and experimental classes, with a significance value of $p = 0.045$. Because this value was below 0.05, the null hypothesis was rejected. The experimental class obtained a mean rank of 28.67, which was higher than the mean rank of 20.50 obtained by the control class. These results indicate that the posttest scores of students in the experimental class were generally higher than those of students in the control class.

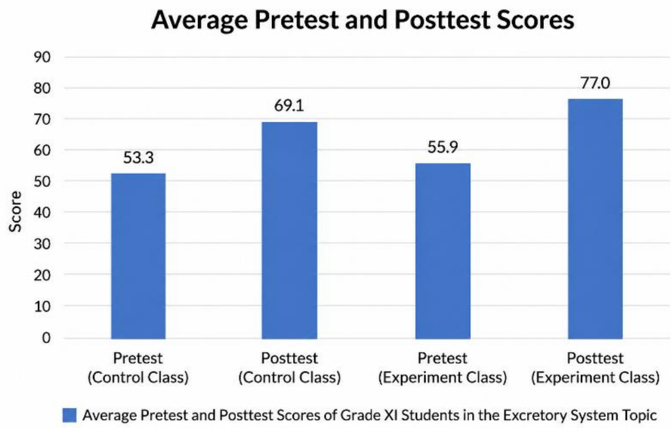

Figure 1. Students' learning outcomes in the excretory system topic

Figure 1 illustrates students' learning outcomes in the excretory system topic before and after instruction. The figure shows an increase in learning outcomes in both classes, with a more pronounced improvement in the experimental class. This pattern is consistent with the Wilcoxon signed-rank and Mann–Whitney U test results, which demonstrate significant within-class improvements and a significant difference in posttest outcomes between the two classes.

The findings indicate that both instructional approaches improved students' cognitive learning outcomes. However, the improvement was more consistent in the experimental class, where 24 of the 27 students obtained higher posttest scores, compared with 17 of the 22 students in the control class. The experimental class also achieved a higher posttest mean rank than the control class. These results suggest that the integration of Discovery Learning and Problem-Based Learning (PBL) within the pedagogical Deep Learning framework was associated with better understanding of the excretory system than conventional instruction. Nevertheless, this interpretation should consider the students' initial achievement and would be strengthened by an inferential comparison of pretest scores or an analysis that controls for baseline differences.

The higher posttest performance of the experimental class may be explained by the learning environment created through Discovery Learning. During this stage, students explored nephron structure, kidney function, urine formation, and disorders of the excretory system. Instead of receiving information solely through teacher explanation, students observed learning materials, identified relevant patterns, formulated explanations, and established relationships among biological concepts. These activities supported Meaningful Learning by allowing students to connect new information with their prior knowledge. Faiza et al. (2025) similarly reported that Discovery Learning can transform rigid biology instruction into a learning process that encourages critical and in-depth exploration.

This form of conceptual exploration is particularly relevant to the excretory system because the topic contains interconnected and relatively abstract biological processes. Understanding urine formation, for example, requires students to relate nephron structure to filtration, reabsorption, and secretion. Discovery-oriented activities can support this process by encouraging students to organize information, examine relationships among concepts, and construct explanations based on evidence rather than merely memorizing factual content.

The incorporation of PBL further supported the Mindful Learning dimension of the pedagogical Deep Learning framework. Students were presented with contextual cases involving kidney stones, glucosuria, and proteinuria and were required to identify the problems, select relevant information, analyze the underlying biological mechanisms, discuss possible explanations, and formulate solutions. These activities were designed to engage higher-order cognitive processes, particularly analysis and evaluation, while some tasks required students to develop possible solutions to the problems presented.

Problem-solving activities are relevant to biology learning because they allow students to apply conceptual knowledge to authentic situations. Nikolić & Antonijević (2024) found that the implementation of research- and problem-solving activities was associated with higher achievement in biology, particularly in knowledge acquisition, conceptual understanding, and knowledge application. They identified several important elements of biological problem-solving, including analyzing the problem, planning and identifying possible solutions, evaluating the selected solution, discussing the problem, and developing student independence. These elements were also reflected in the learning activities conducted in the experimental class.

The present findings are also consistent with Sidampoi et al. (2024), who reported that PBL on the human excretory system encouraged students to think critically when solving kidney-related problems and improved their conceptual understanding and posttest performance. In the present study, the use of cases involving excretory-system disorders required students not only to recall information but also to apply their knowledge of kidney structures and physiological processes. Such contextual application may have strengthened students' conceptual understanding and contributed to the higher posttest outcomes observed in the experimental class.

Although the control class also showed a significant improvement from pretest to posttest, its pattern of improvement was less consistent. Four students in the control class obtained lower posttest scores, whereas only one student in the experimental class showed a decrease. Direct Instruction can improve learning outcomes by providing structured, systematic, and explicit explanations. However, it generally emphasizes teacher-led information delivery and may provide fewer opportunities for students to investigate concepts, formulate questions, discuss contextual problems, and construct knowledge independently (Ninggrat & Suriani, 2023). Thus, although both instructional approaches improved learning outcomes, the integration of Discovery Learning and PBL offered more opportunities for active cognitive processing and knowledge application.

The motivation results showed that students in both classes had very high learning motivation. The experimental class obtained a mean motivation score of 81.37%, whereas the control class obtained a mean score of 81.19%. Because the difference was only 0.18 percentage points and no inferential analysis comparing motivation between the two groups was reported, this descriptive difference should not be interpreted as evidence that the intervention significantly increased motivation. Instead, the findings indicate that students' motivation remained very high during the implementation of the pedagogical Deep Learning framework.

Maintaining high motivation is important because motivation can influence students' willingness to participate, sustain effort, and persist when encountering difficult learning tasks. Liu et al. (2024) found that intrinsic motivation and emotional engagement were positively related to academic performance. Emotional engagement can also support learning by strengthening students' behavioral and cognitive participation. In the present study, the high motivation scores may have supported students' participation in the cognitively demanding activities implemented through Discovery Learning and PBL. However, because motivation was not analyzed inferentially, its contribution to the improvement in learning outcomes cannot be determined conclusively.

The similarly high motivation scores in both classes may indicate that students already possessed strong motivation during the study. The high mean scores may also have limited the observable difference between the groups. Nevertheless, confirming a ceiling effect would require further examination of the score distribution and the proportion of students who obtained scores near the maximum value. Therefore, the small difference in motivation between the experimental and control classes should be interpreted cautiously.

The maintenance of high motivation in the experimental class may also be related to the Joyful Learning dimension. Students participated in observation, discussion, investigation, presentation, and problem-solving activities. These varied activities may have reduced classroom monotony and created a more engaging learning environment. In this context, Joyful Learning should not be interpreted merely as entertainment but as a learning condition that promotes positive emotions, meaningful participation, collaboration, curiosity, and persistence in completing academic tasks.

Putra et al. (2026), through a systematic literature review, explained that Joyful Learning emphasizes positive emotions, intrinsic motivation, and meaningful engagement. Their review showed that enjoyable and supportive learning environments can encourage participation and motivation, although the direct effect of Joyful Learning on cognitive achievement still requires further empirical investigation. Accordingly, the high motivation score in the present study may indicate that the learning activities maintained students' positive affective engagement, but it should not be treated as independent evidence that Joyful Learning caused the increase in posttest scores.

This interpretation is consistent with Rahmawati et al. (2025), who emphasized the importance of Joyful Learning in sustaining students' engagement when they encounter complex learning material. An enjoyable and supportive classroom environment can encourage students to participate, express ideas, ask questions, and persist in solving difficult problems. Similarly, Washul and Kusumadani (2024) reported that active student participation in an enjoyable learning environment can support both the learning process and its outcomes.

Taken together, the findings indicate that the instructional approach produced complementary cognitive and affective learning experiences. Discovery Learning facilitated Meaningful Learning by helping students connect new information with prior knowledge and construct relationships among biological concepts. PBL supported Mindful Learning by requiring students to focus on contextual problems, analyze relevant evidence, evaluate possible explanations, and formulate solutions. Meanwhile, varied and participatory activities supported Joyful Learning by maintaining students' enthusiasm and involvement throughout the learning process.

The interaction among these dimensions provides a plausible explanation for the learning outcomes obtained by the experimental class. Meaningful Learning helped students move beyond memorizing the structures and functions of the excretory organs. Mindful Learning encouraged them to process information carefully and apply biological concepts when examining excretory-system disorders. Joyful Learning helped maintain affective engagement during activities that required sustained attention and cognitive effort. Thus, Meaningful, Mindful, and Joyful Learning functioned as interconnected dimensions rather than as separate instructional elements.

Despite these positive findings, several limitations should be considered. The relatively small sample was drawn from only one school, which limits the generalizability of the results. The analysis also did not report effect sizes or normalized gains; therefore, the magnitude of the difference between the instructional approaches cannot be determined solely from the significance values. In addition, motivation was analyzed descriptively without an inferential comparison between the groups. Future studies should include larger samples from multiple schools, compare baseline achievement statistically, employ validated measures of the three Deep Learning dimensions, and report both statistical significance and effect size.

Overall, the integration of Discovery Learning and PBL within the pedagogical Deep Learning framework was associated with significantly higher posttest performance in the experimental class while students' learning motivation remained very high. The findings suggest that Meaningful, Mindful, and Joyful Learning can provide an interconnected instructional framework for supporting conceptual understanding and sustained engagement in learning abstract biological material, particularly the structure and function of the kidneys, urine formation, and disorders of the excretory system.

CONCLUSION

Deep learning–based instruction had a positive and significant effect on the motivation and cognitive learning outcomes of Grade 11 students at SMA IT Nur Hidayah. The difference in the final learning motivation scores between the two classes was only 0.11%, indicating that the groups did not differ substantively in this respect. This finding suggests that the students' initial learning motivation was already relatively high and may have reached a ceiling effect.

Nevertheless, the Wilcoxon signed-rank test showed that improvements in learning outcomes were more consistent in the experimental class. Furthermore, the Mann–Whitney U test yielded a significance value of 0.045 ($p < 0.05$), confirming a statistically significant difference between the control and experimental classes. These findings indicate that, although deep learning–based instruction did not produce an affective improvement beyond that achieved through conventional instruction, its empirical advantage was evident in the restructuring of students' cognitive understanding. This improvement contributed to greater learning mastery, particularly for complex subject matter.

RECOMMENDATION

Future studies should replicate the implementation of deep learning–based instruction in other complex biology topics or academic subjects to examine the consistency of its effectiveness across different learning contexts. Additional variables relevant to twenty-first-century educational demands should also be investigated, including scientific literacy and metacognitive skills. Researchers may also explore the integration of deep learning–based instruction with augmented reality (AR) technology in laboratory learning environments.

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REFERENCES

Adi, D., Makki, M., & Novitasari, S. (2025). Analisis kesulitan siswa dalam menyelesaikan soal berbasis HOTS (*higher order thinking skill*) kelas IV sekolah dasar. *Jurnal Ilmiah Pendidikan Dasar, 10*(3), 1–8.

Aguiar-Castillo, L., Clavijo-Rodriguez, A., Hernandez-Lopez, L., De Saa-Perez, P., & Perez-Jimenez, R. (2021). Gamification and deep learning approaches in higher education. *Journal of Hospitality, Leisure, Sport & Tourism Education, 29*, 100290. https://doi.org/10.1016/j.jhlste.2020.100290

Andayanie, L. M., Adhantoro, M. S., Purnomo, E., & Kurniaji, G. T. (2025). Implementation of deep learning in education: Towards mindful, meaningful, and joyful learning experiences. *Journal of Deep Learning, 1*(1), 47–56.

Asyva, N. N., Hasanah, J., & Gusmaneli, G. (2025). Strategi pembelajaran langsung (*direct instruction*). *Jurnal Manajemen dan Pendidikan Agama Islam, 3*(3), 186–193.

Faiza, A., Saniyya, A. T., Nurjanah, A., Islam, U., & Rahmat, R. (2025). Model pembelajaran yang mendukung bioedutainment berbasis karakter (*discovery learning, problem-based learning*). *Jurnal Media Akademik, 3*(12), 1–13.

Faiziyah, N., & Priyambodho, B. L. (2022). Analisis kemampuan berpikir kritis dalam menyelesaikan soal HOTS ditinjau dari metakognisi siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 11*(4), 2823–2835.

Fatihah, W., & Wiji. (2026). Implementasi deep learning pada pembelajaran kimia: Tantangan, urgensi, dan transformasi pedagogik. *Jurnal Riset dan Pendidikan Kimia, 14*(1), 1–10.

Fitri, R., Mellisa, & Hidayati, N. (2025). Identifikasi kebutuhan media pembelajaran biologi yang efektif untuk siswa kelas VIII. *Jurnal Pendidikan Sains dan Teknologi Terapan, 2*(1), 20–25.

Fitriani, A., & Santiani. (2025). Analisis literatur: Pendekatan pembelajaran deep learning dalam pendidikan. *Jurnal Ilmiah Nusantara (JINU), 2*(3), 50–57. https://doi.org/10.61722/jinu.v2i3.4357

Hamidah, A., Natalia, D., Aswan, D. M., & Harlis. (2025). Identifikasi kesulitan guru IPA dalam penerapan pembelajaran mendalam. *Seminar Nasional LPPM Universitas Jambi, 1*(1), 259–264.

Harita, K. B. (2024). Analisis kesulitan belajar siswa dalam pembelajaran biologi pada kelas X SMA Negeri 1 Gomo. *TUNAS: Jurnal Pendidikan Biologi, 5*(2), 103–121. https://doi.org/10.57094/tunas.v5i2.2287

Hidayati, R., Triyanto, M., Sulastri, A., & Husni, M. (2022). Faktor penyebab menurunnya motivasi belajar siswa kelas IV SDN 1 Peresak. *Jurnal Educatio, 8*(3), 1153–1160. https://doi.org/10.31949/educatio.v8i3.3223

Hulu, T. D. N., Zega, N. A., Gulo, H., & Harefa, A. R. (2024). Analisis kemampuan berpikir kritis siswa dalam konteks pembelajaran biologi SMA Negeri 1 Lahewa Timur. *LEARNING: Jurnal Inovasi Penelitian Pendidikan dan Pembelajaran, 4*(3), 805–812.

Komara, R., Widyamahati, T., Sahara, & Novita, L. (2026). Pembelajaran mendalam (*deep learning*) dalam pendidikan dasar: A systematic literature review terhadap pemahaman konseptual, HOTS, dan kualitas pembelajaran. *Jurnal Ilmiah Ilmu Pendidikan, 9*(3), 3066–3071.

Listiani, N. M. (2014). Pengaruh kreativitas dan motivasi terhadap hasil belajar mata pelajaran produktif pemasaran pada siswa kelas XI SMK Negeri 2 Tuban. *Jurnal Ekonomi Pendidikan dan Kewirausahaan, 2*(2), 264–276.

Liu, Y., Ma, S., & Chen, Y. (2024). The impacts of learning motivation, emotional engagement, and psychological capital on academic performance in a blended learning university course. *Frontiers in Psychology, 15*, 1357936. https://doi.org/10.3389/fpsyg.2024.1357936

Mustika, R. I., Nurhayati, E., Isnaini, H., Yudamahardika, R., Sahmini, M., & Dewi, Y. R. S. (2025). Peningkatan kualitas pembelajaran sastra di sekolah menengah pertama melalui pendekatan deep learning (mindful–meaningful–joyful): Pengabdian pada masyarakat di MGMP Bahasa Indonesia Kabupaten Purwakarta. *Abdimas Siliwangi, 8*(2), 540–564. https://doi.org/10.22460/as.v8i2.27289

Nikolić, N., & Antonijević, R. (2024). Problem-solving in biology teaching: Students' activities and their achievement. *International Journal of Science and Mathematics Education, 22*, 765–785. https://doi.org/10.1007/s10763-023-10407-5

Ninggrat, A. A., & Suriani, A. (2023). Pemanfaatan model pembelajaran direct instruction berbasis metode ceramah dan tanya jawab di kelas V SDN 06 Padang Besi. *Jurnal Pendidikan Sekolah, 3*(1), 5–10.

Putra, Z. H., Alim, J. A., Kurnia, R., Gunawan, Y., Dahnilsyah, D., & Aljarrah, A. (2026). A systematic literature review of joyful learning in mathematics: An implication for teaching and learning in elementary school. *Frontiers in Education, 11*, 1561649. https://doi.org/10.3389/feduc.2026.1561649

Rahmawati, L., Nisfah, N. L., Anisa, H. B., & Setyawan, A. (2025). Strategi penerapan prinsip deep learning (meaningful, mindful, joyful) untuk mewujudkan pembelajaran bermakna dalam konteks Kurikulum Merdeka di sekolah dasar. *Jurnal Ilmu Sosial, Ekonomi dan Pendidikan, 1*(2), 45–54.

Renoat, I. Y., Novianto, V., & Salamah. (2025). Joyful, experiential, dan social-emotional learning: Integrasi strategi deep learning dalam praktik Merdeka Belajar di Maluku Tenggara. *Jurnal Kependidikan dan Ilmu Sosial, 20*(2), 35–43.

Sidampoi, T., Suriani, N. W., Harahap, F., & Rogahang, M. (2024). Pengaruh model pembelajaran problem-based learning terhadap kemampuan berpikir kritis siswa pada materi sistem ekskresi manusia di SMP Negeri 6 Tondano. *Journal Social, Science and Education, 7*(2), 450–459.

Stivani, E., Djulia, E., & Hasairin, A. (2025). Analisis kemampuan berpikir tingkat tinggi siswa pada materi keanekaragaman hayati di kelas X. *Bioscientist: Jurnal Ilmiah Biologi, 13*(2), 1085–1092.

Ulzana, Y., Apriyanto, S. C., & Inganah, S. (2025). Penerapan pendekatan deep learning untuk meningkatkan pemahaman materi operasi penjumlahan dan pengurangan kelas II SD. *Jurnal Ilmiah Pendidikan Dasar, 10*(4), 414–423.

Washul, S. R., & Kusumadani, A. I. (2024). Pengaruh strategi pembelajaran giving question and getting answer terhadap hasil belajar IPA pada siswa kelas VIII MTs. *Jurnal Inovasi Pendidikan Sains (JIPS), 5*(2), 63–72.