Journal of Islamic Education, Curriculum and Character Development
Vol. 1, No. 01, September 2026: pp. 62-74
DOI: https://doi.org/10.71238/jieccd.v1i01.227

The Effect of Implementing Deep Learning and Teachers' Pedagogical Readiness on Meaningful Learning in Islamic Religious Education at Madrasahs in West Java

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Info Artikel
Article history:
Received: September, 2026
Revised: September, 2026
Accepted: September, 2026

Keywords:
Deep Learning Implementation; Islamic Religious Education; Madrasahs; Meaningful Learning; Teachers' Pedagogical Readiness

ABSTRACT
This study examines the relationship between deep learning implementation, teachers' pedagogical readiness, and meaningful learning in Islamic Religious Education (IRE) at madrasahs in West Java, Indonesia. A quantitative method using a cross-sectional explanatory survey design was employed. A total of 150 madrasah teachers, selected through purposive sampling, participated in the study. Data were collected using a structured questionnaire with a five-point Likert scale, and multiple linear regression analysis was conducted using SPSS version 25. The results of the study indicate that the implementation of deep learning has a positive and significant relationship with meaningful learning ($\beta = 0.536$; $t = 8.607$; $p = 0.001$), and teachers' pedagogical readiness also has a positive and significant relationship ($\beta = 0.308$; $t = 4.948$; $p = 0.001$). Together, these two variables significantly explain the variation in meaningful learning ($F = 71.610$; $p = 0.001$), with an R^2 of 0.493. Compared to teachers' pedagogical readiness, the implementation of deep learning showed a stronger standardized relationship. These findings underscore the importance of integrating contextual, reflective, and student-centered teaching methods with the necessary pedagogical competencies. This study enhances our understanding of meaningful learning in Islamic education and provides practical implications for strengthening teacher professional development, teaching strategies, and authentic assessment in madrasahs.

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INTRODUCTION

Education is vital for developing human potential, reinforcing moral principles, and preparing people to face the challenges of our time. It is increasingly likely that educational institutions will shift from conventional, teacher-centered teaching approaches to student-centered ones. This approach emphasizes meaningful learning experiences, critical thinking, and students'

conceptual understanding. The spread of Deep Learning in Indonesia reflects this transformation. This method combines conscious, meaningful, and enjoyable learning to develop students' abilities holistically (Ministry of Primary and Secondary Education, 2025). Within Islamic Religious Education (IRE), deep learning is particularly relevant because educational objectives extend beyond memorizing religious concepts to developing spiritual awareness, ethical reasoning, and practical applications of Islamic values. Syafi'i and Darnanengsih (2025) emphasize that integrating cognitive, emotional, and social dimensions through contextual activities and reflection can strengthen students' religious understanding. Therefore, implementing deep learning in madrasahs provides opportunities to connect Islamic teachings with students' experiences and everyday practices.

Meaningful learning represents an important educational outcome because it reflects students' ability to understand, integrate, and apply knowledge in relevant situations. In Islamic Religious Education, meaningful learning involves conceptual understanding, ethical reflection, and the application of religious principles beyond classroom activities. The Ministry of Primary and Secondary Education (2025) emphasizes that meaningful learning develops through understanding, application, and reflection rather than memorization alone. However, effective implementation requires teachers to possess appropriate pedagogical competencies, including instructional planning, classroom facilitation, contextual teaching strategies, and authentic assessment. Teachers' pedagogical readiness therefore becomes an essential factor in supporting meaningful learning. Waloyo et al. (2026) identify cognitive readiness, practical instructional skills, and institutional support as important dimensions of teacher preparedness, while highlighting challenges related to reflective learning, professional development, and assessment practices. These findings suggest that meaningful learning is influenced by both instructional implementation and teachers' professional readiness.

The relationship between deep learning implementation and teachers' pedagogical readiness is particularly relevant in madrasahs in West Java, Indonesia, where differences in institutional resources, student characteristics, and professional development opportunities may influence instructional quality. Madrasahs must integrate contemporary pedagogical approaches while maintaining Islamic educational values and objectives. Previous studies have examined these challenges from different perspectives. Syafi'i and Darnanengsih (2025) explored the conceptual integration of mindful, meaningful, and joyful learning in Islamic Religious Education. Waloyo et al. (2026) investigated teacher readiness through a systematic narrative review, emphasizing pedagogical competencies and institutional support. Meanwhile, Afriani and Wiza (2026) examined adaptive pedagogical practices and teacher readiness within the Merdeka Curriculum. Although these studies provide valuable insights into deep learning implementation, their conceptual, literature-based, and qualitative approaches offer limited statistical evidence regarding meaningful learning outcomes in madrasahs.

Understanding the independent and simultaneous relationships among the implementation of deep learning, teachers' pedagogical readiness, and meaningful learning still requires a great deal of research. Existing studies primarily emphasize conceptual frameworks, implementation challenges, and teacher preparedness without quantitatively examining these variables within an integrated model (Syafi'i & Darnanengsih, 2025; Waloyo et al., 2026; Afriani & Wiza, 2026). Furthermore, meaningful learning is frequently considered a principle of deep learning rather than a distinct educational outcome, creating potential conceptual overlap. This study addresses these limitations by distinguishing deep learning implementation as an instructional process, teachers' pedagogical readiness as professional capacity, and meaningful learning as an educational outcome.

Its novelty lies in simultaneously examining these variables through a quantitative framework within the context of Islamic Religious Education at madrasahs in West Java.

Consequently, this study aims to examine how the implementation of individualized and simultaneous deep learning, as well as teachers' pedagogical readiness, influences meaningful learning in Islamic religious education at madrasahs in West Java. This study employs a quantitative explanatory survey method. The survey uses a five-point Likert scale questionnaire and involves 150 madrasah teachers. Multiple linear regression analysis was conducted using SPSS 25. Theoretically, this study helps us understand how teacher readiness, significant learning outcomes, and teaching innovations are interrelated. This study is expected to assist madrasah principals, teachers, and education policymakers in improving the quality of Islamic religious education by developing beneficial professional development programs, contextual teaching methods, and reflective assessment practices.

LITERATURE REVIEW

2.1 Theoretical Foundations of Deep Learning in Education

Modern education has undergone a transformation that has fostered the use of a deep learning approach, which emphasizes conceptual understanding, critical thinking, reflection, and the practical application of knowledge. The deep learning approach strengthens students' cognitive, emotional, social, and ethical skills and encourages them to participate in their learning process in ways that go beyond mere memorization. Ambarita et al. (2025) highlight its role in transforming instructional strategies, teacher competencies, and assessment practices in Indonesia. Theoretically, deep learning aligns with constructivist and experiential learning theories, which emphasize knowledge construction through prior experiences, active engagement, reflection, and contextual application. These methods are used in Islamic Religious Education (PAI) to encourage students to connect religious teachings with their daily experiences and moral decision-making. The Ministry of Primary and Secondary Education (2025) identifies three fundamental principles of deep learning: mindful learning, meaningful learning, and enjoyable learning. Together, these three principles foster awareness of the learning process, contextual understanding, and positive engagement. By applying these principles, one can develop intellectual understanding, spiritual awareness, moral responsibility, and socially responsible behavior within Islamic education.

2.2 Implementation of Deep Learning in Islamic Religious Education

Deep learning implementation emphasizes learning awareness, conceptual understanding, contextual relevance, reflection, and active student engagement through interactive and student-centered instructional practices. Ambarita et al. (2025) highlight that its effectiveness depends on teachers' ability to design engaging activities that accommodate diverse learning needs. In Islamic Religious Education (IRE), deep learning integrates Islamic teachings with students' experiences and everyday ethical practices through four dimensions: mindful learning, contextual instructional practices, joyful learning, and reflective instruction. These dimensions encourage students to develop learning awareness, connect religious knowledge with real-life situations, participate actively, and reflect on their understanding. Effective implementation also requires authentic assessment that evaluates conceptual comprehension, critical reasoning, and practical application. Pujawati et al. (2025) emphasize the importance of collaborative learning, contextual problem-solving, and flexible instructional strategies. Accordingly, this study conceptualizes deep learning implementation as an independent variable representing instructional practices, distinct from

meaningful learning as an outcome reflecting students' understanding, knowledge integration, and application of Islamic teachings.

2.3 Teachers' Pedagogical Readiness

Teachers' pedagogical readiness refers to educators' professional capacity to plan, implement, manage, and evaluate instructional activities effectively through pedagogical knowledge, teaching competencies, and adaptability to students' learning needs. In Islamic Religious Education (IRE), pedagogical readiness enables teachers to integrate religious concepts with contextual learning experiences while promoting critical thinking, active participation, and reflection. Waloyo et al. (2026) identify the cognitive, practical, and institutional aspects of teacher readiness, with an emphasis on challenges in authentic assessment, critical thinking instruction, and professional development. Similarly, Budhi Santosa et al. (2025) emphasize the importance of psychopedagogical characteristics in supporting teachers' readiness to implement deep learning approaches. Effective pedagogical readiness involves instructional planning, appropriate teaching strategies, classroom facilitation, and assessment competencies that encourage meaningful learning. Accordingly, this study conceptualizes teachers' pedagogical readiness through four dimensions: instructional planning readiness, teaching strategy readiness, classroom facilitation readiness, and assessment and reflective readiness, reflecting teachers' ability to implement effective and meaningful Islamic Religious Education.

2.4 Meaningful Learning in Islamic Religious Education

Meaningful learning is a process in which students integrate new knowledge with what they already know, gain conceptual understanding, and apply their knowledge in real-world situations. This approach, based on Ausubel's theory of meaningful learning, places greater emphasis on the integration of knowledge than on rote memorization. Meaningful learning in Islamic Religious Education (PAI) encompasses cognitive, affective, and practical aspects. These dimensions enhance religious understanding, moral awareness, and the application of Islamic values in daily life. The Ministry of Primary and Secondary Education (2025) emphasizes contextual application and reflective understanding as essential elements of meaningful learning. Accordingly, meaningful learning encompasses four dimensions: conceptual understanding, knowledge integration, contextual application, and reflective understanding. These dimensions enable students to interpret religious teachings, connect them with personal experiences, apply Islamic principles in practical situations, and reflect on their moral responsibilities. In this study, meaningful learning is conceptualized as the dependent variable representing perceived learning outcomes, distinct from deep learning implementation as an instructional process.

2.5 The Relationship Between Deep Learning Implementation and Meaningful Learning

The theories of constructivism and meaningful learning are based on the relationship between deep learning and meaningful learning, which emphasize active exploration, the integration of knowledge, contextual application, and reflection. In Islamic Religious Education (IRE), deep learning encourages students to connect religious teachings with personal experiences through critical discussions, reflective activities, and contextual problem-solving. . Ambarita et al. (2025) highlight that deep learning enhances conceptual understanding, critical thinking, and self-reflection through mindful, meaningful, and joyful learning practices. Similarly, Pujawati et al. (2025) emphasize the role of collaborative discussions, discovery-based learning, and contextual activities in promoting student engagement. Although these studies do not establish direct causal relationships, they provide theoretical support for examining the association between deep learning implementation and meaningful learning. Accordingly, higher levels of deep learning

implementation are expected to contribute positively to meaningful learning outcomes in Islamic Religious Education.

H1: Deep learning implementation has a positive and significant effect on meaningful learning in Islamic Religious Education at madrasahs in West Java.

2.6 The Relationship Between Teachers' Pedagogical Readiness and Meaningful Learning

Teachers' pedagogical readiness plays an important role in meaningful learning by supporting effective instructional planning, classroom facilitation, and assessment practices that encourage active participation, conceptual understanding, and reflection. Waloyo et al. (2026) emphasize that teacher readiness involves cognitive preparedness, practical teaching competencies, and institutional support, while identifying challenges in authentic assessment and reflective instruction. Similarly, Budhi Santosa et al. (2025) found significant positive correlations between teacher readiness and self-efficacy ($r = 0.319$; $p < 0.01$) and perceptions of the learning environment ($r = 0.381$; $p < 0.01$), highlighting the importance of psychological and environmental factors. In Islamic Religious Education (IRE), pedagogically prepared teachers are better equipped to connect religious concepts with everyday experiences, facilitate ethical reflection, and implement assessments beyond memorization. Therefore, stronger teachers' pedagogical readiness is expected to contribute positively to meaningful learning outcomes.

H2: Teachers' pedagogical readiness has a positive and significant effect on meaningful learning in Islamic Religious Education at madrasahs in West Java.

2.7 The Simultaneous Relationship Between Deep Learning Implementation, Teachers' Pedagogical Readiness, and Meaningful Learning

Meaningful learning is influenced by both deep learning implementation and teachers' pedagogical readiness, which complement each other in promoting conceptual understanding, contextual application, and reflective engagement. Deep learning provides instructional strategies that encourage active inquiry and knowledge integration, while pedagogical readiness supports effective lesson planning, classroom facilitation, and assessment. Allolinggi et al. (2025) found that teachers' conceptual understanding, pedagogical readiness, and technological competencies play important roles in implementing deep learning, emphasizing that technological proficiency alone is insufficient without adequate pedagogical preparation. Similarly, Waloyo et al. (2026) highlight the importance of pedagogical knowledge, practical competencies, and institutional support in facilitating instructional transformation. In Islamic Religious Education (IRE), integrating these factors is expected to strengthen students' ability to understand religious concepts, connect Islamic teachings with everyday experiences, and apply knowledge meaningfully. Therefore, deep learning implementation and teachers' pedagogical readiness are expected to have a significant simultaneous relationship with meaningful learning outcomes.

H3: Deep learning implementation and teachers' pedagogical readiness simultaneously have a significant effect on meaningful learning in Islamic Religious Education at madrasahs in West Java.

RESEARCH METHODS

This study employs a quantitative approach, using a cross-sectional explanatory survey design, to investigate the relationship between the implementation of deep learning (X1), teachers' pedagogical readiness (X2), and meaningful learning (Y) in Islamic Religious Education (PAI) at madrasahs in West Java, Indonesia. This study involved 150 Islamic Religious Education teachers selected through purposive sampling based on their teaching experience and understanding of teaching practices. How teachers perceive student learning outcomes is what determines meaningful

learning, unlike direct measurements of student achievement. Data were collected using a structured questionnaire with a five-point Likert scale, and the analysis was conducted at a significance level of 0.05 using SPSS version 25. The analysis included the coefficient of determination (R^2), multiple linear regression, t-tests, F-tests, and reliability and validity tests.

The research examines three variables: deep learning implementation (X1), teachers' pedagogical readiness (X2), and meaningful learning (Y). Deep learning implementation encompasses mindful engagement, contextual instructional practices, joyful learning, and reflection. Teachers' pedagogical readiness includes instructional planning, teaching strategies, classroom facilitation, and assessment competencies, while meaningful learning covers conceptual understanding, knowledge integration, contextual application, and reflective understanding. Each variable is measured using eight questionnaire indicators, totaling 24 items. The operational definitions and measurement indicators are presented in Table 1. As the study adopts a nonexperimental design and nonprobability sampling, its findings are interpreted as statistical associations rather than definitive causal effects, with limited generalizability beyond the sampled teachers.

Table 1. Operational Definitions and Measurement Indicators

Variable	Dimensions	Indicators
Deep Learning Implementation (X1)	Mindful learning	Learning awareness and active engagement
	Contextual instructional practices	Real-life relevance and knowledge application activities
	Joyful learning	Positive classroom atmosphere and student participation
	Reflective instructional practices	Reflective discussion and instructional feedback
Teachers' Pedagogical Readiness (X2)	Instructional planning	Lesson preparation and learning objectives
	Teaching strategies	Student-centered methods and instructional adaptability
	Classroom facilitation	Interaction management and support for diverse learning needs
	Assessment and reflection	Authentic assessment and instructional evaluation
Meaningful Learning (Y)	Conceptual understanding	Understanding and explanation of Islamic concepts
	Knowledge integration	Connection between prior knowledge and new Islamic concepts
	Contextual application	Application of Islamic teachings to everyday situations
	Reflective understanding	Reflective reasoning and interpretation of religious values

Data were collected using a structured questionnaire consisting of 24 items that measured the implementation of deep learning (X1), teachers' pedagogical readiness (X2), and meaningful

learning (Y). For each variable, there were eight indicators. Responses were rated on a Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). In addition to data screening and coding, data collection required voluntary participation, confidentiality, and informed consent. In accordance with scale validation standards, the validity of the instrument was assessed using corrected item-total correlations with a minimum value of 0.30. Meanwhile, the reliability of the instrument was assessed using Cronbach's alpha coefficient with a minimum value of 0.70. (Boateng et al., 2018). Data were analyzed using SPSS version 25 through descriptive statistics, classical assumption tests (normality, multicollinearity, heteroscedasticity, and linearity), and multiple linear regression by (University of California Office of Advanced Research Computing, n.d.). Hypotheses were tested using partial t-tests, simultaneous F-tests, and the coefficient of determination (R^2), with a significance level of 0.05.

RESULTS AND DISCUSSION

4.1 Descriptive Statistical Analysis

Descriptive statistical analysis provides an initial overview of the distribution and characteristics of the research variables.

Table 2. Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Deep Learning Implementation (X1)	150	1.125	4.750	3.005	0.850
Teachers' Pedagogical Readiness (X2)	150	1.125	4.750	2.988	0.741
Meaningful Learning (Y)	150	1.000	5.000	2.950	0.750

Table 2 presents the descriptive statistics of the research variables based on 150 respondents. Deep Learning Implementation (X1) recorded a mean of 3.005 (SD = 0.850), ranging from 1.125 to 4.750, while Teachers' Pedagogical Readiness (X2) had a mean of 2.988 (SD = 0.741), with the same minimum and maximum values. Meanwhile, Meaningful Learning (Y) showed a mean of 2.950 (SD = 0.750), ranging from 1.000 to 5.000. These findings indicate that all three variables have mean scores close to the midpoint of the five-point scale, suggesting moderate levels of deep learning implementation, pedagogical readiness, and meaningful learning. The relatively similar standard deviations indicate comparable variability across the measured variables.

4.2 Instrument Validity Testing

Validity testing was conducted using corrected item-total correlations to assess the consistency of questionnaire items with their respective constructs. Items with correlation values of at least 0.30 were considered acceptable, indicating adequate item discrimination and internal consistency.

Table 3. Item Validity Screening Results

Variable	Indicator	Corrected item-total correlation	Decision
Deep Learning Implementation	X1.1	0.696	Retained
	X1.2	0.742	Retained
	X1.3	0.794	Retained
	X1.4	0.753	Retained

	X1.5	0.735	Retained
	X1.6	0.681	Retained
	X1.7	0.756	Retained
	X1.8	0.772	Retained
Teachers' Pedagogical Readiness	X2.1	0.656	Retained
	X2.2	0.682	Retained
	X2.3	0.666	Retained
	X2.4	0.734	Retained
	X2.5	0.623	Retained
	X2.6	0.702	Retained
	X2.7	0.695	Retained
	X2.8	0.641	Retained
Meaningful Learning	Y1	0.678	Retained
	Y2	0.738	Retained
	Y3	0.699	Retained
	Y4	0.658	Retained
	Y5	0.672	Retained
	Y6	0.734	Retained
	Y7	0.653	Retained
	Y8	0.712	Retained

The results of the item validity screening for the 24 indicators of the three research variables are shown in Table 3. Deep Learning (X1) showed correlations ranging from 0.681 to 0.794 for the corrected item-total correlations; Teacher Pedagogical Readiness (X2) showed correlations ranging from 0.623 to 0.733; and Meaningful Learning (Y) showed correlations ranging from 0.653 to 0.738. All metrics met the minimum acceptance criterion of 0.30, indicating satisfactory item discrimination and satisfactory internal consistency within the structure. Consequently, the 24 questionnaire items were retained and deemed suitable for reliability testing and statistical analysis.

4.3 Instrument Reliability Testing

Cronbach's alpha was used to assess the internal consistency of the three questionnaire scales. A value of at least 0.70 is considered acceptable, and a value greater than 0.80 indicates higher reliability.

Table 4. Reliability Test Results

Variable	Number of items	Cronbach's alpha	Interpretation
Deep Learning Implementation (X1)	8	0.921	Excellent
Teachers' Pedagogical Readiness (X2)	8	0.892	Good
Meaningful Learning (Y)	8	0.907	Excellent

The reliability test results for the three research variables—each consisting of eight questionnaire items, as shown in Table 4—are presented in Table 4. Meaningful Learning (Y) has a Cronbach's alpha value of 0.907, indicating that it is highly reliable. The Implementation of Deep Learning (X1) also has a Cronbach's alpha of 0.921, indicating that it is highly reliable. All coefficients exceed the minimum threshold of 0.70, indicating that all three constructs have satisfactory internal consistency. Therefore, each measurement instrument is considered reliable and suitable for use in further statistical analysis.

4.4 Classical Assumption Testing

Classical assumption tests were used to evaluate multicollinearity, heteroscedasticity, and the normality of the residuals to ensure the adequacy of the regression model. In the Kolmogorov-Smirnov normality test, the significance value of 0.200 (N = 150) and the test statistic value of 0.058 exceeded the threshold of 0.05. The results indicate that there is no significant statistical deviation from the normal distribution. This suggests that the regression residuals satisfy the normality assumption and support multiple linear regression analysis.

4.4.1 Multicollinearity Test

The analysis employed tolerance values and the Variance Inflation Factor (VIF). A tolerance value greater than 0.10 and a VIF below 5 were used as practical screening criteria.

Table 5. Multicollinearity Test Results

Independent variable	Tolerance	VIF	Interpretation
Deep Learning Implementation (X1)	0.817	1.127	No problematic multicollinearity
Teachers' Pedagogical Readiness (X2)	0.817	1.127	No problematic multicollinearity

The results of the multicollinearity test for the independent variables "Application of Deep Learning" (X1) and "Teachers' Pedagogical Readiness" (X2) showed tolerance values of 0.817 and 1.127, respectively. The tolerance value exceeds the minimum threshold of 0.10, while the inflation factor remains below the recommended threshold of 5. Table 5 shows the results of the multicollinearity test. The results indicate that the independent variables do not exhibit problematic multicollinearity. Consequently, both predictors can be included in the multiple linear regression model without raising significant concerns about multicollinearity.

4.4.2 Heteroscedasticity Test

The Breusch–Pagan test was conducted to assess heteroscedasticity by examining whether residual variance remained constant across the regression model. A significance value greater than 0.05 indicated the absence of heteroscedasticity.

Table 6. Breusch–Pagan Heteroscedasticity Test

Test	LM statistic	df	Sig.
Breusch–Pagan test	3.568	2	0.168

The results of the Breusch-Pagan test for heteroscedasticity are shown in Table 6, with an LM statistic of 3.568, 2 degrees of freedom, and a p-value of 0.168. Since the p-value exceeds the significance threshold of 0.05, the null hypothesis of homoscedasticity cannot be rejected. This indicates that there is no statistically significant evidence that the regression model exhibits heteroscedasticity. These results support the model's suitability for multiple linear regression analysis; the residual variances are consistent with the assumption of constant variances.

4.5 Multiple Linear Regression Analysis

Multiple linear regression analysis was conducted to examine the relationships between deep learning implementation (X1), teachers' pedagogical readiness (X2), and meaningful learning (Y). The analysis included regression coefficients, standard errors, t-statistics, and significance values.

Table 7. Multiple Linear Regression Results

Predictor	B	Std. Error	Standardized Beta	t	Sig.
Constant	0.596	0.209	—	2.845	0.005
Deep Learning Implementation (X1)	0.473	0.055	0.536	8.607	<0.001
Teachers' Pedagogical Readiness (X2)	0.312	0.063	0.308	4.948	<0.001

Table 7 presents the multiple linear regression results, indicating that both Deep Learning Implementation (X1) and Teachers' Pedagogical Readiness (X2) have positive and statistically significant relationships with Meaningful Learning (Y). Deep Learning Implementation recorded a regression coefficient of 0.473 ($\beta = 0.536$; $t = 8.607$; $p < 0.001$), while Teachers' Pedagogical Readiness showed a coefficient of 0.312 ($\beta = 0.308$; $t = 4.948$; $p < 0.001$). The regression equation is $Y = 0.596 + 0.473X1 + 0.312X2$. These findings indicate that both predictors positively contribute to meaningful learning, with deep learning implementation demonstrating a stronger standardized association than teachers' pedagogical readiness.

Table 8. ANOVA and Simultaneous F-Test

Model	df	F	Sig.
Regression	2	71.610	<0.001
Residual	147	—	—
Total	149	—	—

Table 8 presents the ANOVA and simultaneous F-test results, showing an F-value of 71.610 with 2 regression degrees of freedom and 147 residual degrees of freedom ($p < 0.001$). Since the significance value is below 0.05, the regression model is statistically significant, indicating that Deep Learning Implementation (X1) and Teachers' Pedagogical Readiness (X2) jointly contribute to explaining variations in Meaningful Learning (Y). Therefore, the third hypothesis (H3) is supported, confirming a significant simultaneous relationship between the independent variables and meaningful learning in Islamic Religious Education.

4.6 Coefficient of Determination (R^2)

In the model summary, the correlation coefficient (R) of 0.702 indicates that there is a strong multiple correlation between the Implementation of Deep Learning (X1), Teachers' Pedagogical Readiness (X2), and Meaningful Learning (Y). The coefficient of determination (R^2) of 0.493 indicates that 49.3% of the variation in meaningful learning is explained by these two independent variables

combined, while the remaining 50.7% is attributed to variables outside the model and other factors. Additionally, the model's prediction error is moderate, and the standard error of estimation is 0.537.

4.7 Discussion

The findings indicate that deep learning implementation has a positive and significant relationship with meaningful learning in Islamic Religious Education (IRE) at madrasahs in West Java ($B = 0.473$; $\beta = 0.536$; $t = 8.607$; $p < 0.001$), supporting the first hypothesis (H1). This result suggests that instructional practices emphasizing mindful engagement, contextual learning, active participation, and reflection are associated with stronger meaningful learning outcomes. These findings align with Ambarita et al. (2025) who emphasize that deep learning promotes conceptual understanding, critical thinking, problem-solving, and reflective engagement through student-centered instruction. Similarly, Pujawati et al. (2025) highlight the importance of collaborative discussions, contextual problem-solving, and discovery-based learning in enhancing student participation. From a constructivist perspective, deep learning enables students to integrate new knowledge with prior experiences and apply religious principles in authentic situations. Therefore, incorporating reflective and contextual instructional strategies may strengthen students' understanding of Islamic teachings and their relevance to everyday life.

Teachers' pedagogical readiness also demonstrates a positive and significant relationship with meaningful learning ($B = 0.312$; $\beta = 0.308$; $t = 4.948$; $p < 0.001$), supporting the second hypothesis (H2). This finding indicates that teachers' preparedness in instructional planning, teaching strategies, classroom facilitation, and assessment is associated with improved meaningful learning outcomes. Waloyo et al. (2026) emphasize that cognitive readiness, practical teaching competencies, and institutional support are essential for implementing deep learning effectively, particularly in developing authentic assessment and reflective instructional activities. Similarly, Budhi Santosa et al. (2025) identify psychological and environmental factors as important components of teacher readiness. In Islamic Religious Education, pedagogically prepared teachers are better positioned to connect religious concepts with students' experiences, encourage ethical reflection, and facilitate contextual learning activities. These findings reinforce the importance of continuous professional development, instructional adaptability, and assessment competencies in supporting meaningful learning within madrasah education.

The simultaneous regression analysis confirms that deep learning implementation and teachers' pedagogical readiness jointly demonstrate a significant relationship with meaningful learning ($F = 71.610$; $p < 0.001$), supporting the third hypothesis (H3). The coefficient of determination ($R^2 = 0.493$) indicates that both variables collectively explain 49.3% of the variation in meaningful learning, while the remaining 50.7% reflects unexplained variation and factors outside the research model. Deep learning implementation demonstrates a stronger standardized association ($\beta = 0.536$) than teachers' pedagogical readiness ($\beta = 0.308$), suggesting that instructional practices have a comparatively greater statistical contribution within the model. These findings are consistent with Allolinggi et al. (2025), who emphasize the importance of integrating conceptual understanding and pedagogical preparedness in deep learning implementation, and Waloyo et al. (2026), who highlight the complementary roles of professional competencies and institutional support. Theoretically, the findings strengthen the understanding of meaningful learning as an educational outcome associated with both instructional innovation and teacher preparedness. Practically, madrasahs should prioritize contextual learning strategies, teacher professional development, reflective instruction, and authentic assessment to improve the quality of Islamic Religious Education. However, given the

cross-sectional research design, these relationships should be interpreted as statistical associations rather than definitive causal effects.

CONCLUSION

This study found that in madrasahs in West Java, Indonesia, the implementation of deep learning and teachers' pedagogical readiness have a positive and significant relationship with meaningful learning in Islamic Religious Education. Deep learning showed a stronger standardized relationship with meaningful learning ($\beta = 0.536$) compared to teachers' pedagogical readiness ($\beta = 0.308$), highlighting the importance of contextual, reflective, and student-centered teaching. On the other hand, these two variables significantly contribute to explaining meaningful learning outcomes, accounting for 49.3% of the observed variance ($R^2 = 0$). These results confirm that the complementary roles of teachers' professional competence and instructional innovation are crucial in supporting meaningful Islamic education. In practical terms, if madrasahs wish to enhance students' understanding and application of Islamic values, they must strengthen teacher professional development, contextual teaching approaches, classroom facilities, and authentic assessment. However, causal interpretations and generalizations are limited by the cross-sectional study design, the purposive sample, and the reliance on teachers' self-reports. To provide more comprehensive empirical evidence, future research should involve a broader sample, a longitudinal approach, and direct assessment of student learning outcomes.

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