



Teacher Learning Innovation and Principal Reflective Leadership as Predictors of Pedagogical Deep Learning in Elementary Schools

Endang Widiastuti^{1*}, Imaniar Purbasari², Fina Fakhriyah³
^{1,2,3}Muria Kudus University, Kudus, Indonesia

ARTICLE INFO	ABSTRACT
Article history: Submitted: August 08, 2026 Final Revised: Sept. 29, 2026 Accepted: September 29, 2026 Published: September 30, 2026 Keywords: Teacher Learning Innovation; Principal Reflective Leadership; Pedagogical Deep Learning; Elementary Schools; SEM-PLS	Pedagogical deep learning is an educational approach that emphasizes meaningful understanding, active student engagement, and the ability to connect knowledge with real-life contexts. However, its implementation in elementary schools remains challenging, particularly in relation to teachers' learning innovation and principals' reflective leadership. This study aims to examine the predictive relationships of Teacher Learning Innovation and Principal Reflective Leadership with Pedagogical Deep Learning in elementary schools. A quantitative approach was employed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The research population comprised elementary school teachers in Tlogowungu District, Pati Regency, and a sample of 177 teachers was selected using Proportional Stratified Random Sampling. Data were collected through a structured Likert-scale questionnaire and analyzed using SmartPLS 3.2. The results showed that Teacher Learning Innovation positively and significantly predicted Pedagogical Deep Learning ($\beta = 0.614$; $t = 5.881$; $p < 0.001$). Principal Reflective Leadership also positively and significantly predicted Pedagogical Deep Learning ($\beta = 0.356$; $t = 3.075$; $p < 0.001$). The structural model produced an R^2 value of 0.887, indicating that Teacher Learning Innovation and Principal Reflective Leadership jointly explained 88.7% of the variance in Pedagogical Deep Learning. These findings indicate that strengthening teachers' learning innovation and developing reflective leadership practices among principals are associated with stronger pedagogical deep learning practices in elementary schools. The study contributes practical insights for strengthening teacher capacity and principal leadership to support meaningful, conscious, and engaging learning experiences.



Doi: <https://doi.org/10.61255/jupiter.v4i4.1813>

INTRODUCTION

The transformation of elementary education in the 21st century requires a shift from learning practices primarily oriented toward the transmission and memorization of subject matter toward learning that promotes meaningful understanding, active engagement, and the application of knowledge in authentic contexts. In this context, pedagogical deep learning emphasizes not only cognitive achievement but also students' ability to connect knowledge with real-life situations, develop critical and creative thinking, collaborate with others, and engage in reflection. [Abdurrahman et al. \(2026\)](#) and [Al Fauziyah et al. \(2026\)](#) indicate that deep learning is characterized by learning experiences that are mindful, meaningful, and joyful. Thus, pedagogical deep learning positions students as active participants in constructing knowledge rather than passive recipients of information. This shift consequently requires changes not only in classroom practices but also in the capacity of teachers and school leaders to create an environment that supports active, contextual, and reflective learning.

Despite its potential, the implementation of pedagogical deep learning in elementary schools remains challenging. [Chen et al. \(2026\)](#) reported that learning practices in several elementary school contexts continue to be dominated by conventional teacher-centered approaches, characterized by limited interaction and opportunities for active student participation. Such practices may restrict students' opportunities to construct knowledge, apply concepts, and develop higher-order thinking skills. Conversely, studies implementing learning approaches oriented toward deep learning have

reported improvements in students' understanding as well as reflective, inferential, and literal skills. These contrasting findings suggest that the effectiveness of pedagogical deep learning is not determined solely by the adoption of a particular learning concept but also by the conditions that enable teachers to translate the concept into classroom practice. Teacher pedagogical capacity and the leadership environment of the school therefore become important factors in explaining variations in the implementation of pedagogical deep learning.

One factor that may contribute to the development of pedagogical deep learning is Teacher Learning Innovation. Teacher learning innovation refers to teachers' capacity to develop and apply new or adapted strategies, methods, models, learning resources, and media to respond to students' learning needs and create more active and meaningful learning experiences. [Meng et al. \(2022\)](#) emphasize that instructional innovation involves the development of learning practices that move beyond routine approaches and facilitate more contextualized and student-centered learning. Similarly, [Ashari et al. \(2026\)](#) highlight the relevance of teacher innovation in supporting learning practices oriented toward active student participation. Theoretically, teacher learning innovation can provide a mechanism through which the principles of pedagogical deep learning are translated into actual classroom experiences. Innovative instructional strategies can provide students with greater opportunities to investigate problems, connect concepts with authentic situations, collaborate, reflect on their learning, and construct understanding. Therefore, teachers who are more capable of innovating in their learning practices are expected to be better positioned to facilitate pedagogical deep learning.

However, the capacity to innovate does not develop independently of the organizational context in which teachers work. Previous studies have identified several barriers to sustained instructional innovation, including limited mastery of innovative learning models, insufficient professional development, inadequate digital literacy, administrative workload, limited learning facilities, curriculum pressures, and teachers' reluctance to move away from established practices ([Ashari et al., 2026](#); [Chen et al., 2026](#)). These findings indicate that teacher innovation is not merely an individual technical competence but is also influenced by the conditions created within the school. Consequently, examining Teacher Learning Innovation as a predictor of Pedagogical Deep Learning requires consideration of whether teachers have an organizational environment that encourages experimentation, reflection, professional learning, and continuous improvement.

In addition to teacher-level factors, Principal Reflective Leadership represents an important organizational condition that may support the development of pedagogical deep learning. Reflective leadership refers to the capacity of school principals to critically examine leadership practices, interpret evidence and experiences, receive feedback, and use reflection to guide decisions and continuous improvement. [Pan et al. \(2021\)](#) emphasize the role of principals as instructional leaders who support improvement in teaching and learning through teacher mentoring, supervision, and collaborative professional development. From this perspective, reflective leadership can influence pedagogical deep learning through the creation of a school environment in which teachers are encouraged to examine their instructional practices, receive constructive feedback, collaborate with colleagues, and continuously improve their teaching. Rather than functioning only as an administrative authority, a reflective principal can serve as a facilitator of organizational learning and instructional improvement.

The implementation of reflective leadership, however, also faces substantial challenges. [Emilya et al. \(2026\)](#) and [Halim et al. \(2025\)](#) identify limited time for evaluation, resistance to change, confirmation bias, and weaknesses in managerial competencies as factors that may constrain reflective leadership practices. [Hariyasasti et al. \(2025\)](#) and [Khofifah et al. \(2025\)](#) further indicate that the administrative and operational demands faced by school principals can reduce opportunities for systematic reflection on instructional practices and school improvement. In addition, [Keane et al. \(2020\)](#) and [Lubis et al. \(2025\)](#) highlight the importance of openness to constructive feedback and the ability to use evidence in the reflective process. These findings suggest that reflective leadership is potentially important not simply because principals occupy formal leadership positions, but because their reflective practices can shape the organizational conditions under which teachers learn, innovate, collaborate, and improve instruction. Thus, Principal Reflective Leadership is theoretically expected to be positively associated with the development of pedagogical deep learning.

The relationships among these variables can be further understood through the complementary roles of teacher agency and school-level leadership. Teacher Learning Innovation represents the classroom-level mechanism through which pedagogical changes are enacted, whereas Principal Reflective Leadership represents an organizational-level mechanism that can create conditions for those changes to be sustained. In this sense, reflective leadership may provide direction, feedback, professional support, and a culture of continuous improvement, while teacher learning innovation translates these conditions into concrete instructional practices. When these two dimensions operate in a supportive manner, students may receive greater opportunities to engage in mindful, meaningful, and joyful learning experiences. This theoretical linkage suggests that Pedagogical Deep Learning should not be viewed exclusively as an outcome of

individual teacher practices or leadership practices, but as a phenomenon potentially shaped by the interaction of classroom innovation and the broader instructional leadership environment.

Nevertheless, the existing literature leaves an important empirical gap. Previous studies have established the relevance of teacher learning innovation to instructional improvement and have separately demonstrated the importance of school leadership for teaching and learning quality. However, relatively little is known about how Teacher Learning Innovation and Principal Reflective Leadership jointly function as predictors of Pedagogical Deep Learning within the same elementary-school model. More specifically, the existing literature provides limited empirical evidence regarding whether teacher innovation remains a significant predictor of pedagogical deep learning when principal reflective leadership is considered simultaneously, and whether principal reflective leadership contributes additional explanatory value beyond teacher-level instructional innovation. This gap is particularly relevant in elementary schools, where teachers are responsible for translating broad educational orientations into daily classroom practices while principals are expected to establish the organizational conditions that support instructional improvement. Therefore, an integrated model examining both teacher-level and school-leadership-level predictors is needed to provide a more comprehensive explanation of variations in pedagogical deep learning.

This study addresses this gap by examining the predictive relationships between Teacher Learning Innovation, Principal Reflective Leadership, and Pedagogical Deep Learning in elementary schools in Tlogowungu District, Pati Regency. Specifically, the study aims to: (1) examine the predictive relationship between Teacher Learning Innovation and Pedagogical Deep Learning; (2) examine the predictive relationship between Principal Reflective Leadership and Pedagogical Deep Learning; and (3) examine the extent to which Teacher Learning Innovation and Principal Reflective Leadership jointly explain the variance in Pedagogical Deep Learning within the proposed structural model. By integrating teacher-level and school-leadership-level perspectives, this study is expected to contribute to the theoretical understanding of the factors associated with pedagogical deep learning and provide practical implications for strengthening teacher instructional innovation and reflective school leadership in elementary education.

METHOD

The Method section requires substantial revision to ensure replicability and allow an adequate assessment of methodological rigor. The basis for determining the sample size of 177 respondents is not explicitly reported, and the manuscript still contains an internal note requesting clarification as to whether the sample size was determined using a formula, statistical power analysis, or a PLS-SEM-specific procedure. In addition, the instrument-development and validation procedures are insufficiently described, particularly regarding item sources, the number and qualifications of validators, content-validity results, pilot testing, and missing-data treatment. Because all constructs were measured using self-report questionnaires completed by the same respondents, the authors should also provide a statistical assessment of common method bias rather than relying only on procedural remedies. The rationale for using PLS-SEM, the bootstrapping procedure, number of subsamples, and additional model-assessment criteria

Population and Sampling

The population consisted of 324 elementary school teachers distributed across 24 elementary schools in Tlogowungu District, Pati Regency. The respondents comprised teachers from grades I to VI. The study employed Proportional Stratified Random Sampling to ensure proportional representation of teachers across the participating schools. Each elementary school was treated as a stratum, and the number of teachers selected from each school was determined proportionally according to the size of its teacher population. Within each stratum, teachers were selected randomly according to the predetermined allocation.

A total of 177 elementary school teachers participated in the study. The sample size was determined based on the minimum sample requirement for the proposed PLS-SEM model and the available population, while proportional allocation was applied to maintain representation across the 24 schools. This sampling procedure was intended to minimize disproportionate representation of teachers from particular schools.

Instrument Development and Measurement

Data were collected using a structured self-administered questionnaire developed from the operational definitions and theoretical dimensions of the three latent constructs. The development of the instrument followed four stages: (1) specification of the construct definitions and dimensions; (2) development or adaptation of questionnaire items from relevant theoretical and empirical sources; (3) expert review for content validity; and (4) pilot testing prior to the main survey.

Teacher Learning Innovation (X1) was operationalized as teachers' capacity to develop and apply new or adapted learning strategies, methods, models, learning resources, and instructional media to facilitate active and meaningful student learning. The construct was measured through indicators covering: (a) variation in learning strategies, methods,

and models; (b) utilization of interactive learning media and technology; and (c) provision of opportunities for active student involvement. This operationalization is consistent with the conceptualization of teacher innovation presented in the study, which emphasizes the movement beyond routine instructional practices toward more contextualized and student-centered learning.

Principal Reflective Leadership (X2) was operationalized as the principal's capacity to critically examine instructional and leadership practices, interpret evidence and experience, receive feedback, and use reflection to guide instructional decisions and continuous improvement. The construct was measured through indicators covering: (a) reflection on instructional practices; (b) support for teacher professional development; and (c) collaborative and evidence-based decision-making. This operationalization reflects the study's theoretical position that reflective leadership creates organizational conditions that encourage teachers to examine, improve, and sustain instructional practices.

Pedagogical Deep Learning (Y) was operationalized as the implementation of learning practices that facilitate mindful, meaningful, and joyful learning and enable students to connect and apply knowledge in relevant contexts. The construct was measured through indicators representing: (a) mindful learning; (b) meaningful learning; (c) joyful learning; and (d) the application of knowledge. These dimensions are consistent with the conceptualization of pedagogical deep learning adopted in this study, which emphasizes active participation, meaningful understanding, authentic contextualization, and application rather than the computational concept of deep learning in artificial intelligence.

All questionnaire items were measured using a four-point Likert scale ranging from 1 = strongly disagree to 4 = strongly agree. The four-point format was selected to require respondents to indicate a directional response and avoid the use of a neutral midpoint.

Content Validation and Instrument Preparation

Content validity was established through expert judgment before the main survey. The preliminary questionnaire was reviewed by 4 experts comprising educational management scholars, elementary education specialists, assessment specialists, or experienced school principals. The experts were selected based on their academic and/or professional expertise in relevant field, with professional experience ranging from 15 years. The experts evaluated each item in terms of relevance to the construct, clarity of wording, representativeness of the indicator, and suitability for the elementary-school context.

Data Collection and Data Screening

Data were collected from elementary school teachers in Tlogowungu District, Pati Regency, following the completion of the proportional stratified random sampling procedure. Each selected teacher was invited to complete a structured self-report questionnaire consisting of 40 statement items: 12 items measuring Teacher Learning Innovation (X1), 12 items measuring Principal Reflective Leadership (X2), and 16 items measuring Pedagogical Deep Learning (Y). All items were assessed using a four-point Likert scale ranging from 1 = strongly disagree to 4 = strongly agree. The questionnaire was administered to the teachers selected from the 24 participating elementary schools according to the predetermined proportional allocation.

Before the responses were entered into SmartPLS 3.2, the returned questionnaires were subjected to a data-screening procedure. The screening involved checking the completeness of responses, identifying questionnaires containing missing or unusable responses, and verifying the consistency of the response records. Questionnaires that did not meet the predetermined completeness criteria were excluded from the final dataset. The treatment of missing data was determined before the PLS-SEM analysis. Specifically, insert the actual procedure used in the study, e.g., "questionnaires containing unanswered items were excluded from the analysis" / "item-level missing responses were handled using the specified missing-data procedure" / "no missing responses were identified in the final dataset".

After the screening process, 177 teacher responses were retained as valid observations for subsequent analysis. Thus, the final analytical dataset comprised 177 complete and usable responses. The final sample represented teachers from the participating elementary schools in Tlogowungu District and was subsequently used for the measurement-model and structural-model assessments using SmartPLS 3.2.

Common Method Bias

Because the predictor and outcome constructs were measured using a self-report questionnaire administered to the same respondents, the potential for common method bias was considered. Procedural measures included the use of clear and neutral wording and the assurance of confidentiality to reduce evaluation apprehension and socially desirable responding.

Ethical Considerations

Participation was voluntary. Before completing the questionnaire, respondents were informed about the purpose and academic use of the research data. Participation did not affect respondents' professional status, and respondents were free to decline participation or discontinue their responses. No personally identifying information was reported in the analysis or publication. Data were analyzed and presented in aggregate form to maintain respondent confidentiality.

Reporting of PLS-SEM Results

To facilitate methodological transparency and reproducibility, the results section reports the measurement-model results, including outer loadings, Cronbach's alpha, Composite Reliability, AVE, and discriminant-validity statistics. The structural-model results report collinearity diagnostics, R^2 , f^2 , predictive relevance where applicable, path coefficients, standard errors, t-values, p-values, and bootstrap confidence intervals. The number of bootstrap subsamples and the relevant SmartPLS settings are also reported.

Research Ethics

Participation in the study was voluntary. Before completing the questionnaire, respondents were informed about the purpose of the study and the intended academic use of the data. Respondents' identities and individual responses were treated confidentially, and the findings were reported in aggregate form.

RESULTS

Respondent Characteristics

The respondents in this study were elementary school teachers in Tlogowungu District, Pati Regency, Indonesia. The target population consisted of 324 teachers from 24 elementary schools, while the final analytical sample comprised 177 valid teacher responses. The respondents were selected using proportional stratified random sampling to ensure proportional representation across the participating schools.

The respondent characteristics were described in terms of gender, teaching experience, and grade level taught. The gender and teaching-experience distributions were calculated using the final dataset of 177 valid respondents. The grade-level distribution was also recalculated from the same final respondent database to ensure that all reported frequencies were consistent with the total analytical sample. The distribution of respondents is presented in Table 1.

Table 1. Frequency Distribution of Respondents Based on Gender

Gender	Man	76	42.94%
	Woman	101	57.06%
Teaching Experience	< 5 years	37	20.90%
	5-10 years	53	29.94%
	11-15 years	48	27.12%
	> 15 years	39	22.03%
Grade Level Taught	I	24	11.69%
	II	25	12.99%
	III	29	18.18%
	IV	33	23.38%
	V	27	15.58%
	VI	19	18.18%

The frequencies and percentages in Table 1 were calculated from the final dataset used in the PLS-SEM analysis. Accordingly, the frequencies for each respondent characteristic sum to 177 respondents, and the percentages are based on the same denominator. The final respondent profile should be interpreted descriptively and is presented only to characterize the analytical sample. No inferential conclusions were drawn from these demographic characteristics.

Research Data Analysis

The hypotheses were examined using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS version 3.2. The analysis was conducted using the final dataset of 177 valid teacher responses and the final model specification established prior to hypothesis testing. The analysis comprised two sequential stages: (1) evaluation of the measurement model and (2) evaluation of the structural model. The measurement model was assessed in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. The structural model was subsequently evaluated using collinearity diagnostics, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2 , where applicable), and bootstrapped path coefficients. The original questionnaire contained

40 indicators: 12 indicators for Teacher Learning Innovation (X1), 12 indicators for Principal Reflective Leadership (X2), and 16 indicators for Pedagogical Deep Learning (Y). All indicators were measured using a four-point Likert scale ranging from 1 = strongly disagree to 4 = strongly agree.

Table 2. Indicators for each variable

Variables	Indicator	Number of Grains
Teacher Learning Innovation (X1)	Variation in learning strategies, methods, and models; innovative use of learning media and technology; active student involvement	12
Principal Reflective Leadership (X2)	Reflection on instructional policies and practices; support for teacher reflection and professional development; evaluation- and data-based decision-making; collaborative decision-making	12
Pedagogical Deep Learning (Y)	Learning awareness and mindfulness; meaningful learning; emotional engagement and motivation; application of knowledge in real-life contexts	16
Amount		40

Source: Research data, processed using SmartPLS 3.2 (2026).

Based on the model framework and hypotheses that have been developed in this study, the form of the PLS SEM model that will be estimated in this study is as follows:

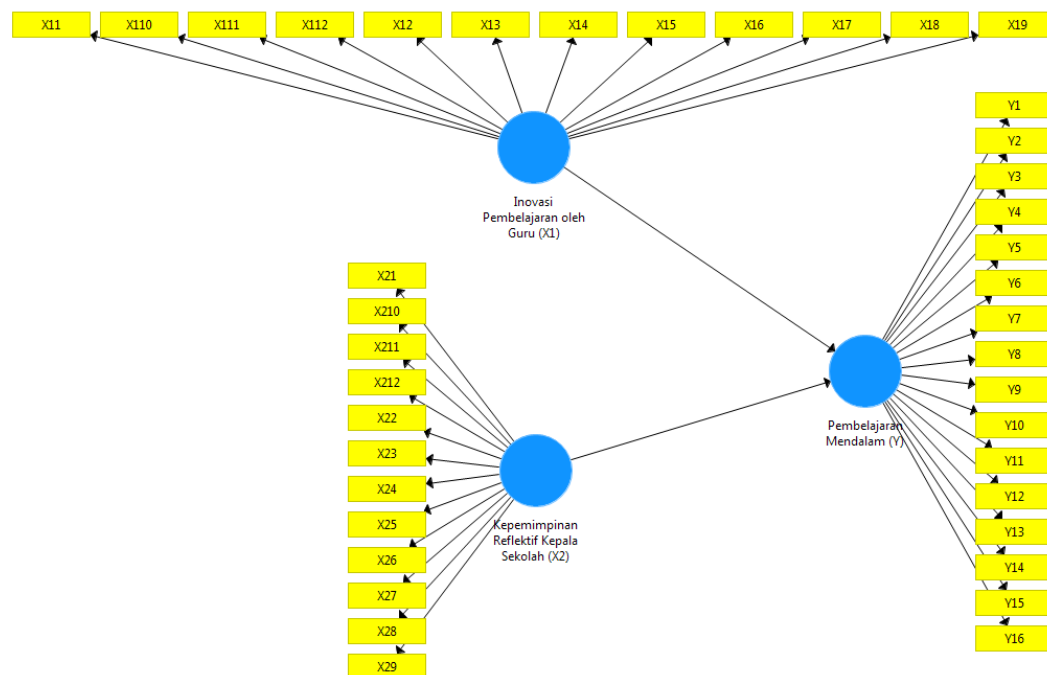


Figure 2. SEM Model Specifications

Source: Processed data (2026) PLS

The stages in this PLS analysis include the testing stage *outer model* and testing stage *inner model*. Testing stage *outer model* used to test the validity and reliability of all indicators in measuring the construct, while testing *inner model* used to test research hypotheses. The following are the overall stages in the PLS analysis:

Measurement Model Evaluation

The measurement model was evaluated to determine whether the indicators adequately represented their respective latent constructs. The assessment included convergent validity, discriminant validity, and construct reliability.

Indicator Reliability and Convergent Validity

Indicator reliability was assessed using standardized outer loadings. The initial measurement model was estimated using all 40 indicators. Indicators with low outer loadings were subsequently evaluated according to the predetermined measurement-model criteria and the effect of their removal on construct reliability and convergent validity. Importantly, the final manuscript reports only the indicators that remained in the final measurement model. The number

and identity of deleted indicators were determined directly from the final SmartPLS estimation and were kept consistent throughout the Results section.

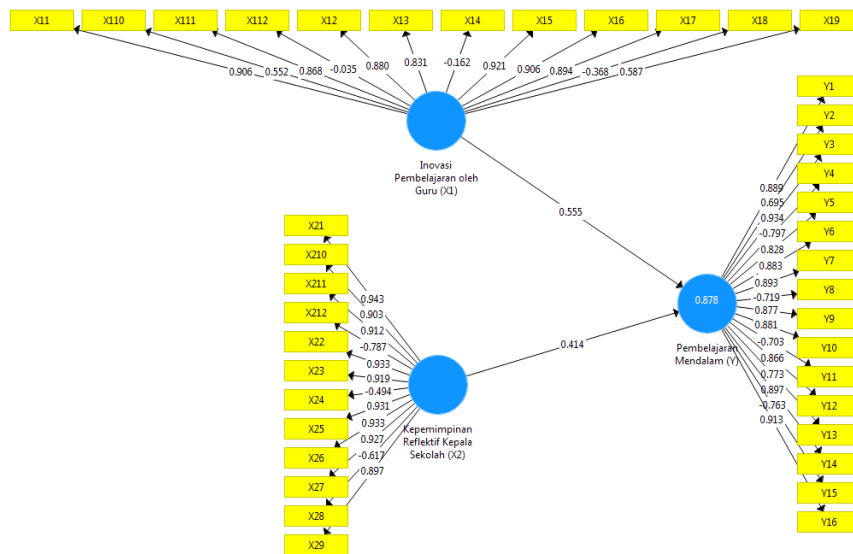


Figure 3. PLS Model Estimation Results with all Indicators
Source: Processed data (2026) PLS

Based on the results of the PLS model estimation in Figure 3 above, it can be seen that there are several indicators that are not valid in measuring the construct because they have *loading factor* low < 0.7 , namely indicators X110, X112, X14, X18, X19, X212, X24, X27, X28, Y4, Y11, Y15 and Y8. Because these two indicators are invalid, these two indicators are removed from the SEM PLS model. After the indicators are removed from the model, the results of the model estimation can be seen in the following figure:

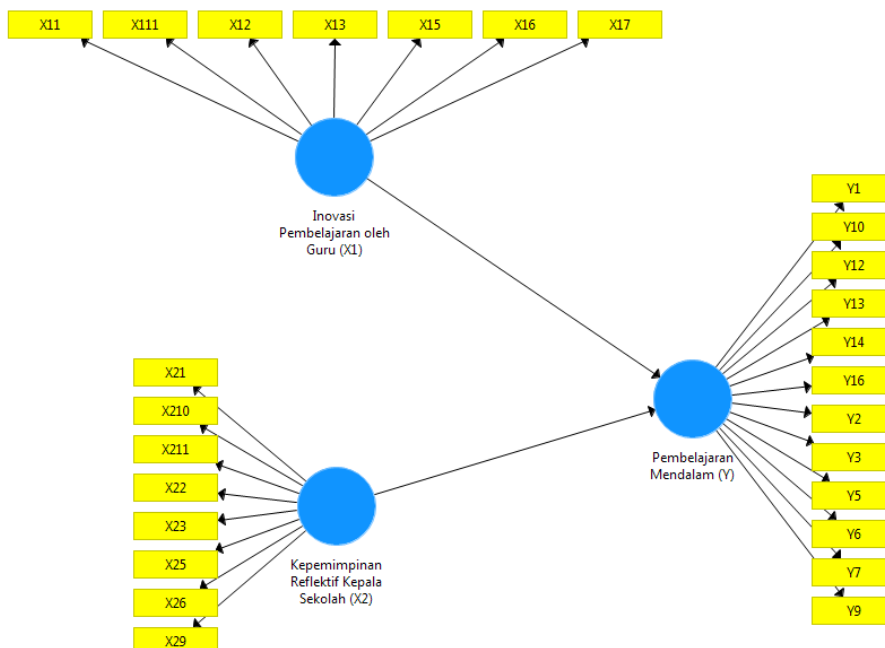


Figure 4. Results of the PLS SEM Model after being removed from the model
Source: Processed data (2026) PLS

Based on the PLS model estimation results in Figure 4a, it can be seen that after two invalid indicators were removed from the model, all indicators in each construct are now valid so that testing can continue to the next stage, namely the assessment of the AVE value for each construct. This is because in addition to looking at the indicator loading factor

value, convergent validity must also be assessed from the AVE value of each construct. All constructs in the PLS model are declared to have met convergent validity if the AVE value of each construct is > 0.5 . The complete AVE value for each construct can be seen in the following table:

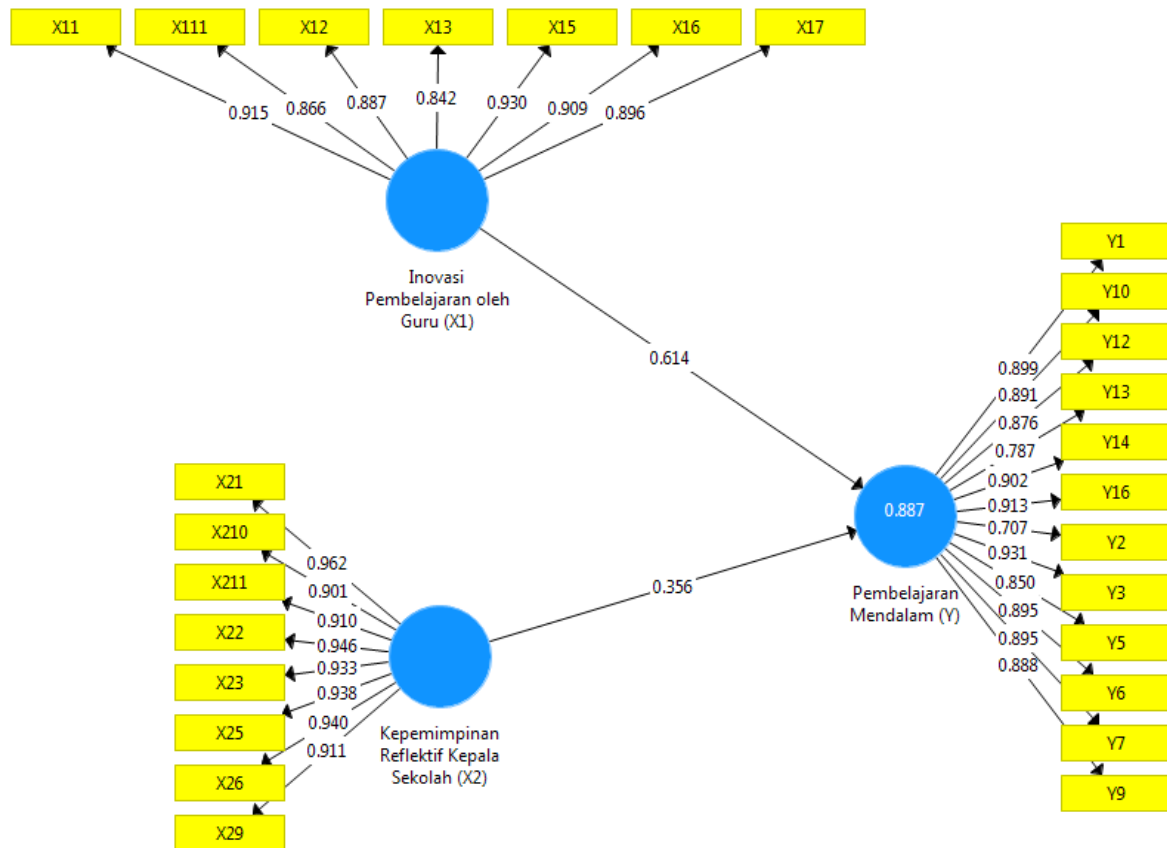


Figure 4b. Results of the PLS SEM Model after being removed from the model

Source: Processed data (2026) PLS

Table 2. Loading Values *Factor* and AVE Value

Variables	Indicator	Outer Loading	AVE	Validity
Teacher Learning Innovation (X1)	X11	0.915	0.665	valid
	X111	0.866		valid
	X12	0.887		valid
	X13	0.842		valid
	X15	0.930		valid
	X16	0.909		valid
	X17	0.896		valid
Principal Reflective Leadership (X2)	X21	0.962	0.753	valid
	X210	0.901		valid
	X211	0.910		valid
	X22	0.946		valid
	X23	0.933		valid
	X25	0.938		valid
	X26	0.940		valid

Pedagogical Deep Learning (Y)	X29	0.911	0.798	valid
	Y12	0.876		valid
	Y13	0.787		valid
	Y14	0.902		
	Y16	0.913		
	Y2	0.707		
	Y3	0.931		
	Y5	0.850		
	Y6	0.895		
	Y7	0.895		
	Y9	0.888		
	Y1	0.899		
	Y10	0.891		

Source: Research data, processed using SmartPLS 3.2 (2026).

Based on the displayed outer loading values, all retained indicators met the recommended loading threshold of 0.70. The AVE values obtained from the final SmartPLS output should subsequently be reported to confirm convergent validity. An AVE value above 0.50 indicates adequate convergent validity.

Discriminant Validity

Discriminant validity was assessed using the Fornell–Larcker criterion. Unlike AVE, which is used to assess convergent validity, the Fornell Larcker criterion evaluates whether each construct is empirically distinct from the other constructs in the measurement model. Under the Fornell Larcker criterion, the square root of the AVE of each construct should be greater than its correlations with the other constructs. Therefore, the diagonal values in the Fornell–Larcker matrix should exceed the corresponding off-diagonal correlation values.

	X1	X2	AND
X1	0,797		
X2	0,772	0,878	
AND	0,623	0,754	0,878

Source: Processed data (2026)

The discriminant validity criterion is satisfied when the square root of the AVE for each construct is greater than its correlations with the other constructs. The final values should be taken directly from the Fornell–Larcker output generated by SmartPLS 3.2

Construct Reliability

Construct reliability was assessed using Cronbach’s alpha and Composite Reliability. Values above 0.70 were considered indicative of acceptable internal consistency reliability.

Table 4. Construct Reliability

	Cronbach's Alpha	Composite Reliability
X1	0,854	0,873
X2	0,853	0,823
AND	0,732	0,845

Source: Processed data (2026)

The reliability results should be interpreted using the final SmartPLS output. A construct is considered reliable when its Cronbach’s alpha and Composite Reliability values meet the recommended threshold of 0.70.

Structural Model Evaluation

After the measurement model satisfied the required validity and reliability criteria, the structural model was evaluated. The structural model assessment included the coefficient of determination (R^2) and the path coefficients obtained through bootstrapping.

Coefficient of Determination (*R Square*)

The coefficient of determination (R^2) indicates the proportion of variance in an endogenous construct that can be explained by its predictor constructs within the structural model. Table 5. R Square Value of the Model

Variables	R Square	Criteria
Deep learning	0,887	Strong enough

Source: Research data, processed using SmartPLS 3.2 (2026).

The structural model produced an R^2 value of 0.887 for Pedagogical Deep Learning. This indicates that Teacher Learning Innovation and Principal Reflective Leadership jointly explain 88.7% of the variance in Pedagogical Deep Learning within the proposed structural model, while the remaining 11.3% is attributable to other factors not included in the model. The R^2 value indicates substantial explanatory power of the model based on the specified predictors. However, R^2 should not be interpreted as a test of statistical significance or as evidence that the predictors "simultaneously influence" the endogenous construct. The statistical significance of each predictive relationship is evaluated separately through the path coefficients and bootstrapping results.

Hypothesis Testing and Path Coefficients

The hypothesized predictive relationships were assessed using the path coefficients, t-statistics, and p-values obtained from the bootstrapping procedure. Because the analysis was evaluated using a two-tailed significance level of $\alpha = 0.05$, a t-value greater than 1.96 and a p-value below 0.05 were considered statistically significant.

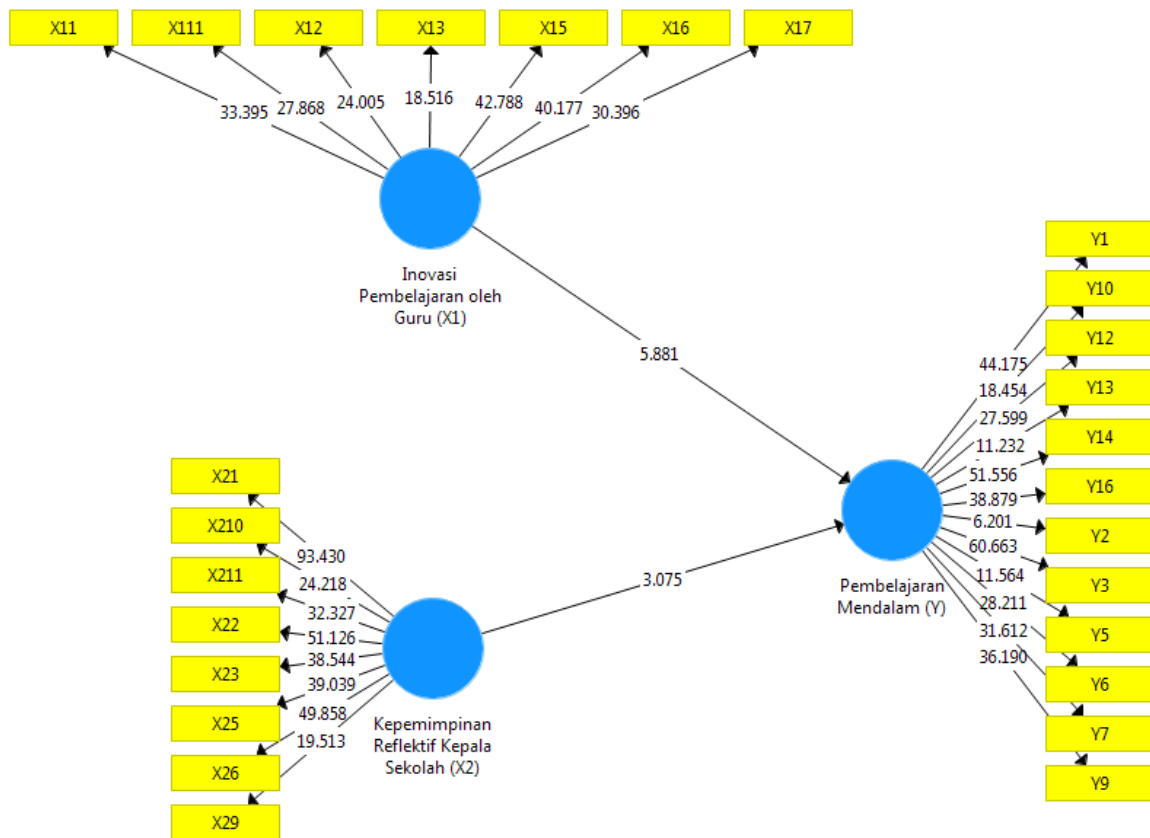


Figure 4. Hypothesis Testing Results

Source: Processed data (2026) PLS

Direct Predictive Relationships

Nu.	Hypothesized Path	Path Coefficient (β)	t-statistic	p-value	Decision
1	X1 $\rightarrow$ Y	0.614	5.881	0.001	Supported
2	X2 $\rightarrow$ Y	0.356	3.075	0.001	Supported

Source: Research data, processed using SmartPLS 3.2 (2026).

Teacher Learning Innovation → Pedagogical Deep Learning

The path from Teacher Learning Innovation (X1) to Pedagogical Deep Learning (Y) produced a positive path coefficient of $\beta = 0.614$, with a t-statistic of 5.881 and a p-value of 0.001. Because the t-statistic exceeds the critical value of 1.96 and the p-value is below 0.05, the relationship is statistically significant. These findings indicate that higher levels of Teacher Learning Innovation are associated with higher levels of Pedagogical Deep Learning. The positive coefficient also indicates that the predictive relationship operates in a positive direction. Thus, the hypothesis proposing a positive predictive relationship between Teacher Learning Innovation and Pedagogical Deep Learning is supported.

Principal Reflective Leadership → Pedagogical Deep Learning

The path from Principal Reflective Leadership (X2) to Pedagogical Deep Learning (Y) produced a positive path coefficient of $\beta = 0.356$, with a t-statistic of 3.075 and a p-value of 0.001. The t-statistic is greater than 1.96 and the p-value is below 0.05, indicating a statistically significant positive predictive relationship. The result indicates that stronger Principal Reflective Leadership is associated with higher levels of Pedagogical Deep Learning. Therefore, the hypothesis proposing a positive predictive relationship between Principal Reflective Leadership and Pedagogical Deep Learning is supported.

DISCUSSION**A. Teacher Learning Innovation and Pedagogical Deep Learning**

The results indicate a positive and statistically significant predictive relationship between Teacher Learning Innovation (X1) and Pedagogical Deep Learning (Y), with a path coefficient of $\beta = 0.614$, a t-statistic of 5.881, and a p-value of 0.001. The magnitude of the coefficient suggests that Teacher Learning Innovation has a relatively stronger standardized association with Pedagogical Deep Learning than Principal Reflective Leadership ($\beta = 0.356$) within the proposed structural model. However, because the study employed a cross-sectional survey design, this finding should be interpreted as a predictive relationship rather than evidence of a causal effect.

The finding suggests that variation in teachers' learning strategies, methods, use of learning media and technology, and opportunities for active student involvement are associated with stronger implementation of pedagogical deep learning. One possible explanation is that innovative instructional practices provide students with more opportunities to construct and connect knowledge rather than merely receive information. When teachers employ inquiry, discussion, problem solving, project-based activities, contextual tasks, or interactive media, students are more likely to engage with learning processes that require interpretation, reflection, application, and connection with real-life contexts.

This interpretation is consistent with the findings reported by [Ashari et al. \(2026\)](#) and [Chen et al. \(2026\)](#), who emphasize the role of innovative instructional practices in creating active, contextual, and student-centered learning environments. Similarly, [Resintia et al. \(2026\)](#) and [Paletta et al. \(2026\)](#) highlight the potential of Project-Based Learning and Problem-Based Learning to provide opportunities for students to analyze problems, evaluate alternatives, and apply knowledge in authentic situations. These studies provide a plausible pedagogical explanation for the positive relationship identified in the present study.

The association can also be interpreted through the three pedagogical dimensions represented in this study: meaningful, mindful, and joyful learning. Innovative learning activities may support meaningful learning by connecting academic concepts with students' experiences and real-world problems. Inquiry, discussion, and reflective activities may support mindful learning by encouraging students to become more aware of how they understand and use knowledge. Meanwhile, interactive learning media, collaborative activities, and varied instructional strategies may contribute to joyful learning by increasing students' engagement and motivation. Thus, the observed relationship between Teacher Learning Innovation and Pedagogical Deep Learning is theoretically plausible because the indicators of instructional innovation provide pedagogical mechanisms through which the characteristics of deep learning can be enacted.

Nevertheless, the magnitude of $\beta = 0.614$ should not be interpreted as evidence that Teacher Learning Innovation independently determines Pedagogical Deep Learning. The coefficient represents the standardized predictive relationship within a model that simultaneously includes Principal Reflective Leadership. Moreover, the data were collected at one point in time using self-report measures. Therefore, alternative explanations, including differences in teacher characteristics, school context, professional experience, access to instructional resources, or respondents' perceptions of both instructional innovation and deep learning, cannot be excluded.

An additional consideration concerns the measurement model. Thirteen indicators with outer loadings below the predetermined threshold were removed before the final structural model was evaluated. Although the remaining indicators demonstrated acceptable statistical properties according to the reported measurement criteria, the removal of a relatively large proportion of the original indicators may affect the breadth of construct representation. In particular, removing five indicators from Teacher Learning Innovation, four from Principal Reflective Leadership, and four from Pedagogical Deep Learning means that the final constructs may represent a narrower empirical operationalization than originally intended. Consequently, the relatively strong relationship between X1 and Y should be interpreted together with the measurement refinement process rather than independently of it. Future studies should confirm the factor structure using a new sample and, where possible, combine questionnaire indicators with observational or other non-self-report measures.

B. Principal Reflective Leadership and Pedagogical Deep Learning

Principal Reflective Leadership (X2) also demonstrated a positive and statistically significant predictive relationship with Pedagogical Deep Learning (Y), with $\beta = 0.356$, $t = 3.075$, and $p = 0.001$. The positive coefficient indicates that stronger perceptions of reflective leadership are associated with higher levels of pedagogical deep learning in the participating elementary schools.

This finding suggests that reflective leadership may provide an organizational context in which teachers are encouraged to evaluate instructional practices, engage in professional reflection, participate in professional development, and use evidence and collaboration in making instructional decisions. Rather than assuming that leadership directly produces changes in classroom practice, the result can be understood as indicating that leadership practices characterized by reflection and collaborative evaluation are associated with conditions that are more supportive of pedagogical deep learning.

This interpretation is broadly consistent with [A'yun et al. \(2025\)](#) and [Ashlan et al. \(2025\)](#), who emphasize the role of reflective practices among school leaders in encouraging teachers to reconsider and improve their instructional practices. [Pan et al. \(2021\)](#) and [Qin et al. \(2025\)](#) similarly emphasize reflection, continuous evaluation, and adaptive decision-making as important dimensions of educational leadership. Taken together, these studies provide a theoretical basis for understanding why Principal Reflective Leadership may be positively associated with pedagogical deep learning.

The relationship may operate through several organizational mechanisms. A principal who routinely facilitates professional dialogue and reflection can create opportunities for teachers to examine instructional problems collectively. Feedback and reflective supervision may also encourage teachers to reconsider established teaching routines and experiment with alternative strategies. In addition, evidence- and collaboration-based decision-making can potentially strengthen the alignment between school-level priorities and classroom instructional practices. These mechanisms are consistent with the conceptualization of reflective leadership used in this study, which includes reflection on instructional policies and practices, support for teacher reflection and professional development, and collaborative and evidence-based decision-making.

However, the smaller coefficient for Principal Reflective Leadership ($\beta = 0.356$) compared with Teacher Learning Innovation ($\beta = 0.614$) should be interpreted carefully. The difference does not establish that teacher innovation is inherently more important than leadership. It only indicates that, within this particular sample and measurement model, Teacher Learning Innovation showed a stronger standardized statistical association with Pedagogical Deep Learning. Differences in measurement, school context, organizational culture, teacher autonomy, and other unmeasured variables may contribute to this pattern.

The cross-sectional design also limits causal interpretation. It is possible, for example, that schools with stronger pedagogical deep learning practices develop leadership practices that teachers perceive as more reflective. Conversely, reflective leadership may create conditions that support teachers' instructional innovation. The present design cannot determine the temporal ordering of these possibilities. Longitudinal or multilevel studies would therefore be valuable for examining how leadership practices and teacher innovation develop over time and whether changes in one construct precede changes in another.

C. Interpreting the High R² Value

The structural model produced an R² value of 0.887 for Pedagogical Deep Learning, indicating that Teacher Learning Innovation and Principal Reflective Leadership jointly account for 88.7% of the variance in the endogenous construct within the estimated model. This represents a high level of explained variance and suggests substantial explanatory power in the observed sample.

Nevertheless, the exceptionally high R^2 value warrants careful interpretation rather than being presented simply as evidence of a highly successful model. One possible explanation is that the three constructs are conceptually related. Teacher Learning Innovation and Pedagogical Deep Learning both involve dimensions of instructional practice, active student engagement, contextual learning, and meaningful learning experiences. Consequently, some degree of conceptual proximity among the constructs may contribute to the high proportion of explained variance.

A second consideration is common method variance. The predictor and outcome constructs were measured through a questionnaire administered to the same respondents. Therefore, shared measurement procedures, response tendencies, social desirability, or respondents' general perceptions of instructional quality may have contributed to correlations among the constructs. The high R^2 value should consequently not be interpreted as if it were derived exclusively from substantive relationships among objectively independent measures. If a formal common method bias assessment was conducted, its results should be reported together with this interpretation. If such an assessment was not conducted, this issue should be acknowledged explicitly as a methodological limitation.

The characteristics of the sample may also contribute to the magnitude of R^2 . The respondents were elementary school teachers from a single district in Pati Regency. The relative similarity of institutional, curricular, and administrative contexts across the participating schools may have reduced contextual variation and potentially strengthened associations among the measured constructs. Therefore, the 88.7% explained variance should not automatically be generalized to elementary schools in other districts or educational contexts.

Furthermore, R^2 represents explained variance, not causal contribution. The value of 0.887 does not mean that the two predictors "cause" 88.7% of Pedagogical Deep Learning, nor does it establish that the remaining 11.3% is caused by specific unidentified variables. Rather, it indicates that the two predictors included in the structural model statistically account for 88.7% of the observed variance in Pedagogical Deep Learning in this sample.

Thus, the high R^2 should be regarded as an important empirical finding but also as a reason for additional validation. Replication with independent samples, longitudinal designs, multilevel analysis, and multiple sources of measurement would help determine whether the magnitude of explained variance remains stable across different contexts.

D. Integrated Interpretation of Teacher Innovation and Reflective Leadership

Taken together, the findings indicate that Teacher Learning Innovation and Principal Reflective Leadership are both positively associated with Pedagogical Deep Learning, although their standardized path coefficients differ. Teacher Learning Innovation demonstrated the stronger statistical association ($\beta = 0.614$), while Principal Reflective Leadership showed a positive association of moderate magnitude ($\beta = 0.356$).

The findings suggest a potentially complementary relationship between teacher-level and school-level factors. Teacher Learning Innovation represents an instructional-level condition that is directly connected with how learning experiences are designed and implemented. Principal Reflective Leadership represents an organizational-level condition that may provide the professional environment, feedback, collaboration, and reflective processes within which instructional innovation can be developed. The two constructs therefore address different but potentially interconnected dimensions of pedagogical improvement.

However, the present study does not test whether Principal Reflective Leadership mediates or moderates the relationship between Teacher Learning Innovation and Pedagogical Deep Learning. Therefore, claims that leadership "enables," "causes," or "strengthens the effect" of teacher innovation would go beyond the evidence provided by the current model. Future research could explicitly test mediation or moderation models to determine whether leadership operates as an organizational mechanism through which teacher innovation is associated with pedagogical deep learning.

The integrated findings therefore support a more cautious conclusion: elementary schools in which teachers report higher levels of learning innovation and principals report stronger reflective leadership also tend to report higher levels of pedagogical deep learning. This interpretation is consistent with the cross-sectional nature of the study and avoids assigning causal direction beyond what the empirical design can establish.

E. Practical Implications

The findings have several practical implications for elementary-school practice. Because the results identify predictive associations rather than causal effects, the implications should be understood as areas for strengthening school practice rather than as interventions proven to produce particular outcomes.

Strengthening Teacher Learning Innovation

Schools may provide teachers with opportunities to develop and exchange innovative instructional practices, particularly strategies that involve inquiry, problem solving, project-based activities, contextual learning,

collaboration, and interactive learning media. Professional learning activities can focus not only on introducing new teaching methods but also on helping teachers evaluate whether those methods promote meaningful understanding, student awareness, engagement, and knowledge application.

Developing Reflective Leadership Practices

Principals may strengthen reflective leadership by establishing structured opportunities for teachers to discuss instructional challenges, examine evidence of learning, receive constructive feedback, and collaboratively identify areas for improvement. Reflective supervision should therefore be positioned not merely as an evaluative activity but also as a professional learning process.

Aligning School-Level Support with Classroom Innovation

The positive association between Principal Reflective Leadership and Pedagogical Deep Learning suggests the importance of aligning school-level leadership practices with classroom instructional development. Principals can facilitate professional learning communities, peer discussion, collaborative lesson review, and evidence-informed decision-making. Such practices may provide a supportive organizational environment for teachers who seek to diversify their instructional approaches.

Strengthening Authentic and Contextual Learning

The findings also support greater attention to learning activities that enable students to connect concepts with authentic situations. Teachers can complement conventional assessment with projects, portfolios, observations, presentations, performance tasks, and reflective activities. These approaches are consistent with the pedagogical dimensions of meaningful, mindful, and joyful learning represented in the Pedagogical Deep Learning construct.

F. Limitations and Directions for Future Research

Several limitations should be considered when interpreting the findings. First, the cross-sectional survey design does not establish temporal or causal relationships among the constructs. Future studies should employ longitudinal or experimental designs to examine whether changes in teacher innovation or reflective leadership are followed by changes in pedagogical deep learning.

Second, all three constructs were measured through self-report questionnaires completed by the same respondents. This creates the possibility of common method variance and shared perceptual bias. Future research should consider combining teacher questionnaires with classroom observations, student-level measures, principal assessments, or other objective indicators.

Third, the high R^2 value of 0.887 should be interpreted cautiously because the constructs may have conceptual overlap and the sample was drawn from elementary schools within a single district. Replication across districts and regions would improve the generalizability of the findings.

Fourth, 13 indicators were removed from the initial measurement model because their outer loadings were below the predetermined threshold. Although the retained indicators met the statistical criteria used in the final model, the elimination of a substantial number of indicators may narrow the content coverage of the original constructs. Future studies should therefore refine the instrument through additional content validation, pilot testing, and confirmatory assessment with independent samples before using the instrument for broader generalization.

Finally, future research could extend the model by examining contextual variables such as teacher professional development, school organizational culture, instructional resources, teacher self-efficacy, or digital competence. Mediation and moderation analyses could also be used to determine whether reflective leadership functions as an organizational mechanism linking teacher-level innovation with pedagogical deep learning.

Overall, the findings provide empirical evidence of positive predictive relationships between Teacher Learning Innovation, Principal Reflective Leadership, and Pedagogical Deep Learning in the participating elementary schools. However, the magnitude of these relationships and the high explanatory power of the model should be interpreted within the limitations of the cross-sectional design, self-report measurement, sample context, and measurement refinement process.

CONCLUSION

The results of this study confirm that Teacher Learning Innovation (X_1) has a significant positive predictive relationship with Pedagogical Deep Learning (Y) among elementary school teachers in Tlogowungu District ($\beta = 0.614$, $p < 0.001$). This finding indicates that higher levels of teacher creativity and pedagogical innovation are strongly associated with the realization of mindful, meaningful, and joyful learning experiences. Through student-centered and contextually relevant instructional strategies, teachers facilitate critical thinking and deeper conceptual understanding

among students, positioning teacher learning innovation as an important predictive driver of Pedagogical Deep Learning.

Similarly, Principal Reflective Leadership (X_2) exhibits a significant positive predictive relationship with Pedagogical Deep Learning (Y) ($\beta = 0.356$, $p = 0.002$). Principals who practice reflective leadership characterized by objective evaluation, strong support for ongoing professional development, and collaborative decision-making foster an institutional environment conducive to instructional improvement. This supportive climate encourages teachers to adopt deeper, student-centered practices.

Together, Teacher Learning Innovation and Principal Reflective Leadership account for 88.7% of the variance in Pedagogical Deep Learning ($R^2 = 0.887$, Adjusted $R^2 = 0.886$). This demonstrates the strong predictive accuracy of the estimated PLS-SEM structural model, emphasizing that the successful implementation of Pedagogical Deep Learning is closely tied to both teacher-level pedagogical agility and school-level reflective leadership. Theoretical Implications

This study contributes to the educational leadership and pedagogy literature in three key ways:

- **Framework Integration:** It provides empirical support for integrating Principal Reflective Leadership and Teacher Learning Innovation within a unified predictive model aimed at fostering Pedagogical Deep Learning in elementary education settings.
- **Empirical Validation of Reflective Leadership:** It extends the theoretical boundary of reflective leadership by demonstrating its empirical association with deep pedagogical outcomes rather than purely administrative compliance.
- **Predictive Insights:** It offers robust PLS-SEM empirical evidence validating that pedagogical transformation requires alignment between instructional leadership and classroom-level innovation.

Research Limitations

The findings of this study should be interpreted in light of several methodological limitations:

- **Cross-Sectional Design:** The study utilized a cross-sectional survey design. While PLS-SEM evaluates predictive relationships, the data collection at a single point in time precludes making absolute causal claims or tracking long-term behavioral changes.
- **Geographical Scope:** The sample was restricted to elementary school teachers within Tlogowungu District, Pati Regency. Consequently, the generalizability of the findings to broader regional, national, or urban educational contexts may be limited.
- **Self-Reported Data:** Data were collected via self-reported questionnaires, which may introduce potential response biases such as social desirability or common method variance, despite procedural controls.

Recommendations

1. Practical Recommendations for Teachers

Teachers are encouraged to continuously enhance their innovative capacity by integrating digital technologies, inquiry-based approaches, and real-world contextual problem-solving into their daily instruction. Cultivating these practices will help sustain mindful, meaningful, and engaging learning environments necessary for Pedagogical Deep Learning.

2. Practical Recommendations for Principals

Principals should institutionalize reflective leadership by establishing regular collaborative reflection sessions, leveraging Teacher Working Groups (Kelompok Kerja Guru/KKG) as professional learning communities, and shifting instructional supervision from administrative compliance toward supportive, feedback-oriented mentoring.

3. Recommendations for Future Research

Future studies are advised to employ longitudinal or mixed-methods research designs to better capture the dynamic mechanisms underlying Pedagogical Deep Learning over time. Expanding the geographic scope and sample size across diverse educational tiers will enhance generalizability. Additionally, future model specifications could incorporate potential mediating or moderating constructs such as teachers' digital self-efficacy, organizational climate, or professional learning community engagement to further clarify the path mechanisms identified in this research.

REFERENCE

- Abdurrahman, I., Hasanah, E., & Sukirman, S. (2026). Principals' instructional leadership strategies for building fostering meaningful learning in primary schools. *Tadbir: Jurnal Manajemen Pendidikan Islam*, 10(1), 169–190.
- Al Fauziyah, I. R., & Ngindom, W. I. B. (2026). Transformational leadership by the school principal in the implementation of deep learning at SDN 10 Air Kumbang, Banyuasin. *JMKSP (Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan)*, 11(1), 261–269.
- Ashari, M. F., & Khoiri, N. (2026). The transformation of deep learning in the Merdeka Curriculum at madrasahs: Instructional leadership and strengthening the 6C competencies. *Journal of Education and Teaching Learning*, 8(2), 553–569.
- Ashlan, S., & Fajri, R. (2025). The impact of self-efficacy and teaching innovation on teacher performance. *Journal of Pedagogy and Education Science*, 4(2), 274–287.
- A'yun, Q., Hendiyani, H., & Rahmadani, M. T. (2025). Teachers leadership in encouraging the implementation of deep learning through internal training programs at Kindergarten Children Ceria Bandung. *Thufuli: Jurnal Ilmiah Pendidikan Islam Anak Usia Dini*, 7(2), 1–8.
- Chen, J., He, X., Ning, Y., Wijaya, T. T., & Liu, J. (2026). Task/technology fit or technology attraction? The intentions of STEM teachers to use AI technologies for teaching innovation. *The Asia-Pacific Education Researcher*, 35(2), 219–233.
- Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Lawrence Erlbaum Associates.
- Emilya, S., Somantri, M., & Kristiawan, M. (2026). Instructional leadership and deep learning in the implementation of the student center learning: A case study of a junior high school in Indonesia. *Journal of Counseling and Education*, 14(1), 23–32.
- Fakhriyah, F., Masfuah, S., & Roysa, M. (2025). Developing innovative science learning models to enhance critical thinking skills in elementary school students. *Jurnal Pendidikan Sekolah Dasar (JPSD)*, 11(1), 45–58.
- Ghozali, I. (2016). *Aplikasi analisis multivariete dengan program IBM SPSS 23* (Edisi 8). Badan Penerbit Universitas Diponegoro.
- Halim, M. F. (2025). Transforming educational leadership: The role of school principals in implementing deep learning-based curricula. *Journal of Educational Management Research*, 4(1), 308–321.
- Hariyasasti, Y. (2025). The influence of competence, work culture on the performance of elementary school teachers in Gunungwungkal District. *International Journal of Social, Policy and Law*, 6(1), 37–41.
- Keane, T., Boden, M., Chalmers, C., & Williams, M. (2020). Effective principal leadership influencing technology innovation in the classroom. *Education and Information Technologies*, 25(6), 5321–5338.
- Khofifah, E. N., Mislikhah, S., & Usriyah, L. (2025). Teacher leaders' strategies in implementing deep learning within the Merdeka Curriculum: A multi-case study in Islamic primary schools. *Al-Adzka: Jurnal Ilmiah Pendidikan Guru Madrasah Ibtidaiyah*, 15(2), 112–125.
- Lubis, F. M., Ramli, A., Jayanto, I., Djunaedi, D., & Ibrahim, M. M. (2025). Analysis of the influence of facilities and infrastructure, adoption of IT and principal leadership on teacher performance. *Edu Cendikia: Jurnal Ilmiah Pendidikan*, 5(1), 229–236.
- Mulyani, H., Istiaq, M. A., Shauki, E. R., Kurniati, F., & Arlinda, H. (2025). Transforming education: Exploring the influence of generative AI on teaching performance. *Cogent Education*, 12(1), Article 2448066.
- Paletta, A., & Alimehmeti, G. (2026). Does the professional learning community intermediate the effects of principal's leadership on teaching innovation? *Management in Education*, 40(3), 192–201.
- Pan, H. L. W., & Chen, W. Y. (2021). How principal leadership facilitates teacher learning through teacher leadership: Determining the critical path. *Educational Management Administration & Leadership*, 49(3), 454–470.
- Pangestika, I., Karsono, K., & Musadad, A. A. (2025). Integrating transformational and instructional leadership to support deep learning in elementary schools: A systematic review. *Social, Humanities, and Educational Studies (SHES): Conference Series*, 9(1), 105–116.
- Purbasari, I., & Fajrie, N. (2025). Collaborative and innovative learning strategies in primary education contexts. *INOPENDAS: Jurnal Ilmiah Kependidikan*, 8(2), 115–124.
- Qin, S., Jia, S., & Su, S. (2025). How does teacher collaboration impact teachers' innovation ability? The chain mediation of teaching motivation and teaching efficacy. *Humanities and Social Sciences Communications*, 12(1), Article 142.
- Resintia, K. M. Y., Rizal, R., Wilade, S., Nashrullah, N., Al Kamil, M. N., & Lapasere, S. (2026). Strategic management of school principals in implementing deep learning: A case study of Indonesian elementary education. *Journal of Innovation and Research in Primary Education*, 5(1), 1409–1421.

- Setiadi, G., & Ratnasari, Y. (2025). The influence of instructional leadership and school climate on teacher pedagogical innovation in elementary schools. *Jurnal Pendidikan Dasar Muria*, 6(1), 88–99.
- Setyadi, A., Pawirosumarto, S., Damaris, A., & Dharma, R. (2025). Risk management, digital technology literacy, and modern learning environments in enhancing learning innovation performance: A framework for higher education. *Education and Information Technologies*, 30(11), 15095–15123.
- Silvani, T., & Sari, M. N. (2026). The principals' role as instructional leaders in the implementation of deep learning in elementary schools in Pekanbaru. *PAJAR (Pendidikan dan Pengajaran)*, 10(3), 405–413.
- Wulansari, S., Valianti, R. M., & Putra, M. J. (2026). Principal strategies for implementing Merdeka Belajar through a deep learning approach at SD Negeri 35 Talang Kelapa. *JMKSP (Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan)*, 11(1), 384–391.
- Zamroni, E., & Widjanarko, M. (2025). Supportive leadership and psychological safety as drivers of teacher innovation in schools. *Jurnal Bimbingan dan Konseling Muria*, 7(2), 201–212.

ACKNOWLEDGEMENT

The Acknowledgements section contains a thank you to the person or institution that assisted in the search and provision of literature and data, the arrangement of materials, or the writing process.

AUTHOR CONTRIBUTION STATEMENT

"E.W. and I.P. conceived the presented idea. F.F. developed the theory and performed the computations. I.W. verified the analytical methods. I.P. and F.F. encouraged I.P. to investigate specific aspects and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript

AI DISCLOSURE STATEMENT

The author declares that artificial intelligence (AI) tools were used in a limited capacity to assist in language editing and improving the clarity of the manuscript. All ideas, analyses, and conclusions presented in this study are the original work of the author, who takes full responsibility for the content of this manuscript

*Endang Widiastuti (Corresponding Author)

Mahasiswa Magister Pendidikan Dasar,

Universitas Muria Kudus,

Jalan Lingkar Utara UMK, Desa Gondangmanis, Kabupaten Kudus, Jawa Tengah , 59327. Indonesia

Email: widiastuti1178.endang@gmail.com

Imaniar Purbasari

Universitas Muria Kudus,

Jalan Lingkar Utara UMK, Desa Gondangmanis, Kabupaten Kudus, Jawa Tengah , 59327. Indonesia

Email: imaniar.purbasari@umk.ac.id

Fina Fakhriyah

Dosen Mahasiswa Magister Pendidikan Dasar,

Universitas Muria Kudus,

Jalan Lingkar Utara UMK, Desa Gondangmanis, Kabupaten Kudus, Jawa Tengah , 59327. Indonesia

Email: fina.fakhriyah@umk.ac.id
