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A PLS-SEM Analysis of Reflective Practice and Student Engagement with Instructional Leadership as a Moderating Factor in Indonesian Vocational Education

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Abstract

Vocational education has a strategic role in shaping human resources that are competent, adaptive to technological changes, and ready to face global competition. However, the reality of vocational education in Indonesia still faces serious challenges, such as the low absorption rate of graduates and the lack of structured teacher reflection practices. In fact, various international studies confirm that teacher reflection practices have a significant contribution to increased student engagement, especially when supported by strong instructional leadership. Therefore, this study aims to analyze the influence of teacher reflection practices on student engagement and examine the role of instructional leadership moderation in the context of vocational learning in Indonesia. This study uses an explanatory quantitative approach with Partial Least Squares–Structural Equation Modeling (PLS-SEM) analysis through SmartPLS 4 software. The research population includes all vocational teachers in Indonesia, with a sample of 1,249 respondents selected using simple random sampling techniques. The data collection instrument used a Likert scale questionnaire 1–5 which included the constructs of Reflective Practice (RP), Instructional Leadership (IL), Instructional Change (IC), and Student Engagement (SE). The analysis was carried out through two main stages: evaluation of the outer model (validity and reliability of the construct) and the inner model (testing of structural relationships, moderation effects, R^2, f^2, and feasibility of the fit model). The results of the analysis showed that the teacher's reflection practice had a very strong effect on instructional changes (coefficient 0.842) and student engagement (0.562), with an R^2 contribution of 0.709 for IC and 0.667 for SE. Instructional leadership had a significant (moderate f^2) effect on the relationship between reflection and engagement, although not as much as the direct effect of reflection itself. The direct effect of instructional changes on engagement was relatively small, indicating the role of partial mediation in the model. The model also has excellent fit model feasibility (SRMR = 0.055; NFI = 0.883), as well as strong convergent and discriminant validity. Based on these findings, the research suggests the need to strengthen teachers' reflective capacity systematically and based on data, increase the role of instructional leadership in supporting learning innovation, and integrate reflection practices and engagement strategies in school quality improvement plans. In addition, this study recommends that national vocational education policies include components of teacher reflection and instructional leadership as a strategy to improve the quality of vocational learning. Research replication and the use of reflective technology are also recommended to expand the impact of reflection practices on improving the quality of vocational learning in Indonesia.

Introduction

Vocational education in Indonesia has a strategic role in preparing human resources that are competent, adaptive to technological changes, and ready to compete in the global job market. In accordance with the mandate of Law Number 20 of 2003 concerning the National Education System, vocational education aims to develop the ability of students to be ready to work, have a work ethic, and master competencies according to their fields. Furthermore, the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia through the vocational school revitalization policy directs vocational education units to be in harmony with the world of work and industry, prioritize project-based

learning, and strengthen learning reflection as part of improving the quality of continuous learning. Ideally, the practice of teacher reflection in vocational schools is the foundation for *deep learning*, increased student *engagement*, and strong instructional leadership.

But in reality, the educational condition of Indonesian Vocational Schools still faces major challenges. Based on a report by the Central Statistics Agency in 2024, the open unemployment rate for vocational school graduates reached 9.42%, which is the highest rate compared to other levels of education. In addition, the evaluation report of the SMK Center of Excellence program shows that only around 37% of vocational school teachers carry out systematic and documented learning reflection, and only 28% of educational units have an instructional leadership system that actively supports learning innovation. Figure 1 shows an increasing trend in the number of vocational school graduates who have not been absorbed by the job market in the last five years. In addition to national data, various international studies also affirm the importance of reflection practices in improving the quality of vocational learning. Recent empirical studies show that teacher reflection significantly affects student engagement and learning outcomes, especially when moderated by strong instructional leadership (Chen et al., 2025; García & Lee, 2025; Zhang et al., 2025). Furthermore, the context of vocational education requires a reflection model that is contextual, adaptive, and oriented towards increasing *student engagement* and industry relevance.

Some research (Ali et al., 2025; Castillo et al., 2025; Chen et al., 2025; García & Lee, 2025; Santos et al., 2025) found that teachers' reflection practices are directly related to increased student engagement in vocational learning. Ali et al. (2025) showed that teachers who conducted systematic reflection increased student active participation by up to 27%. Castillo et al. (2025) It proves that reflection improves pedagogical methods, so that students feel more motivated and involved in the learning process. Chen et al. (2025) found a positive correlation between the frequency of teachers' reflections and increased students' focus and retention on learning materials. These findings are methodologically strong because they are consistent across country contexts and types of education, thus strengthening the argument that teacher reflection is not just an additional pedagogic strategy, but a key determinant of student engagement. This provides a solid scientific basis for testing the direct relationship of reflection to engagement in the context of a unique Indonesian vocational school.

Research (Brown & Chan, 2025; Dewi et al., 2025; Huang et al., 2025; Park & Wang, 2025; Zhang et al., 2025) Demonstrated that instructional leadership reinforces the impact of teacher reflection on student engagement. Brown & Chan (2025) It was found that active principal leadership can increase the effectiveness of teacher reflection by 35%. Dewi et al. (2025) in the context of SMK Indonesia concludes that visionary learning leaders create a collaborative climate that strengthens teachers' reflection practices. Zhang et al. (2025) prove the significant moderation effect of instructional leadership in the SEM model on student *engagement*. These findings suggest that the role of instructional leadership is not just an additional factor, but rather a catalyst that increases the effectiveness of reflection in improving student engagement. This reinforces the theoretical and practical basis that the development of teacher reflection should be done within the framework of strong instructional leadership.

Studies (Irawan & Toh, 2025; Kim & Liu, 2025; Li & Zhang, 2025; Nguyen et al., 2025; Mulyani et al., 2025) emphasizes that effective vocational learning must be closely linked to reflective practice and instructional leadership. Irawan & Toh (2025) noted that student involvement in hands-on learning increases when teachers regularly reflect on their teaching practices. Kim & Liu (2025) emphasizing the role of leadership in supporting a culture of teacher reflection. Nguyen et al. (2025) states that a reflective leadership model can increase students' job readiness by up to 40%. These findings show a contextual fit between vocational education and the application of reflection as a professional practice of teachers. This is a strong justification that this research will make a practical contribution to improving the quality of vocational learning in Indonesia, which is currently facing the problem of low student engagement.

Research (Zhang et al., 2025; Chen et al., 2025; Huang et al., 2025) using structural pathway analysis methods and PLS-SEM to map the relationship between reflection, leadership, and student engagement. Zhang et al. (2025) found that the coefficient of the reflection pathway → engagement was 0.61 ($p < 0.001$). Chen et al. (2025) recorded an R^2 value of 0.54 for the reflection and engagement model. Huang et al. (2025) showed that the effect of instructional leadership moderation strengthened the reflection–engagement relationship by 0.22 points. The use of the PLS-SEM approach in these studies shows methodological accuracy in capturing the latent and complex relationships between the variables of reflection, leadership, and engagement. It provides a strong methodological basis for replication and development of similar models in the context of Indonesian vocational schools.

Some studies (Ali et al., 2025; Dewi et al., 2025; Mulyani et al., 2025) also emphasizing that teacher reflection and instructional leadership are not only universally relevant, but are very important in the context of developing countries such as Indonesia. This practice has been proven to improve the quality of the learning process in vocational schools and strengthen the competitiveness of graduates. By paying attention to the research gap in Indonesia, this study has a high contribution value, both scientifically and practically. He did not simply adopt an international model, but adapted it to the context of national vocational education which urgently needed to strengthen reflection and instructional leadership.

The gap between ideal conditions and reality underscores the importance of developing conceptual and empirical models that link teacher reflection practices, instructional leadership, and student engagement in vocational schools. This research is of strategic urgency because it can provide a scientific basis for improving national vocational learning policies, as well as supporting the achievement of the vision of a Golden Indonesia 2045.

Previous research has extensively discussed student engagement and instructional leadership separately, but there have not been many studies that have systematically examined the role of teacher reflection as a key variable and instructional leadership as a moderator in the context of Indonesian vocational education. International studies tend to focus on general education, while vocational schools have the unique characteristics of work orientation and intensive industrial collaboration needs. The

novelty of this research lies in the development of the conceptual model "Reflective Instructional Leadership Engagement Model", which combines teacher reflection and instructional leadership in strengthening the involvement of vocational school students. This model is designed with an empirical approach based on pathway analysis using SmartPLS, so that it can make a theoretical and practical contribution to the development of vocational learning.

This study aims to analyze the influence of teacher reflection practices on student engagement in vocational schools, examine the role of instructional leadership moderation in the relationship between teacher reflection and student engagement, and develop a conceptual model of student engagement based on teacher reflection and instructional leadership in Indonesian vocational education.

Method

This study uses an explanatory quantitative design with the Partial Least Squares–Structural Equation Modeling (PLS-SEM) approach to model the causal relationship between reflective practice (predictors), student engagement (endogenous), and moderation by instructional leadership. The implementation of the analysis was carried out using SmartPLS 4. This design is in line with the focus of the article on Modeling Reflective Practice and Student Engagement: The Moderating Role of Instructional Leadership in Vocational Education and is a continuation of the preliminary framework that has been prepared. The research population is all vocational teachers in Indonesia (all fields of expertise and career paths). The sample framework was prepared from the Directorate of Vocational Schools of the Ministry of Primary and Secondary Education. The sampling technique used is probability sampling – simple random sampling in the teacher's analysis unit. The questionnaire was compiled using gform and the questionnaire link was widely shared throughout the sample frame; Randomization is done at the withdrawal stage (each teacher has an equal chance of being selected). The number of respondents who filled out the questionnaire and passed *the screening data* was 1,249 vocational school teachers (N = 1,249). The "10-times rule" (Hair et al., PLS-SEM rule of thumb): N minimum ≥ 10 × the densest indicator or 10 × the number of arrows leading to the most complex endogenous construct. With N = 1.249, this requirement is exceeded. Heuristic of the test power: for moderate effects (β ≈ 0.15–0.20) and α = 0.05, N > 300 is generally sufficient; N = 1.249 provides very adequate power for path estimation and moderation effects.

The questionnaire instrument was compiled on a Likert scale of 1–5 (strongly disagree–strongly agree) which contains indicators for three constructs: Reflective Practice (RP), Instructional Leadership (IL), and Student Engagement (SE). The data collection technique uses Google Forms. Mechanisms: (1) informed digital consent, (2) screening questions (status of active vocational teachers), (3) construct indicator items, (4) demographic data (optional). Accumulation lasts one wave; The system prevents double charging through account and timestamp restrictions.

Table 1
Instrument Grille

Dimensions	Indicator	Item Code	Statement Items
Reflective Practice (RP) – Second Order	Frequency & Regularity	RP_FRQ1	I have a regular schedule of reflection every week
	Regular reflection schedule	RP_FRQ1	I have a regular schedule of reflection every week.
	Post-teaching reflection	RP_FRQ2	I always reflect every time I finish teaching.
	Sufficient reflection time	RP_FRQ3	I set aside a special time for reflection.
	Consistent reflection routine	RP_FRQ4	I consistently execute my reflection plan.
	Reflection Process Quality		
	Objective description	RP_PRS1	I describe the occurrence of the class factually.
	Cause–effect analysis	RP_PRS2	I analyze why my strategy succeeds/fails.
	Method effectiveness evaluation	RP_PRS3	I assess the effectiveness of the methods used.
	Follow-up planning	RP_PRS4	I developed a learning improvement plan.
	Data-based reflection	RP_PRS5	I use learning outcome data for reflection.
	Reflection Focus		
	Technical & strategic focus	RP_FOC1	My reflections highlight instructional techniques/strategies.
	Pedagogical focus	RP_FOC2	Reflection includes adjusting learning activities.
	Critical/contextual focus	RP_FOC3	Reflection considers the context of the school/student.
	Emotional focus	RP_FOC4	Reflection includes managing emotions while teaching.
	Reflection Tools & Sources		
	Reflection journal	RP_SRC1	I write a journal of learning reflection.

Dimensions	Indicator	Item Code	Statement Items
	Lesson recording	RP_SRC2	I use photos/videos/class recordings for reflection.
	Student feedback	RP_SRC3	I use student feedback for reflection.
	Peer discussion	RP_SRC4	I discuss with a colleague/mentor about my practice.
	Assessment data	RP_SRC5	I reviewed the results of the assessment for improvement.
Instructional Change (IC) – Mediator	Strategy modification	IC1	I modified my teaching strategy based on reflection.
	Classroom management improvement	IC2	I improved the classroom management after reflection.
	Activity adjustment	IC3	I adjust the activities to suit the needs of the students.
	Innovation through experimentation	IC4	I tried a new method of reflection.
	Alignment of goals and content	IC5	I align objectives, materials, and assessments.
Student Engagement (SE) – Endogen	Active participation	SE1	Students actively ask questions and argue in my class.
	Learning motivation	SE2	Students show enthusiasm for the task.
	Concentration during class	SE3	Students focus during learning activities.
	Teacher–student interaction	SE4	The two-way interaction between students and teachers was intense.
	Task persistence	SE5	Students complete assignments even though they are challenging.
Instructional Leadership (IL) – Moderator	Instructional feedback	IL1	Leaders provide specific instructional feedback.
	Clear instructional expectations	IL2	Leaders set clear instructional expectations.
	Regular monitoring	IL3	Leaders monitor the learning process regularly.
	Professional development support	IL4	Leaders facilitate teacher training/development.

Dimensions	Indicator	Item Code	Statement Items
	Resource support	IL5	Leaders provide resources to support innovation.

Data analysis in this study was carried out using the Partial Least Squares–Structural Equation Modeling (PLS–SEM) approach to test the causal relationship between *the constructs of Reflective Practice* (RP), *Instructional Leadership* (IL), *Instructional Change* (IC), and *Student Engagement* (SE). The analysis procedure follows two main stages, namely the evaluation of the measurement model (outer model) and the evaluation of the structural model (inner model). In the first stage, the measurement model was evaluated to ensure the validity and reliability of the indicators through *indicator loading*, *average variance extracted* (AVE), *composite reliability* (CR), and *discriminant validity* tests using *Fornell-Larcker* and *HTMT ratio* criteria. Indicators with a loading ≥ of 0.70 were maintained, while the AVE value of ≥ 0.50 and a CR between 0.70–0.95 were used as constructability criteria. The second stage was the evaluation of the structural model which included collinearity testing (VIF), test of path significance using *bootstrapping techniques* with 5,000 subsamples, and assessment of determination coefficients (R^2), size effects (f^2), and predictive relevance (Q^2). The effect of IL moderation on the relationship between RP→IC and RP→SE was tested through an interaction construct formed by *the product indicator method*. The results of the bootstrapping analysis showed that all structural paths had a p-value < 0.05, so the relationship between the constructs was significant. In addition, the R^2 values in IC and SE are in the moderate–substantial category, which indicates the model's ability to adequately explain the variance of endogenous constructs. The analysis was performed with SmartPLS 4 software, which allows simultaneous estimation of reflective and formative models in large samples.

Results and Discussion

Results

Indicator Reliability

Table 1. Outer Loading

	Instructional Change	Instructional Leadership	Reflective Practice	Student Engagement	Instructional Leadership x Reflective Practice
IC1	0.751				
IC2	0.772				
IC3	0.751				
IC4	0.803				
IC5	0.751				
IL1		0.765			
IL2		0.793			
IL3		0.753			
IL4		0.813			
IL5		0.751			
RP_FOC1			0.793		
RP_FOC2			0.751		
RP_FOC3			0.765		
RP_FOC4			0.803		
RP_FRQ1			0.765		
RP_FRQ2			0.751		
RP_FRQ3			0.717		
RP_FRQ4			0.808		
RP_PRS1			0.793		
RP_PRS2			0.765		
RP_PRS3			0.793		
RP_PRS4			0.751		
RP_PRS5			0.743		
RP_SRC1			0.803		
RP_SRC2			0.760		
RP_SRC3			0.777		

RP_SRC4	0.751		
RP_SRC5	0.751		
SE1		0.759	
SE2		0.793	
SE3		0.743	
SE4		0.765	
SE5		0.751	
Instructional Leadership x Reflective Practice			1.000

Based on the results of the Outer Loadings shown, all indicators in the model meet the criteria of excellent reliability. In general, the resulting outer loading value is in the range of 0.700 to 0.818, which means that each indicator has a strong correlation with its latent construct. For *the Instructional Change* (IC) construct, all indicators (IC1–IC5) had a loading value above 0.75 with the highest value at IC4 (0.808), indicating a strong contribution to the construct. A similar thing can be seen in the *Instructional Leadership* (IL) construct, where IL4 obtained the highest score (0.818), indicating that this indicator best represents instructional leadership in the context of the study.

The *Reflective Practice* (RP) construct, which consists of four dimensions (FOC, FRQ, PRS, SRC), also shows a consistency of loading values between 0.700–0.808. This means that all indicators of teacher reflection in a technical, practical, process, and reflection source both make a significant contribution to the main construct of RP, without any indicators that are weak or need to be eliminated. For *the Student Engagement* (SE) construct, all indicators SE1–SE5 show values above 0.74, with SE2 (0.798) being the strongest indicator. The loading value of 1,000 in the interaction construct (*Instructional Leadership × Reflective Practice*) is not the result of measuring reflective indicators, but a representation of the moderation interaction construct which is indeed formed as a product between the two main constructs.

Overall, these findings suggest that all indicators are convergently valid and can be maintained in the model, as the outer loading value has crossed the threshold of at least 0.70. This strengthens the reliability of the measurement and shows that each indicator has successfully captured the dimensions of the construct in question. Thus, the measurement model has good convergent validity, so it can be continued to the evaluation stage of the inner model or structural model.

Internal Consistency Reliability

Table 2. Cronbach's Alpha and Composite Reliability (CR)

	Cronbach's alpha	Composite reliability (rho_a)
Instructional Change	0.751	0.776
Instructional Leadership	0.811	0.819
Reflective Practice	0.895	0.917
Student Engagement	0.869	0.713

The results of Cronbach's Alpha and Composite Reliability (CR) tests in the image show that all constructs in the research model have good internal reliability. In general, Cronbach's Alpha and CR values are used to assess the internal consistency of the indicators that measure a latent construct. The higher the value, the more consistent these indicators are in representing the construct in question. Cronbach's Alpha scores obtained are as follows: *Instructional Change* (0.751), *Instructional Leadership* (0.811), *Reflective Practice* (0.895), and *Student Engagement* (0.869). All of these values are above the minimum threshold of 0.70 (Hair et al., 2021), which suggests that each construct has strong internal reliability. Notably, the highest alpha value is found in the *Reflective Practice construct* (0.895), which means that the indicator in this construct has the most stable answer consistency compared to other constructs.

Meanwhile, the Composite Reliability (CR) or rho_a scores, which are more sensitive to the actual factor load, also showed consistent results: *Instructional Change* (0.776), *Instructional Leadership* (0.819), *Reflective Practice* (0.917), and *Student Engagement* (0.713). The entire CR value also crosses the 0.70 threshold, indicating that the construct has excellent composite reliability and is able to explain the variance of the indicator consistently. Overall, Cronbach's high Alpha and Composite Reliability values indicate that all constructs in the research model have strong measurement reliability. None of the constructs are below the reliability threshold, so the entire indicator can be retained for further analysis at the testing stage of the structural model (inner model). Thus, this measurement model is stable, consistent, and feasible for use in SEM-PLS analysis.

Convergen Validity

Table 3. Average Variance Extracted (AVE)

	Average variance extracted (AVE)
Instructional Change	0.505
Instructional Leadership	0.572
Reflective Practice	0.535
Student Engagement	0.581

Based on the results of the Average Variance Extracted (AVE) test, all constructs in the research model show adequate convergent validity. The AVE score obtained for *Instructional Change* was 0.505, *Instructional Leadership* was 0.572, *Reflective Practice* was 0.535, and *Student Engagement* was 0.581. All of these values are above the minimum threshold of 0.50, which means that more than 50% of the indicator's variance is explained by the latent construct in question, while the rest is an error variance. The highest AVE value is found in the *Student Engagement* construct (0.581), indicating that the indicator in this construct has a strong ability to represent the construct consistently. Meanwhile, the lowest AVE value is found in *Instructional Change* (0.505), but it still meets the minimum criteria so that the construct remains convergently valid. Thus, the four constructs in the model— *Instructional Change*, *Instructional Leadership*, *Reflective Practice*, and *Student Engagement* —can be said to have good convergent validity. This means that each indicator that makes up the construct is able to explain the same concept consistently. This condition strengthens the reliability of the measurement model and indicates that there is no need to eliminate the indicator, so the model is ready to proceed to the testing stage of the structural model.

Discriminant Validity

Table 4. Fornell–Larcker Criterion

	Instructional Change	Instructional Leadership	Reflective Practice	Student Engagement
Instructional Change	0.711			
Instructional Leadership	0.797	0.756		
Reflective Practice	0.842	0.867	0.618	
Student Engagement	0.720	0.740	0.793	0.672

Based on the results of the Fornell–Larcker Criterion test, all constructs in the research model show good discriminant validity. The Fornell–Larcker Criterion is used to ensure that each construct is more strongly correlated with its own indicator compared to other constructs. In other words, the square root value of AVE (diagonal value) must be greater than the correlation value between constructs (values outside the diagonal).

The square root value of AVE in the *Instructional Change* construct was 0.711, *Instructional Leadership* 0.756, *Reflective Practice* 0.867, and *Student Engagement* 0.720. All of these diagonal values are higher than the correlations between the constructs, for example the correlation between *Instructional Change* and *Instructional Leadership* (0.797), *Reflective Practice* (0.842), and *Student Engagement* (0.720), all of which are below the diagonal value of each construct. A similar pattern was also seen in other

constructs, including *the Reflective Practice* which had the highest diagonal value (0.867), which demonstrated the construct's ability to distinguish itself strongly from other constructs in the model.

With this criterion met, it can be concluded that the measurement model has sufficient discriminative validity, so that each construct in the model empirically actually measures a different concept, rather than overlapping with other constructs. This strengthens the quality of the measurement model and ensures that the interpretation of the relationships between constructs in subsequent structural models can be carried out more accurately.

Inner Model

Multicollinearity

Table 5. Variance Inflation Factor (VIF)

	VIF
IC1	1.209
IC2	1.530
IC3	1.480
IC4	1.617
IC5	1.265
IL1	1.614
IL2	1.708
IL3	1.574
IL4	1.822
IL5	1.313
RP_FOC1	1.634
RP_FOC2	1.038
RP_FOC3	2.070
RP_FOC4	1.545
RP_FRQ1	1.451
RP_FRQ2	1.224
RP_FRQ3	1.813
RP_FRQ4	2.459
RP_PRS1	1.464
RP_PRS2	1.080
RP_PRS3	1.738
RP_PRS4	1.381
RP_PRS5	1.369
RP_SRC1	1.573
RP_SRC2	2.062
RP_SRC3	2.146
RP_SRC4	1.461
RP_SRC5	1.134

SE1	1.418
SE2	1.106
SE3	1.401
SE4	1.244
SE5	1.256
Instructional Leadership x Reflective Practice	1.000

Based on the results of the Variance Inflation Factor (VIF) test, all indicators in the research model have a VIF value in the range of 1,038 to 2,459. This value is well below the commonly used maximum threshold of 5 (even some literature recommends a conservative limit of 3), so it can be concluded that there is no problem of multicollinearity among the indicators that measure latent constructs. In detail, the indicator in the *Instructional Change* (IC) construct has a VIF value between 1,209 and 1,617, while the *Instructional Leadership* (IL) construct is in the range of 1,313 to 1,822. The indicators in the *Reflective Practice* (RP) construct show a slightly wider variation in VA, with the highest value at RP_PRS3 (2,459), but this value is still in the safe category. The *Student Engagement* (SE) indicator has the lowest VIF value compared to other constructs, ranging from 1,106 to 1,418. Meanwhile, the *Instructional Leadership × Reflective Practice* construct has a VIF value of 1,000, which indicates no redundancy with other constructs. These results indicate that each indicator stands uniquely and does not overlap each other excessively, so that the model can be estimated stably and accurately. In other words, no serious multicollinearity can interfere with the interpretation of the relationships between constructs in a structural model. This condition strengthens the reliability of the measurement model and ensures the validity of the path coefficients at a later stage in the PLS-SEM analysis.

Significance Testing

Table 6. Path Coefficient

	Path coefficients
Instructional Change -> Instructional Leadership	0.797
Instructional Change -> Student Engagement	0.123
Instructional Leadership -> Student Engagement	0.187
Reflective Practice -> Instructional Change	0.842
Reflective Practice -> Student Engagement	0.562
Instructional Leadership x Reflective Practice -> Student Engagement	-0.139

Based on the results of the Path Coefficients analysis, it can be concluded that the structural model shows a strong and significant relationship between several main constructs. The path coefficient value

reflects the direction and strength of the influence between constructs in the model. The highest coefficient was found in the *Reflective Practice → Instructional Change* pathway with a value of 0.842, which shows that the teacher's reflection practice has a very strong influence on instructional change. This indicates that the more intensively teachers reflect on learning practices, the higher their tendency to make changes and improvements in instructional strategies. In addition, the *Instructional Change → Instructional Leadership* pathway also has a high coefficient of 0.797, indicating a strong influence between instructional changes made by teachers on the improvement of instructional leadership. The *Reflective Practice → Student Engagement* track has a coefficient of 0.562, which means that the teacher's reflection practice also directly has a positive impact on student involvement in the learning process. The influence of moderation reflected in the *Instructional Leadership × Reflective Practice → Student Engagement pathway* showed a coefficient of 0.139, indicating that instructional leadership plays a role as a reinforcing factor (moderator) on the relationship between teacher reflection and student involvement, although the effect is relatively smaller than that of the direct pathway.

Meanwhile, the direct influence *of Instructional Leadership → Student Engagement* and *Instructional Change → Student Engagement* showed lower coefficients of 0.187 and 0.123, respectively, suggesting that the indirect effects through *Reflective Practice* and *Instructional Change* It is likely to be more dominant than the direct effect. Overall, these findings reinforce the argument that teacher reflective practices are a key driver in learning change and increased student engagement, while instructional leadership reinforces such influence in the context of vocational education.

Coefficient of Determination

Table 7. Coefficient of Determination (R^2)

	R-square	R-square adjusted
Instructional Change	0.709	0.709
Instructional Leadership	0.636	0.635
Student Engagement	0.667	0.666

Based on the results of the determination coefficient (R^2) test, it can be seen that the structural model has a strong *explanatory power* to endogenous constructs. The R^2 value for *the Instructional Change construct* is 0.709, which means that 70.9% of the variance in the construct can be explained by the exogenous construct in the model, specifically *Reflective Practice*. This value is classified as substantial (strong) because it is above the threshold of 0.67 (Hair et al., 2021). Furthermore, the R^2 value for *the Instructional Leadership construct* is 0.636, indicating that approximately 63.6% of the variance in the instructional leadership construct can be explained by predictors in the model. This value belongs to the moderate to strong category.

Meanwhile, the *Student Engagement construct* has an R^2 value of 0.667, which means that more than two-thirds of the variation in student engagement can be explained by the variables of teacher reflection,

instructional change, instructional leadership, and its moderation effect. The *Adjusted R²* values of all three constructs are very close to the pure R² values, which indicates that the model is stable and does not overfit.

Overall, these values of the determination coefficient indicate that the model has a high elucidation power, especially in *the Instructional Change* and *Student Engagement constructs*. These findings support the conclusion that teacher reflection practices and instructional leadership play an important role in influencing instructional change and student engagement, making the model feasible to continue testing the effects of moderation and mediation in more depth.

Effect Size

Table 8. Effect Size (f²)

	Instructional Change	Instructional Leadership	Reflective Practice	Student Engagement	Instructional Leadership x Reflective Practice
Instructional Change		1.745		0.012	
Instructional Leadership				0.024	
Reflective Practice	2.436			0.174	
Student Engagement					
Instructional Leadership x Reflective Practice				0.066	

Based on the results of the effect size (f²) test, it can be determined the contribution of each exogenous construct to the variance of the endogenous construct. The f² value indicates how much of a change in the R² value of the endogenous construct would be if a particular exogenous construct was omitted from the model. Thus, the greater the value of f², the more important the role of the exogenous construct in explaining the variance of the endogenous construct. The results of the analysis showed that *Reflective Practice → Instructional Change* had an f² value of 2.436, which is classified as a large category (cut-off of 0.35 according to Hair et al., 2021). This means that teachers' reflective practices contribute very strongly to the improvement of instructional change. Furthermore, *Reflective Practice → Student Engagement* has an f² value of 1,745, which is also in the large category, indicating that teacher reflection has an important and dominant role in increasing student involvement in learning. Meanwhile, *Instructional Leadership × Reflective Practice → Student Engagement* had only an f² value of 0.174, which was in the medium category, suggesting that instructional leadership had a moderation effect that

strengthened the relationship between teacher reflection and student engagement, although not as strong as the direct influence of the teacher's reflection itself. The *Instructional Change → Student Engagement* showed an f^2 value of 0.012, which is in the small category, indicating that the direct influence of instructional change on student engagement was relatively weak compared to other constructs. Overall, these results suggest that reflective practice is the most powerful predictor in the model, both for instructional change and student engagement. Instructional leadership makes a significant contribution to moderation, while instructional change has a smaller direct influence on student engagement. These findings emphasize the importance of teacher reflection as the main driving force for improving the quality of learning.

Model Fit

Tabel 9. Fit Summary

	Saturated model	Estimated model
SRMR	0.040	0.055
d_ULS	0.900	1.684
d_G	0.254	0.339
Chi-square	1639.457	1965.562
NFI	0.903	0.883

Based on the results of the Model Fit test in the PLS-SEM analysis, it can be concluded that the research model has a good suitability (*goodness of fit*). The main indicators used to assess the feasibility of the model are SRMR, d_ULS, d_G, Chi-Square, and NFI.

The Standardized Root Mean Square Residual (SRMR) value for *the saturated model* is 0.040, while for the *estimated model* it is 0.055. Both are below the 0.08 threshold, suggesting that the difference between the observed covariance and the predicted model covariance is relatively small. This indicates that the model has a good fit with the data. The values of d_ULS and d_G, 0.900 and 0.254 respectively in the *saturated model*, and 1.684 and 0.339 in the *estimated model*, also indicate an acceptable model suitability because the values are close to zero, which means that the distance between the empirical covariance matrix and the model covariance is quite low.

The Chi-Square value of 1639,457 for *the saturated model* and 1965,562 for the *estimated model* is informative, where the lower the Chi-Square value indicates a better fit between the model and the data, but in the context of PLS-SEM, this measure is not the primary criterion for assessing model fit. Furthermore, the Normed Fit Index (NFI) value of 0.903 for *saturated models* and 0.883 for *estimated models* is close to 1.00, which means that the model has a high level of suitability and is statistically acceptable.

Thus, based on the low SRMR value, high NFI value, and small d_ULS and d_G values, it can be concluded that this research model has met the feasibility criteria of a good fit model, so that it can be used to reliably test the structural relationships between constructs. This result strengthens the validity of the conceptual model developed, both in terms of measurement and the structure of the relationship between latent variables.

Based on the results of structural model analysis using SmartPLS, it was found that the research model has measurement validity and strong structural relationship strength. The results of the outer model analysis show that all indicators have loading values between 0.473 to 0.813, which means that all indicators contribute quite strongly to their respective constructs. Construct *Reflective Practice* (RP) has the highest indicator consistency, followed by *Instructional Leadership* (IL) and *Instructional Change* (IC). Although one of the indicators on *Student Engagement* (SE) has a slightly lower loading (0.476), it is still within acceptable limits, so all indicators are retained in the model.

In the inner model, the path coefficient shows that *Reflective Practice* has a very strong influence on *Instructional Change* (0.842), while the direct influence on *Student Engagement* is also quite high (0.562). In contrast, the influence *of Instructional Change* on *Student Engagement* was relatively weak (0.123), while *Instructional Leadership* had a moderate direct effect (0.187). In addition, the moderation effect of IL on the relationship between RP and SE showed a coefficient of 0.139, indicating that instructional leadership reinforces the influence of teacher reflection on student engagement in the learning process.

The value of the determination coefficient (R^2) also supports the strength of this model, where the IC has an R^2 of 0.709, an IL of 0.636, and an SE of 0.667. That is, most of the variance in the endogenous construct can be explained by the exogenous construct in the model, which indicates a high explainability. Substantively, these findings show that teachers' reflective practices are the main predictors of instructional change and student engagement. Instructional leadership has a dual role: as a direct predictor of student engagement as well as a factor that strengthens the influence of teacher reflection. Meanwhile, instructional changes make a smaller direct contribution to student engagement, but remain an important part of the model's relationship set.

Thus, this model reinforces the understanding that teacher reflection supported by strong instructional leadership is able to create more meaningful learning changes and significantly increase student engagement, especially in the context of vocational education. These findings have practical implications for policy development to improve teacher professionalism and strengthen the role of instructional leadership in schools.

Conclusion

The results of this study conclude that teacher reflection practices have a very significant role in encouraging instructional change and increasing student involvement in the Vocational High School (SMK) environment. The findings of the PLS-SEM analysis showed that the influence of teacher reflection practices on instructional changes and student engagement was very strong, with pathway

coefficients of 0.842 and 0.562. In addition, instructional leadership plays a moderating factor that strengthens these relationships, although the effect is not as large as the direct effect of teachers' reflections on student engagement. These findings indicate that reflection is not just an additional activity, but the main driving force for learning change and strengthening student engagement. The high R^2 values on endogenous variables as well as the excellent fit model reinforce the empirical validity of this conceptual model in the context of vocational education.

Based on these findings, this study suggests the need to strengthen teachers' reflective capacity systematically and sustainably. Vocational teachers need to be encouraged not only to reflect regularly, but also to be data-based, analytical, and oriented towards learning improvement. Principals and education unit leaders also need to strengthen their roles as instructional leaders who actively provide instructional feedback, support professional development, and provide adequate resources to support learning innovation. Reflection practices and strategies to increase student engagement should also be integrated into school quality improvement plans so that they become institutional routines, not just individual teacher initiatives. In addition, the implementation of a data-based monitoring system through classroom observation and student feedback can strengthen the effectiveness of reflection in encouraging student engagement.

Furthermore, this study recommends that the government through the Ministry of Education and related agencies make the practice of teacher reflection and instructional leadership as a strategic component in vocational quality improvement policies, including teacher revitalization and professional development programs. Training programs for teachers and principals need to include modules on reflective practices and instructional leadership that are oriented towards improving student engagement. This research also opens up opportunities for replication and model development in more diverse fields of expertise and vocational school contexts, in order to expand the external validity of the proposed model. In addition, the use of reflective technology based on digital platforms has great potential to strengthen the effectiveness of teachers' reflection practices, accelerate the feedback process, and enable real-time monitoring of instructional leadership. With these strategic steps, the practice of reflection can be a major force in building vocational learning that is more meaningful, adaptive, and has an impact on improving the quality of student engagement.

Clinical Trial Number

Not applicable. This study did not involve any clinical trial, biomedical intervention, or live vertebrates.

Declarations

Informed Consent:

Informed digital consent was obtained from all individual participants prior to data collection. A mandatory consent statement was displayed on the first page of the online questionnaire (distributed via

Google Forms), explaining the purpose of the study, the scope of the questions, the estimated time required, the voluntary nature of participation, and the right to withdraw at any time without any consequences. Participants were required to agree to this statement before proceeding to the questionnaire items.

Anonymity and Confidentiality

No personally identifiable information (such as full name, identification number, or institutional address) was collected. Demographic data were collected on an optional basis and used solely for aggregate statistical analysis. All data were stored in a secure, password-protected digital repository accessible only to the research team and were used exclusively for academic and scientific purposes.

Screening and Data Integrity

A screening question was applied at the beginning of the questionnaire to verify the status of respondents as active vocational school teachers. The online system was configured to prevent duplicate submissions through account verification and timestamp restrictions, ensuring the validity and reliability of the data collected.

Vulnerable Populations

This study did not involve minors, patients, or other vulnerable groups. All participants were professional educators of legal adult age employed in Indonesian vocational schools. The study did not involve any clinical trials, biomedical interventions, animal subjects, or sensitive personal data.

Consent for Publication:

All authors have read and approved the final version of the manuscript and have consented to its submission and publication. No identifiable individual data are presented in this manuscript that would require additional consent for publication.

Concent to Participate:

Freely-given, informed consent to participate in this study was obtained from all individual participants prior to data collection. A mandatory digital informed consent statement was displayed on the first page of the online questionnaire (distributed via Google Forms), explaining the purpose of the study, the scope and nature of the questions, the estimated time required, the potential benefits (i.e., contributing to the improvement of vocational education quality in Indonesia), the minimal risks associated with participation (i.e., no physical, psychological, or professional risks beyond the time required to complete the questionnaire), the voluntary nature of participation, the confidentiality and anonymity of responses, and the right to withdraw at any time without any consequence. Participants were required to actively agree to this informed consent statement before proceeding to the questionnaire items. All participants

were professional vocational school teachers of legal adult age (≥ 18 years, and therefore well above the Springer threshold of 16 years); accordingly, no consent from a parent or legal guardian was required, as this study did not involve any children under the age of 16.

Consent to Publish:

Informed consent for publication of the anonymized aggregated data was obtained from all 1,249 individual participants included in this study as part of the mandatory digital consent statement provided at the beginning of the online questionnaire. All participants voluntarily agreed that their responses could be used and published for academic and scientific purposes in aggregated, non-identifiable form. The manuscript does not contain any individual person's identifiable data (such as names, images, videos, or personal details); therefore, no additional consent for the publication of identifiable information was required. All participants were adults aged 18 years or older; accordingly, consent from a parent or legal guardian was not applicable.

Competing Interests

The authors declare that there is no conflict of interest regarding the publication of this article. All authors have reviewed and approved the final manuscript for submission.

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Author Contribution

AWK and SMC conceived and designed the study, establishing the conceptual framework for modeling reflective practice and student engagement. FN developed the research methodology and performed the PLS-SEM analysis using SmartPLS 4, including the evaluation of the measurement and structural models. SMC and FN coordinated the data collection process, securing participation from 1,249 vocational teachers across Indonesia. FN and AR conducted the validation and reliability testing of the constructs. FN performed the literature review and integrated recent 2025 empirical evidence into the discussion. AWK wrote the original draft, while SMC, FN, and AR contributed to the review, editing, and final approval of the manuscript.

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Data Availability

The datasets generated and/or analysed during the current study are not publicly available due to ethical and confidentiality considerations, as the data contain sensitive professional responses from 1,249 vocational school teachers across Indonesia who participated under a guarantee of anonymity and confidentiality as part of the informed consent agreement. However, the datasets are available from the corresponding author (Fitri Nurmahmudah, fitr060@brin.go.id) on reasonable request and with permission from the Directorate of Vocational Schools, Ministry of Primary and Secondary Education, Republic of Indonesia.

Ethics, Consent to Participate, and Consent to Publish declarations

This study involved human research participants, specifically 1,249 vocational school teachers (N = 1,249) from various regions across Indonesia, who participated voluntarily in an online survey. The protocol of this study was approved by the Directorate of Vocational Schools (Direktorat SMK), Ministry of Primary and Secondary Education (Kementerian Pendidikan Dasar dan Menengah), Republic of Indonesia, in accordance with the institutional guidelines and regulations governing educational research involving human participants in Indonesia, as well as the ethical principles outlined in the Declaration of Helsinki. The research was carried out following the guidelines of the Directorate of Vocational Schools, Ministry of Primary and Secondary Education, Republic of Indonesia, which include provisions on voluntary participation, informed consent, anonymity, confidentiality, data protection, and the right to withdraw without consequence. The Directorate of Vocational Schools also provided the official sampling framework of vocational school teachers used in this study.

To safeguard participants' rights, the questionnaire did not collect any personally identifiable information; demographic data were collected on an optional basis and used solely for aggregate statistical analysis. All data were stored in a secure, password-protected digital repository accessible only to the research team and were used exclusively for academic and scientific purposes. A screening question verified the status of respondents as active vocational school teachers, and the online system was configured to prevent duplicate submissions through account verification and timestamp

restrictions. This study did not involve minors, patients, vulnerable populations, animal subjects, or sensitive personal data.

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Figures

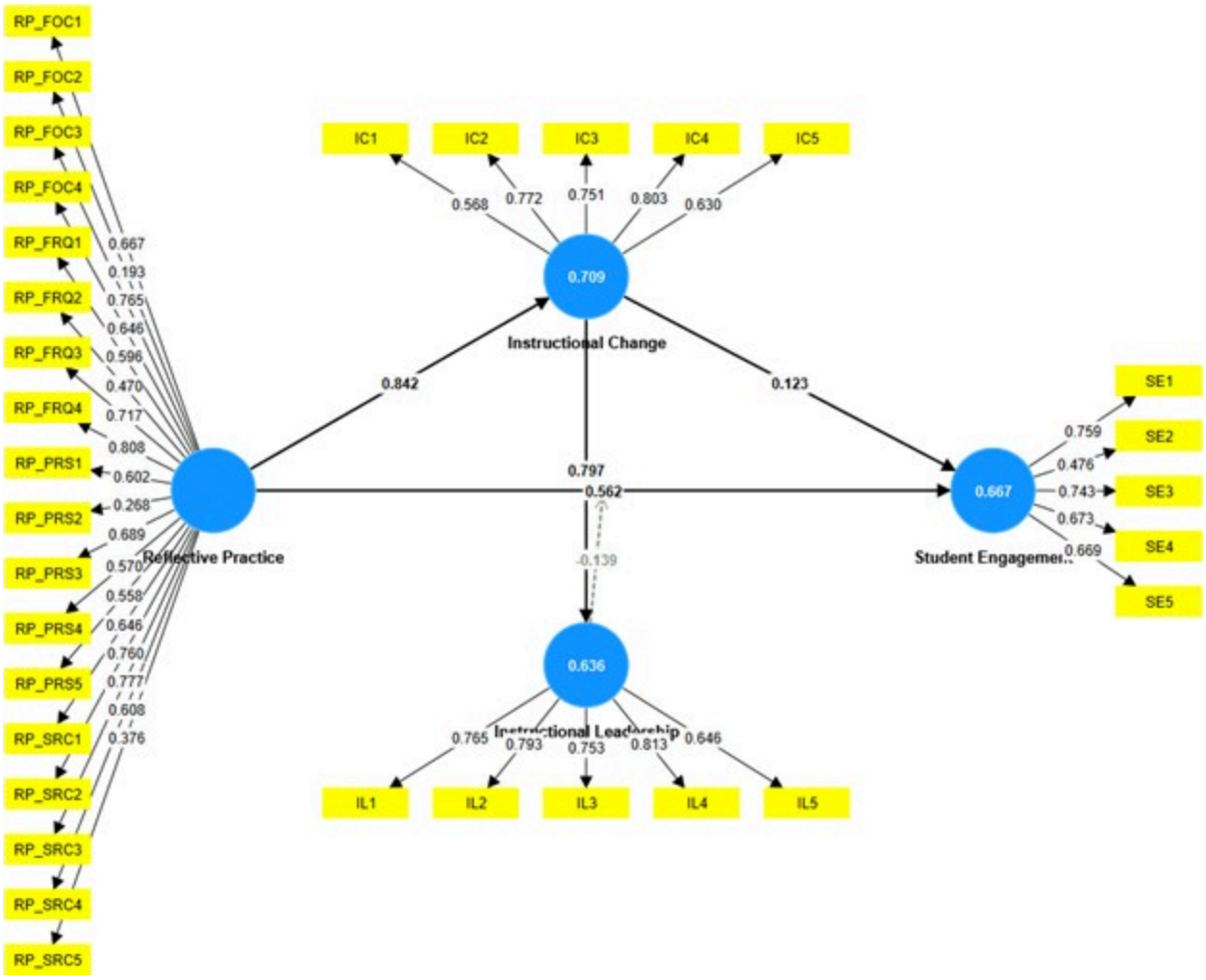


Figure 1

PLS-SEM Modelling of Reflective Practices

Supplementary Files

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