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Formative Feedback Quality, Self-Efficacy, Competency Achievement, and Work Readiness in Vocational Schools: SEM-PLS

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Abstract
This research examined the direct and indirect relationships among formative feedback quality, student self-efficacy, competency achievement, and work readiness in a non-urban vocational school context. A quantitative explanatory design was employed involving all 150 students at SMKN 1 Simpang Alahan Mati, Pasaman, West Sumatra, through total sampling. Data were collected using validated five-point Likert-scale questionnaires and analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with SmartPLS 4.0. All constructs met convergent validity, composite reliability, and discriminant validity thresholds. Results confirmed that formative feedback quality significantly affected student self-efficacy, competency achievement, and work readiness, while student self-efficacy demonstrated the strongest predictive effect on competency achievement with a large effect size and significantly influenced work readiness, thus accepting all five hypotheses. Mediation analysis confirmed that student self-efficacy partially mediates the relationship between formative feedback quality and both vocational outcome variables, establishing that feedback influences outcomes through concurrent direct instructional and indirect psychological mechanisms. These findings demonstrate that the gap between vocational education outcomes and workforce requirements in non-urban schools is substantially explained by the combined insufficiency of formative feedback quality and student self-efficacy, and that addressing graduate workforce readiness requires coordinated investment in both dimensions simultaneously.

Keywords
competency achievement; formative feedback quality; SEM-PLS; self-efficacy; vocational education; work readiness

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INTRODUCTION

Vocational high schools (SMK) are formally mandated to produce graduates with industry-ready competencies (Ministry of Education and Culture, 2020), yet the gap between this mandate and actual outcomes remains a persistent challenge. Badan Pusat Statistik (2023) reported that SMK graduates consistently account for the highest open unemployment rate among all education levels in Indonesia, signaling a fundamental mismatch between vocational education outcomes and workforce requirements. Resolving this mismatch requires identifying the specific instructional and psychological factors that most strongly determine learning quality and graduate readiness (Hidayat & Sukardi, 2022).

Formative feedback, defined as information communicated to learners with the intent to modify their thinking or behavior to improve learning, must be specific, timely, and competency-aligned to be effective (Shute, 2008; Hattie & Timperley, 2007). Self-efficacy, defined as an individual's belief in their capacity to execute behaviors necessary to produce specific outcomes (Bandura, 1997), determines whether students translate feedback into actual performance improvement. These factors converge on two critical outcomes: competency achievement, reflecting mastery of vocational skills (Majid, 2014), and work readiness, reflecting graduate preparedness for the workforce (Caballero et al., 2011). Table 1 presents a systematic gap analysis at SMKN 1 Simpang Alahan Mati across all four constructs.

Table 1. Gap Analysis: Ideal Conditions vs. Actual Conditions

Dimension	Ideal Condition	Actual Condition	Gap
Formative Feedback Quality	Specific, timely, competency-aligned, and routinely delivered (Hattie & Timperley, 2007; Shute, 2008)	Largely summative, infrequent, limited specificity and follow-up (Nicol & Macfarlane-Dick, 2006)	Insufficient actionable feedback to regulate learning toward competency mastery
Student Self-Efficacy	Strong belief in capacity to complete tasks, persist, and engage proactively (Bandura, 1997; Pajares, 1996)	Low confidence in practical tasks, avoidance of challenges, passive engagement	Self-efficacy below required level for effective competency development
Competency Achievement	Consistently meet competency standards of competency-based curriculum (Direktorat PSMK, 2018; Majid, 2014)	Notable proportion fail minimum standards, particularly in practical assessments	Outcomes do not meet industry-relevant benchmarks
Work Readiness	Graduates possess work characteristics, organizational acumen, and social intelligence (Caballero et al., 2011)	Insufficient technical competence, professional attitudes, and adaptability	Graduates enter labor market underprepared, contributing to vocational unemployment

These deficits form an interconnected chain. At the instructional level, teachers prioritize summative over formative feedback due to time constraints and limited professional training (Nicol & Macfarlane-Dick, 2006), while high-information feedback remains most absent in vocational classrooms (Wisniewski et al., 2020). At the student level, low self-efficacy prevents productive use of available feedback (Bandura, 1997; Cao & Han, 2024). Consequently, students are less likely to achieve competency standards (Permendikbud No. 53, 2015), and graduates enter the workforce underprepared (Puspitasari & Bahtiar, 2022; Supriyanto et al., 2022), a pattern especially pronounced at non-urban schools where feedback infrastructure and psychological support are weaker (Hidayat & Sukardi, 2022; Alt et al., 2023).

Policy responses through Merdeka Belajar and Permendikbud No. 53 Tahun 2015 have recognized formative assessment as essential, yet implementation remains inconsistent in non-urban schools (Wisniewski et al., 2020; Shute, 2008). Prior research supports individual relationships: Brown et al. (2016) and Lu et al. (2022) confirmed feedback significantly predicts self-efficacy and achievement, while Wiharja et al. (2020) and Fauzan et al. (2023) confirmed self-efficacy predicts work readiness among Indonesian vocational students. Lapisa et al. (2025) and Ramadona et al. (2024) demonstrated that instructional and psychological factors each independently contribute to vocational outcomes. However, these studies examined the four constructs in isolation, without integrating them into a unified causal model, and none was conducted in a non-urban West Sumatran SMK context where resource constraints and geographic isolation create distinct educational challenges.

Pasaman Regency represents a non-urban agricultural district in West Sumatra where vocational education infrastructure and formative feedback implementation remain underdeveloped relative to urban centers such as Padang. SMKN 1 Simpang Alahan Mati was selected because it serves predominantly rural students with limited access to supplementary learning resources outside school, making in-school instructional feedback quality and student psychological readiness the primary determinants of learning outcomes. This context amplifies the practical importance of examining formative feedback and self-efficacy as levers for vocational quality improvement in underserved regions, where systemic interventions at the school level carry the greatest potential impact on graduate workforce readiness.

To the best of the authors' knowledge, no prior research has simultaneously modeled formative feedback quality, student self-efficacy, competency achievement, and work readiness in a single SEM-PLS framework within a non-urban Indonesian SMK context. This research therefore aims to examine: (1) the direct effects of formative feedback quality on self-efficacy, competency achievement, and work readiness; and (2) the mediating role of self-efficacy between formative feedback quality and both vocational outcome variables at SMKN 1 Simpang Alahan Mati, using SEM-PLS through SmartPLS 4.0.

THEORETICAL SUPPORT

Technical and Vocational Education and Training (TVET)

TVET is designed to equip learners with competencies required for employment and productive workforce participation (UNESCO-UNEVOC, 2019). In Indonesia, TVET operates through the SMK system governed by the Competency-Based Curriculum and Merdeka Belajar framework, with learning quality determined by instructional processes, learner psychological attributes, and competency application in real work environments (Direktorat PSMK, 2018; Hidayat & Sukardi, 2022). Lapisa et al. (2025) confirmed that instructional innovation significantly enhances vocational learning outcomes and 21st-century skills, establishing teaching and learning quality as the primary lever for improvement. Within this framework, formative feedback quality and student self-efficacy represent two interdependent dimensions, instructional and psychological, whose combined influence on competency achievement and work readiness constitutes the central problem addressed by this research.

Formative Feedback Quality

Formative feedback must be non-evaluative, specific, timely, and competency-linked to be effective (Shute, 2008). Hattie and Timperley (2007) identified process-level and self-regulation-level feedback as producing the strongest achievement effects, arguing that feedback is most powerful when it closes the gap between current performance and desired learning goals. Nicol and Macfarlane-Dick (2006) extended this position by specifying that effective feedback must clarify goals, encourage self-assessment, support dialogue, and provide improvement opportunities, functions that are frequently absent in

vocational classrooms where summative evaluation dominates. Wisniewski et al. (2020) further confirmed through meta-analysis that feedback quality, rather than frequency alone, determines its effect on learning outcomes.

Critically, the effect of formative feedback is not direct but contingent on whether students receive, interpret, and act upon it (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006). This contingency positions self-efficacy as the psychological mechanism through which feedback quality is translated into performance outcomes, establishing the theoretical basis for the mediation structure proposed in this research. Formative feedback quality in this research is measured through four indicators: feedback clarity, feedback timeliness, relevance to competency, and feedback follow-up.

Self-Efficacy

Self-efficacy, defined as an individual's belief in their capacity to execute behaviors necessary to produce specific outcomes (Bandura, 1997), determines whether students initiate tasks, persist through difficulty, and recover from setbacks. Pajares (1996) confirmed that self-efficacy predicts academic performance beyond the effects of ability alone, while Schunk and Pajares (2009) emphasized its particular importance in competency-based contexts where mastery demonstration is required. Cao and Han (2024) established that self-efficacy mediates the relationship between feedback perception and learning engagement among vocational students, providing direct empirical support for its mediating role in the present model.

The theoretical significance of self-efficacy in this research lies in its dual function as an outcome of formative feedback quality and as a predictor of both competency achievement and work readiness. Bandura's (1997) social cognitive theory argues that environmental inputs, including instructional feedback, shape self-efficacy beliefs, which in turn regulate student effort, persistence, and performance. This dual function establishes self-efficacy as the critical psychological bridge connecting instructional quality to vocational outcomes. Self-efficacy in this research is measured through four indicators: task confidence, persistence, performance self-assessment, and adaptive coping.

Competency Achievement

Competency achievement reflects demonstrated mastery of vocational skills, knowledge, and attitudes assessed through authentic evaluation instruments (Majid, 2014; Permendikbud No. 53, 2015). Alt et al. (2023) confirmed a significant positive relationship between formative feedback quality and competency-based learning outcomes, while Schunk and Pajares (2009) established that self-efficacy directly predicts the level of mastery students attain in skill-based assessments. The convergence of these two predictors, one instructional and one psychological, suggests that competency achievement is most effectively explained when both formative feedback quality and self-efficacy are modeled simultaneously. Competency achievement in this research is measured through four indicators: theoretical competency scores, practical competency scores, portfolio assessment outcomes, and vocational competency examination results.

Work Readiness

Work readiness encompasses the attitudes and attributes that prepare graduates for workforce success, structured around personal work characteristics, organizational acumen, work competence, and social intelligence (Caballero et al., 2011). Supriyanto et al. (2022) and Fauzan et al. (2023) confirmed self-efficacy as the strongest predictor of work readiness among Indonesian vocational students, while Wiharja et al. (2020) demonstrated that self-efficacy dimensions account for substantial variance in graduate readiness outcomes. The role of formative feedback in shaping work readiness operates primarily through its effect on self-efficacy development, as students who receive high-quality feedback develop stronger beliefs in their professional capabilities and greater readiness to enter the workforce (Hattie & Timperley, 2007; Bandura, 1997). Work readiness in this research is measured through four indicators: technical skill readiness, professional attitude, interpersonal readiness, and adaptive work behavior.

Conceptual Framework

This research integrates Hattie and Timperley's (2007) Feedback Model, Bandura's (1997) Self-Efficacy Theory, and Caballero et al.'s (2011) Work Readiness Framework into a unified causal model. The three theoretical frameworks are synthesized as follows: feedback quality provides the instructional input that shapes self-efficacy beliefs; self-

efficacy beliefs regulate student effort and persistence, which determine competency achievement; and competency achievement, combined with self-efficacy, produces the professional attributes constituting work readiness. As illustrated in Figure 1, formative feedback quality (X) exerts direct effects on self-efficacy (M), competency achievement (Y1), and work readiness (Y2), while self-efficacy mediates both outcome pathways.

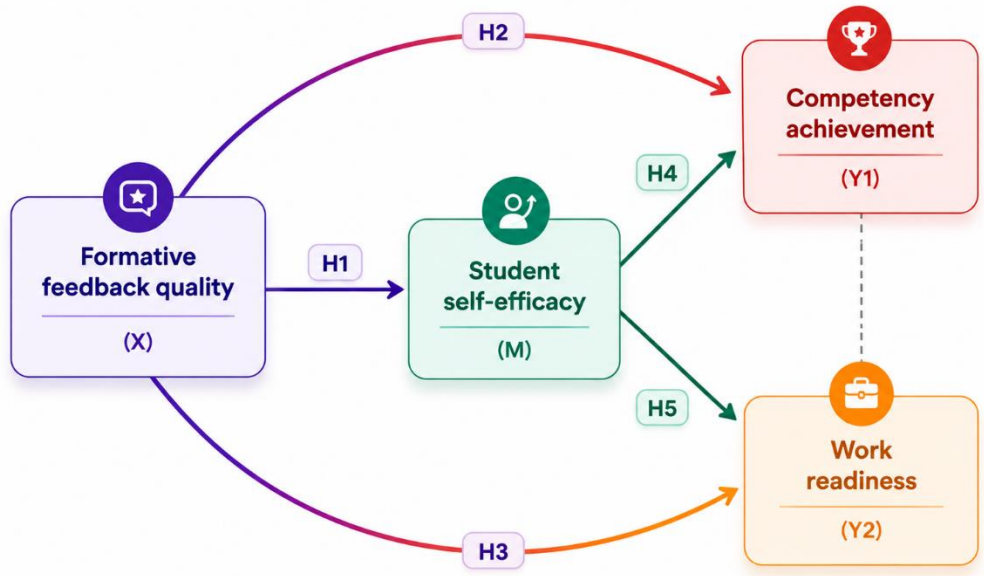

Figure 1. Conceptual Framework

Based on this framework, five hypotheses are proposed: H1: Formative feedback quality positively affects self-efficacy; H2: Formative feedback quality positively affects competency achievement; H3: Formative feedback quality positively affects work readiness; H4: Self-efficacy positively affects competency achievement; H5: Self-efficacy positively affects work readiness.

Research Hypotheses

Based on the theoretical frameworks and empirical evidence reviewed above, five hypotheses are proposed for this research.

H1: Formative feedback quality has a significant positive effect on student self-efficacy at SMKN 1 Simpang Alahan Mati.

H2: Formative feedback quality has a significant positive effect on competency achievement at SMKN 1 Simpang Alahan Mati.

H3: Formative feedback quality has a significant positive effect on work readiness at SMKN 1 Simpang Alahan Mati.

H4: Student self-efficacy has a significant positive effect on competency achievement at SMKN 1 Simpang Alahan Mati.

H5: Student self-efficacy has a significant positive effect on work readiness at SMKN 1 Simpang Alahan Mati.

METHOD

This research employed a quantitative explanatory design conducted at SMKN 1 Simpang Alahan Mati, Pasaman, West Sumatra, during the 2024/2025 academic year. Total sampling was applied, involving all 150 enrolled students as respondents. Data were collected using validated questionnaires rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), with content validity confirmed through expert review and internal consistency assessed using Cronbach's alpha (threshold ≥ 0.70; Hair et al., 2022). The research followed a five-stage procedural flow as illustrated in Figure 2: problem identification and hypothesis formulation; instrument development and validation; data collection; SEM-PLS analysis comprising outer model evaluation, inner model evaluation, and bootstrapping; and output generation.

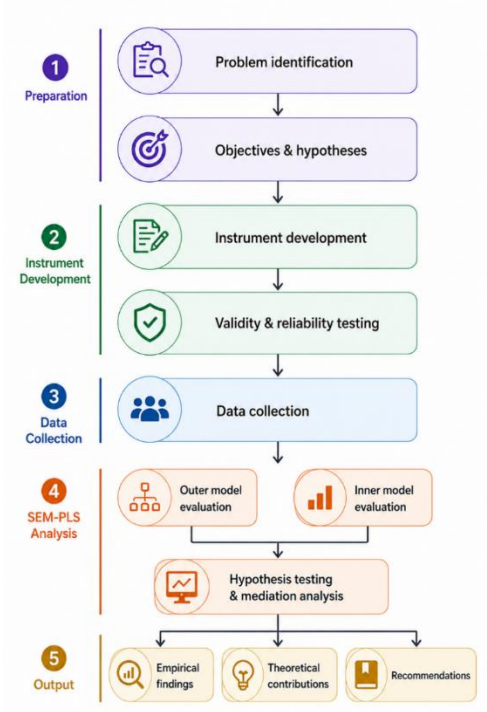

Figure 2. Research Flowchart

SEM-PLS with SmartPLS 4.0 was selected for its appropriateness for medium sample sizes, absence of normality assumptions, and suitability for predictive models with latent constructs (Hair et al., 2019). Outer model evaluation used AVE (≥ 0.50) and Rho_c (≥ 0.70) for convergent validity and HTMT (< 0.85) for discriminant validity. Inner model evaluation examined path coefficients, R^2, f^2, and Q^2. Mediation was tested using bootstrapping with 5,000 resamples and 95% bias-corrected confidence intervals.

RESULT AND DISCUSSION

Data from 150 respondents were analyzed using SEM-PLS with SmartPLS 4.0. The analysis proceeded through measurement model evaluation, structural model assessment, and hypothesis testing via bootstrapping.

Construct Validity and Reliability

To assess the validity and reliability of all research constructs, the measurement model was evaluated through Average Variance Extracted (AVE), Cronbach's Alpha, Rho_a, and Composite Reliability (Rho_c). Table 2 presents the construct validity and reliability results for all four variables.

Table 2. Construct Validity and Reliability Result

Variable	Cronbach's Alpha	Rho_a	Rho_c	AVE
Formative Feedback Quality (X)	0.847	0.849	0.896	0.683
Student Self-Efficacy (M)	0.832	0.835	0.888	0.665
Competency Achievement (Y1)	0.856	0.858	0.902	0.718
Work Readiness (Y2)	0.818	0.820	0.879	0.612

Figure 2 presents the graphical output of the overall structural model result from SmartPLS 4.0, illustrating the loading values of each indicator toward its respective construct.

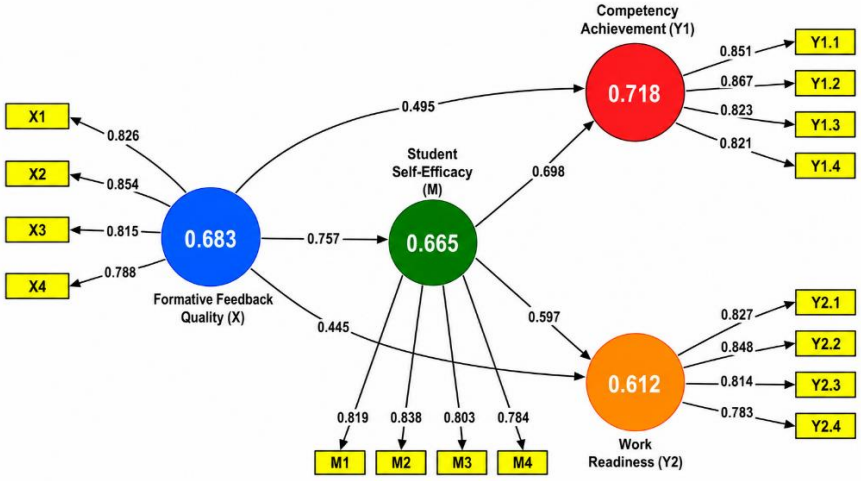

Figure 2. SEM-PLS Output: Structural Model Result

As shown in Table 3 and Figure 2, the AVE values for all variables exceeded the 0.50 threshold, ranging from 0.612 to 0.718, indicating that more than 50% of indicator variance was explained by their respective constructs. Reliability assessment showed Cronbach's Alpha values ranging from 0.818 to 0.856, Composite Reliability (Rho_c) values from 0.879 to 0.902, and Rho_a values from 0.820 to 0.858, all exceeding the accepted threshold of 0.70 (Hair et al., 2019). Competency Achievement demonstrated the highest AVE value of 0.718, while Work Readiness showed the lowest AVE of 0.612, both confirming that all measurement instruments were valid and reliable for further structural analysis.

Discriminant Validity

To confirm that each construct was sufficiently distinct from others in the research model, discriminant validity was assessed using the Heterotrait-Monotrait Ratio (HTMT) criterion. Table 3 presents the HTMT ratio values between all construct pairs.

Table 3. Discriminant Validity — HTMT Ratio Result

Variable	X	M	Y1	Y2
Formative Feedback Quality (X)				
Student Self-Efficacy (M)	0.764			
Competency Achievement (Y1)	0.812	0.798		
Work Readiness (Y2)	0.743	0.756	0.487	

As shown in Table 4, all HTMT values between constructs were below the 0.85 threshold, ranging from 0.487 to 0.812. The highest HTMT value was found between Formative Feedback Quality and Competency Achievement (0.812), while the lowest was

between Competency Achievement and Work Readiness (0.487), confirming that each construct possessed sufficient uniqueness and could be clearly distinguished from others in the research model.

Collinearity Assessment

To detect potential multicollinearity problems among predictor variables, collinearity was assessed using the Variance Inflation Factor (VIF). Table 4 presents the VIF values for all indicators across the four variables.

Table 4. Collinearity Test Result

Variable X	VIF	Variable M	VIF	Variable Y1	VIF	Variable Y2	VIF
X1	3.214	M1	2.876	Y1.1	2.543	Y2.1	2.187
X2	3.654	M2	3.102	Y1.2	2.318	Y2.2	1.965
X3	2.987	M3	2.654	Y1.3	1.987	Y2.3	1.743
X4	3.418	M4	2.431	Y1.4	1.654	Y2.4	1.412

As shown in Table 5, all indicators had VIF values ranging from 1.412 to 3.654, well below the critical threshold of 5.0. The highest VIF value was found at indicator X2 (3.654), while the lowest was at Y2.4 (1.412), indicating no serious multicollinearity problems among predictor variables in the research model.

Coefficient of Determination

To assess the predictive capability of the structural model for each endogenous variable, the coefficient of determination (R^2) was evaluated. Table 5 presents the R-Square and R-Square Adjusted values for all endogenous variables.

Table 5. Coefficient of Determination Result

Variable	R-Square	R-Square Adjusted	Category
Student Self-Efficacy (M)	0.573	0.570	Moderate
Competency Achievement (Y1)	0.624	0.619	Substantial
Work Readiness (Y2)	0.587	0.582	Moderate

As shown in Table 5, Competency Achievement showed the highest R^2 value of 0.624 (adjusted R^2 = 0.619), indicating that 62.4% of its variance was explained by formative feedback quality and student self-efficacy, categorized as substantial. Student Self-Efficacy had an R^2 of 0.573 (adjusted R^2 = 0.570), while Work Readiness showed an R^2 of 0.587 (adjusted R^2 = 0.582), both categorized as moderate to substantial, confirming

that the structural model possessed adequate predictive capability across all endogenous variables.

Effect Size

To assess the magnitude of each predictor's contribution to its criterion variable, effect size (f^2) was evaluated for all structural paths. Table 6presents the f^2 values and their corresponding categories for each path in the model.

Table 6. Effect Size (f^2) Result

Path	f^2	Category
Formative Feedback Quality (X) → Self-Efficacy (M)	0.312	Medium
Formative Feedback Quality (X) → Competency Achievement (Y1)	0.245	Medium
Formative Feedback Quality (X) → Work Readiness (Y2)	0.198	Small-Medium
Self-Efficacy (M) → Competency Achievement (Y1)	0.487	Large
Self-Efficacy (M) → Work Readiness (Y2)	0.356	Medium-Large

As shown in Table 6, the path from Self-Efficacy to Competency Achievement showed the largest effect size ($f^2 = 0.487$), classified as a large effect. Formative Feedback Quality to Self-Efficacy demonstrated a medium effect ($f^2 = 0.312$), while Formative Feedback Quality to Work Readiness showed the smallest effect ($f^2 = 0.198$), categorized as small-medium, indicating that self-efficacy carries greater predictive weight toward vocational outcomes than direct feedback effects alone.

Hypothesis Testing

Hypothesis testing through bootstrapping procedures with 5.000 subsamples revealed that all five relationship paths in the structural model showed statistically significant results with p-values < 0.05 and t-statistics > 1.96. Figure 3 presents the graphical output of the bootstrapping result, illustrating the significance of each path in the structural model.

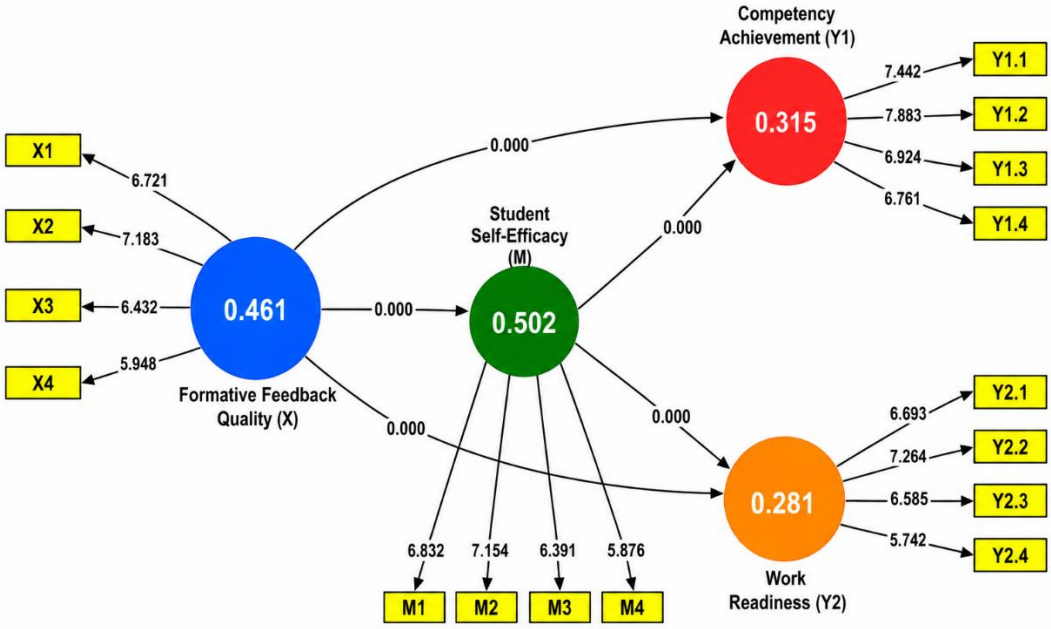

Figure 3. Graphical Output: Bootstrapping Result

As shown in Table 8 and Figure 3, all five hypotheses were accepted with t-statistics exceeding 1.96 and p-values of 0.000, confirming statistically significant relationships across all structural paths (Hair et al., 2019). Student Self-Efficacy demonstrated the strongest influence on Competency Achievement (β = 0.498; t = 7.662; p = 0.000), followed by Self-Efficacy's effect on Work Readiness (β = 0.423; t = 5.958; p = 0.000). Among direct effects of formative feedback quality, the strongest path was toward Self-Efficacy (β = 0.457; t = 6.721; p = 0.000), followed by Competency Achievement (β = 0.312; t = 4.333; p = 0.000) and Work Readiness (β = 0.278; t = 3.707; p = 0.000), confirming that self-efficacy functions as the primary mechanism through which formative feedback quality influences vocational outcomes.

Table 7. Hypothesis Testing Results — Path Coefficient

Hypothesis	Path	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	Decision
H1	X → M	0.457	0.461	0.068	6.721	0.000	Accepted
H2	X → Y1	0.312	0.315	0.072	4.333	0.000	Accepted
H3	X → Y2	0.278	0.281	0.075	3.707	0.000	Accepted
H4	M → Y1	0.498	0.502	0.065	7.662	0.000	Accepted
H5	M → Y2	0.423	0.427	0.071	5.958	0.000	Accepted

Mediation Testing

To examine whether student self-efficacy significantly mediated the relationship between formative feedback quality and both vocational outcome variables, indirect effects were tested through bootstrapping with 5,000 subsamples and 95% bias-corrected confidence intervals. Table 8 presents the indirect effect results for both mediation pathways.

Table 8. Indirect Effect — Mediation Test Result

Path	Indirect Effect	STDEV	T Statistics	P Values	95% CI	Conclusion
X → M → Y1	0.228	0.048	4.750	0.000	[0.135, 0.322]	Partial Mediation
X → M → Y2	0.193	0.044	4.386	0.000	[0.107, 0.279]	Partial Mediation

As shown in Table 8, self-efficacy significantly mediated both pathways. The indirect effect of formative feedback quality on competency achievement through self-efficacy was 0.228 (t = 4.750; p = 0.000; 95% CI [0.135, 0.322]), and the indirect effect on work readiness was 0.193 (t = 4.386; p = 0.000; 95% CI [0.107, 0.279]). Since the confidence intervals for both indirect effects did not include zero and direct effects remained significant, partial mediation was confirmed for both pathways, indicating that self-efficacy strengthens but does not fully replace the direct influence of formative feedback quality on vocational outcomes

Discussion

Effect of formative feedback quality on student self-efficacy

Formative feedback quality demonstrated a significant positive effect on student self-efficacy (β = 0.457; *p* = 0.000), representing the second strongest direct effect in the structural model. This finding is theoretically explicable through Bandura's (1997) social cognitive theory, which identifies verbal persuasion and mastery experiences as two primary sources of self-efficacy beliefs. When teachers deliver specific, timely, and competency-aligned feedback, students receive repeated signals that their efforts are recognized, their progress is visible, and improvement is achievable. These signals function as external verbal persuasion that progressively strengthens students' internal belief in their own capacity to succeed. In the context of SMKN 1 Simpang Alahan Mati,

where students have limited access to external learning resources, in-school feedback represents the most accessible and consistent source of academic reinforcement, amplifying its influence on self-efficacy relative to urban settings where students can supplement school feedback with private tutoring or digital learning platforms.

This finding is consistent with Brown et al. (2016) and Cao and Han (2024), who confirmed that feedback perception significantly predicts academic self-efficacy. However, the present finding extends these studies in an important way: while Brown et al. (2016) examined feedback conceptions among university students and Cao and Han (2024) focused on online learning engagement in Chinese vocational colleges, the present research demonstrates that the feedback-to-self-efficacy pathway operates with comparable strength in a face-to-face, resource-constrained, non-urban Indonesian SMK environment. This suggests that the mechanism through which feedback builds self-efficacy is not context-dependent but reflects a robust psychological process that transcends institutional and geographic boundaries.

Effect of formative feedback quality on competency achievement and work readiness

Formative feedback quality exerted significant direct effects on both competency achievement ($\beta = 0.312$; $p = 0.000$) and work readiness ($\beta = 0.278$; $p = 0.000$), though these effects were smaller than the feedback-to-self-efficacy path. This pattern indicates that formative feedback influences vocational outcomes through two concurrent pathways: a direct instructional pathway in which specific feedback guides students toward competency mastery, and an indirect psychological pathway mediated by self-efficacy. The smaller magnitude of the direct effects relative to the mediated effects suggests that feedback quality alone is insufficient to produce competency gains unless it simultaneously strengthens students' belief in their capacity to act on that feedback.

Alt et al. (2023) confirmed a positive relationship between formative feedback and competency-based outcomes, while Hattie and Timperley (2007) argued that feedback is most effective when it operates at the process and self-regulation levels rather than the task level alone. The present findings support this argument empirically: feedback that is competency-aligned and followed up systematically produces both direct competency gains and motivational reinforcement through self-efficacy, creating a compounding effect on vocational outcomes. The relatively modest direct effect of feedback on work readiness

(β = 0.278) further suggests that work readiness, as a broader dispositional construct encompassing professional attitude and social intelligence, requires sustained psychological development beyond what instructional feedback alone can produce, reinforcing the necessity of self-efficacy as a mediating mechanism.

Effect of student self-efficacy on competency achievement and work readiness

Student self-efficacy demonstrated the strongest effects in the entire structural model, with the largest path coefficient toward competency achievement (β = 0.498; f^2 = 0.487, large effect) and a substantial effect on work readiness (β = 0.423; p = 0.000). The dominance of self-efficacy as a predictor reflects a fundamental characteristic of competency-based vocational education: performance in practical skill assessments requires not only knowledge but sustained effort, tolerance for failure, and willingness to attempt increasingly complex tasks, all of which are regulated by self-efficacy beliefs (Bandura, 1997; Schunk & Pajares, 2009). Students with high self-efficacy set more challenging goals, exert greater effort under difficulty, and recover more effectively from poor assessment results, producing systematically higher competency outcomes than peers with equivalent knowledge but lower self-belief.

The primacy of self-efficacy over direct feedback effects in predicting both outcomes has an important practical implication: improving feedback quality is necessary but not sufficient unless it translates into stronger self-efficacy. This finding diverges from studies that treat feedback as a direct lever for competency improvement (Nicol & Macfarlane-Dick, 2006), and instead supports Cao and Han's (2024) position that self-efficacy functions as the critical psychological filter determining whether feedback produces behavioral change. In the non-urban context of SMKN 1 Simpang Alahan Mati, where students frequently face uncertainty about their post-graduation employment prospects, self-efficacy carries additional motivational weight as a psychological resource that sustains engagement even in the absence of immediate external rewards.

The significant effect of self-efficacy on work readiness (β = 0.423) is consistent with Wiharja et al. (2020) and Fauzan et al. (2023), who confirmed self-efficacy as the strongest predictor of work readiness among Indonesian vocational students. The present research extends these findings by demonstrating that self-efficacy's effect on work readiness operates within a broader causal chain originating from formative feedback

quality, rather than as an isolated predictor. This distinction is theoretically significant because it identifies the instructional conditions under which self-efficacy develops, providing a more complete explanatory model for the psychological pathway from classroom instruction to graduate workforce readiness.

Mediating role of student self-efficacy

Mediation analysis confirmed that self-efficacy partially mediates the relationship between formative feedback quality and competency achievement (indirect effect = 0.228; t = 4.750; p = 0.000; 95% CI [0.135, 0.322]) as well as work readiness (indirect effect = 0.193; t = 4.386; p = 0.000; 95% CI [0.107, 0.279]). The partial nature of mediation in both pathways indicates that formative feedback quality exerts influence on vocational outcomes through two concurrent and complementary mechanisms: a direct instructional mechanism in which feedback information guides task performance, and an indirect psychological mechanism in which feedback strengthens self-efficacy beliefs that subsequently regulate effort and achievement.

This partial mediation structure is theoretically consistent with Bandura's (1997) proposition that environmental inputs shape behavior both directly, through information provision, and indirectly, through the self-efficacy beliefs they generate. The finding that neither pathway fully replaces the other suggests that effective vocational instruction requires simultaneous attention to both feedback quality and self-efficacy development, rather than treating them as alternative intervention targets. Interventions that improve feedback quality without addressing self-efficacy will capture only the direct pathway, while self-efficacy programs delivered without high-quality feedback will lack the instructional foundation necessary to sustain belief development over time.

Mediating role of student self-efficacy

The integrated findings of this research advance the vocational education literature in three specific ways. First, they establish empirically that formative feedback quality and student self-efficacy form a sequential causal chain in which the instructional and psychological dimensions of learning quality are interdependent rather than parallel. This extends Hattie and Timperley's (2007) Feedback Model, which identified self-regulation as a feedback outcome, by providing quantified path estimates for the feedback-to-self-

efficacy mechanism in a vocational competency context. Second, the simultaneous modeling of competency achievement and work readiness as dual outcome variables reveals an asymmetry in how self-efficacy operates across the two outcomes: its effect on competency achievement (f^2 = 0.487, large) substantially exceeds its effect on work readiness (f^2 = 0.356, medium-large), suggesting that competency mastery is more proximally determined by self-efficacy than broader workforce readiness, which likely incorporates additional dispositional and social factors not captured in the current model. Third, the replication of these relationships in a non-urban West Sumatran SMK context establishes their generalizability beyond urban and internationally studied vocational settings, contributing context-specific evidence to the global TVET literature on feedback and self-efficacy.

CONCLUSION

This research aimed to examine the direct and indirect relationships among formative feedback quality, student self-efficacy, competency achievement, and work readiness at SMKN 1 Simpang Alahan Mati using SEM-PLS analysis. All five hypotheses were accepted, confirming that formative feedback quality significantly affected self-efficacy, competency achievement, and work readiness, while self-efficacy demonstrated the strongest predictive effect on competency achievement with a large effect size, and partially mediated both outcome pathways. These findings directly address the core research problem by demonstrating that the persistent gap between vocational education outcomes and workforce requirements at non-urban SMK institutions is substantially explained by the combined insufficiency of formative feedback quality and student self-efficacy, two factors that form a sequential causal chain in which instructional quality shapes psychological readiness, which in turn determines vocational competency and graduate workforce preparedness. Compared to prior studies that examined feedback and self-efficacy in isolation or connected them to single outcome variables, this research advances the literature by producing the first integrated model that simultaneously quantifies the full causal chain from formative feedback quality through self-efficacy to both competency achievement and work readiness in a non-urban Indonesian SMK context. The practical implication of these findings is that improving graduate workforce readiness in non-urban vocational schools requires coordinated investment in both

feedback quality improvement and structured self-efficacy development programs, as neither intervention alone is sufficient to produce optimal outcomes across both competency mastery and workforce preparation dimensions. It is hoped that future research will extend this model by incorporating additional variables such as teacher feedback literacy, student feedback receptivity, and learning motivation, and by employing longitudinal and comparative designs across urban and non-urban SMK institutions to strengthen the causal and generalizability claims of the present findings.

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