

**Jurnal Ilmiah Pendidikan Citra Bakti**

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<https://jurnal.citrabakti.ac.id/index.php/jil>**THE IMPACT OF INSTRUCTIONAL STRATEGIES AND EDUCATIONAL TECHNOLOGY AVAILABILITY ON LEARNING EFFECTIVENESS: THE MEDIATING ROLE OF STUDENT ENGAGEMENT AMONG VOCATIONAL TRAINING INSTRUCTORS**Sairah<sup>1)\*</sup>, Tata Rustandi<sup>2)</sup>, and Khaeruman<sup>3)</sup><sup>1,2,3)</sup>Program Studi Manajemen, Program Pascasarjana, Universitas Bina Bangsa\*Corresponding author email: [sairahsutardi79@gmail.com](mailto:sairahsutardi79@gmail.com)**Article History***Received:*  
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February 28, 2026**Abstract**

This study aims to examine the impact of instructional strategies and the availability of educational technology on learning effectiveness through student engagement in Vocational Training Institutions in Karawang Regency, Indonesia. The research addresses a gap in the non-formal education literature by elucidating the mediating mechanism of student engagement within an integrated structural model. An explanatory quantitative approach was employed using a cross-sectional design. Data were analyzed through Structural Equation Modeling based on Partial Least Squares (SEM-PLS). The sample consisted of 185 teachers selected through proportional random sampling from a population of 208 teachers. The findings indicate that instructional strategies significantly influence learning effectiveness ( $\beta = 0.562$ ;  $p < 0.001$ ) and student engagement ( $\beta = 0.410$ ;  $p < 0.001$ ). The availability of educational technology also significantly affects learning effectiveness ( $\beta = 0.429$ ;  $p < 0.001$ ) and student engagement ( $\beta = 0.408$ ;  $p < 0.001$ ). Furthermore, student engagement has a significant positive effect on learning effectiveness ( $\beta = 0.408$ ;  $p < 0.001$ ). The  $R^2$  value demonstrates that the model explains 66.5% of the variance in learning effectiveness. Mediation analysis confirms that student engagement partially mediates the relationship between both exogenous variables and learning effectiveness. These findings highlight that improving learning effectiveness in vocational training institutions depends not only on instructional strategies and technological availability but also on their capacity to foster active student engagement.

**Keywords:** Instructional strategies; Educational technology availability; Student engagement; Learning effectiveness

**Abstrak.** Penelitian ini bertujuan untuk menguji dampak strategi pengajaran dan ketersediaan teknologi pendidikan terhadap efektivitas pembelajaran melalui keterlibatan siswa di Lembaga Pelatihan Vokasi di Kabupaten Karawang, Indonesia. Penelitian ini mengisi kekosongan dalam literatur pendidikan non-formal dengan menjelaskan mekanisme mediasi keterlibatan siswa dalam model struktural terintegrasi. Pendekatan kuantitatif eksplanatori digunakan dengan desain potong lintang. Data dianalisis menggunakan Structural Equation Modeling berbasis Partial Least Squares (SEM-PLS). Sampel terdiri dari 185 guru yang dipilih melalui pengambilan sampel acak proporsional dari populasi 208 guru. Temuan menunjukkan bahwa strategi pengajaran berpengaruh signifikan terhadap efektivitas pembelajaran ( $\beta = 0,562$ ;  $p < 0,001$ ) dan keterlibatan siswa ( $\beta = 0,410$ ;  $p < 0,001$ ). Ketersediaan teknologi pendidikan juga berpengaruh signifikan terhadap efektivitas pembelajaran ( $\beta = 0,429$ ;  $p < 0,001$ ) dan keterlibatan siswa ( $\beta = 0,408$ ;  $p < 0,001$ ). Selain itu, keterlibatan siswa memiliki pengaruh positif signifikan terhadap efektivitas pembelajaran ( $\beta = 0,408$ ;  $p < 0,001$ ). Nilai  $R^2$  menunjukkan bahwa model ini menjelaskan 66,5% variansi dalam efektivitas pembelajaran. Analisis mediasi mengonfirmasi bahwa keterlibatan siswa memediasi sebagian hubungan antara kedua variabel eksogen dan efektivitas pembelajaran. Temuan ini menyoroti bahwa peningkatan efektivitas pembelajaran di lembaga pelatihan vokasi tidak hanya bergantung pada strategi pengajaran dan ketersediaan teknologi, tetapi juga pada kemampuan mereka untuk mendorong keterlibatan aktif siswa.

**Kata kunci:** Strategi pengajaran; Ketersediaan teknologi pendidikan; Keterlibatan siswa; Efektivitas pembelajaran

## Background

Improving educational quality remains a strategic priority in the development of competitive and skilled human resources, particularly within non-formal education institutions that prepare a workforce aligned with industry needs (Yudhanti et al., 2019). In this context, learning effectiveness functions as a primary indicator of educational success, reflecting the extent to which instructional objectives are achieved through competency attainment, active learner participation, and optimal utilization of available educational resources (Abidin, 2020; Andi Sadriani et al., 2023). Learning effectiveness therefore extends beyond academic performance to encompass behavioral transformation, skill enhancement, and work readiness—dimensions that are especially critical in vocational education settings.

Theoretically, learning effectiveness is influenced by the quality of instructional strategies implemented by educators. Problem-based learning, collaborative learning, and project-based learning have been empirically shown to enhance students' cognitive, affective, and behavioral engagement, resulting in more meaningful and contextualized learning processes (Ariyani & Prasetyo, 2021; Hamidah & Citra, 2021; Sugianto et al., 2020). These strategies are grounded in constructivist learning theory, which emphasizes active learner participation in knowledge construction. However, the effectiveness of instructional strategies does not operate independently. Their implementation is often contingent upon structural support, particularly the availability of educational technology infrastructure, including hardware, software, and supporting systems (Banggur et al., 2018; Purwanto, 2021).

The advancement of educational technology has created opportunities for more flexible, interactive, and efficient learning environments. The availability of Learning Management Systems (LMS), digital media, and online learning platforms can enhance accessibility and enrich learning experiences when appropriately integrated into instructional strategies (Damayanti & Nuzuli, 2023; Pubian & Herpratiwi, 2022). In this study, educational technology availability is conceptualized as the readiness of technological infrastructure and resources to support instructional processes, rather than merely the extent of utilization. Nevertheless, prior research indicates that the mere presence of technology does not guarantee learning effectiveness unless accompanied by pedagogical practices that actively foster student engagement (Far-Far, 2021; Sipayung et al., 2021).

Student engagement is widely recognized as a critical mechanism linking instructional practices and technological resources to learning outcomes. It encompasses cognitive, emotional, and behavioral dimensions manifested in active participation, learning motivation, and meaningful interaction with teachers and the learning environment (Marpaung & Cendana, 2020; Christanty & Cendana, 2021). Several studies report a positive influence of student engagement on learning effectiveness (Depita, 2024; Hussein & Khoiruzzadittaqa, 2024). However, inconsistent findings have also been reported (Priyanto & Kock, 2021), suggesting that the mediating role of student engagement requires further empirical verification. Moreover, prior studies more frequently position student engagement as either an independent or dependent variable rather than as a mediating construct within an integrated structural model. In the present study, student engagement is measured based on teachers' perceptions, as the unit of analysis consists of vocational training instructors.

Empirically, Vocational Training Institutions (Lembaga Pendidikan Keterampilan/LPK) in Karawang Regency operate within a major industrial region that demands practice-oriented and technology-based competencies. However, internal recapitulation and instructional performance evaluations indicate that learning effectiveness remains at a low to moderate level. Innovative instructional strategies have not been optimally implemented, and educational technology is frequently limited to administrative functions. This condition may hinder the achievement of competency-based training objectives in an industrial context requiring high levels of technical and practical proficiency.

A review of the literature reveals two primary research gaps. First, empirical findings regarding the effects of instructional strategies and educational technology availability on learning effectiveness remain inconsistent, both in terms of direct effects and indirect effects mediated by student engagement. Second, most prior studies focus on formal education settings, while comprehensive investigations within non-formal vocational education contexts remain limited. These gaps highlight the need for an integrative model that systematically

examines the interplay among instructional strategies, technological availability, student engagement, and learning effectiveness.

Accordingly, this study offers three main contributions. First, it tests an integrative model combining instructional strategies and educational technology availability within a non-formal vocational education context. Second, it positions student engagement as a mediating variable to clarify the mechanism underlying the relationships among constructs. Third, it provides empirical evidence using Structural Equation Modeling–Partial Least Squares (SEM-PLS) to explain determinants of learning effectiveness among vocational training instructors.

Therefore, this study aims to analyze the impact of instructional strategies and educational technology availability on learning effectiveness through the mediating role of student engagement in Vocational Training Institutions in Karawang Regency, Indonesia. The findings are expected to enrich the literature on technology-supported learning in non-formal education and provide practical implications for competency-based instructional management.

## **Method**

This study employed a quantitative approach using an explanatory–correlational and cross-sectional design. The design aimed to examine structural relationships among latent variables within a conceptual framework incorporating both direct and indirect effects of instructional strategies and educational technology availability on learning effectiveness through student engagement as a mediating variable.

Although the proposed model is theoretically causal, interpretations of the relationships were made cautiously due to the cross-sectional nature of data collection. The explanatory quantitative approach is appropriate for testing theory-based hypotheses using inferential statistical analysis (Sugiyono, 2017). The research model was analyzed using Structural Equation Modeling based on Partial Least Squares (PLS-SEM) to simultaneously examine relationships among latent constructs.

The population consisted of all teachers at Vocational Training Institutions (Lembaga Pendidikan Keterampilan/LPK) in Karawang Regency, West Java, Indonesia, totaling 208 instructors distributed across 13 districts.

Probability sampling was applied using proportional random sampling to ensure that respondent proportions reflected the distribution of teachers across districts or institutions. After determining proportional allocation, respondents were randomly selected within each group. This approach ensured equal probability of selection while maintaining regional representativeness (Sugiyono, 2017).

The sample size was determined based on SEM requirements, which recommend a minimum of 5–10 times the number of indicators (Ferdinand, 2014). With 37 measurement items, the minimum required sample size was 185 respondents. This number satisfies the requirements for PLS-SEM analysis of a moderately complex model. All respondents were active teachers involved in competency-based training programs at LPKs.

The unit of analysis was the teacher. Consequently, the construct of student engagement was measured based on teachers' perceptions of students' participation and interaction during the learning process.

Data were collected using a structured questionnaire developed based on theoretical foundations and prior empirical research. The instrument comprised four latent variables: instructional strategies, educational technology availability, student engagement, and learning effectiveness. A total of 37 items were measured using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

The indicators were developed through a synthesis of relevant literature and adapted to the non-formal vocational education context. Prior to distribution, the instrument was reviewed by two experts in educational management to ensure content validity.

The measurement model (outer model) was evaluated using SmartPLS based on the following criteria:

- a) Outer loading  $\geq 0.70$
- b) Average Variance Extracted (AVE)  $\geq 0.50$
- c) Composite Reliability  $\geq 0.70$
- d) Cronbach's Alpha  $\geq 0.70$

(Ghozali & Latan, 2014; Hair et al., 2021)

In addition to convergent validity, discriminant validity was assessed using the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT), with a threshold value of HTMT  $< 0.90$  (Hair et al., 2021). To reduce potential common method bias, collinearity was tested using the Variance Inflation Factor (VIF) with a threshold value of VIF  $< 3.3$ .

Data collection was conducted from July to August 2025. Prior to data collection, formal coordination was undertaken with LPK administrators, and research permission was obtained.

Questionnaires were distributed directly to eligible respondents. Before completing the instrument, participants were informed about the research objectives, confidentiality assurances, and instructions for completing the questionnaire. Participation was voluntary, and respondents completed the questionnaire independently without researcher intervention.

The data analysis for this study was conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with SmartPLS version 3.0. PLS-SEM was chosen due to its

advantages, such as not requiring multivariate normal distribution, its ability to handle models with numerous indicators, suitability for medium-sized samples, and its effectiveness for mediation analysis (Ghozali & Latan, 2014; Hair et al., 2021). The analysis was carried out in two main stages: the Measurement Model Evaluation (Outer Model) and the Structural Model Evaluation (Inner Model). In the first stage, the evaluation included convergent validity (outer loading and AVE), discriminant validity (Fornell–Larcker and HTMT), construct reliability (Composite Reliability and Cronbach’s Alpha), and collinearity assessment (VIF).

In the second stage, the Structural Model Evaluation focused on path coefficients, coefficient of determination ( $R^2$ ), predictive relevance ( $Q^2$ ) through blindfolding, effect size ( $f^2$ ), and model fit index (SRMR), if required by the journal guidelines. The significance of relationships was tested using bootstrapping with 5,000 subsamples, a two-tailed test, and a significance level of  $\alpha = 0.05$  (Hair et al., 2021). Mediation testing followed the approach proposed by Zhao et al. (2010) and Hair et al. (2021), examining the significance of indirect effects and calculating the Variance Accounted For (VAF) to determine whether mediation was partial or full.

## Result and Discussion

### Result

This study involved 185 teachers from Vocational Training Institutions (Lembaga Pendidikan Keterampilan/LPK) in Karawang Regency selected using proportional random sampling. Respondent characteristics were analyzed based on age, gender, educational attainment, and length of service to ensure adequate representation of the teacher population.

Table 1. Respondent Characteristics Based on Age

Age	Frequency	Percentage (%)
< 30 years	38	20.72
30–40 years	68	36.94
> 40 years	79	42.34
Total	185	100

Based on Table 1, the majority of respondents were over 40 years old (42.34%). This distribution indicates that most teachers are in a mature professional stage, which theoretically correlates with pedagogical experience and instructional stability.

Table 2. Respondent Characteristics Based on Gender

Gender	Frequency	Percentage (%)
Male	71	38.38
Female	114	61.62
Total	185	100

Table 2 shows a predominance of female teachers (61.62%). This composition reflects the general structure of instructors in vocational training institutions within the research area and does not indicate sampling bias.

Table 3. Respondent Characteristics Based on Educational Attainment

Education Level	Frequency	Percentage (%)
High School/Equivalent	2	1.08
Bachelor's Degree (S1)	159	85.95
Master's Degree (S2)	24	12.97
Total	185	100

The majority of respondents held a Bachelor's degree (85.95%), indicating that LPK instructors generally meet professional academic standards.

Table 4. Respondent Characteristics Based on Length of Service

Length of Service	Frequency	Percentage (%)
< 2 years	30	15.86
2–5 years	55	29.91
6–10 years	100	54.23
Total	185	100

More than half of the respondents (54.23%) had 6–10 years of teaching experience, reinforcing the assumption that questionnaire responses were provided by teachers with substantial practical experience.

Descriptive analysis was conducted using the Three-Box Method to classify respondents' perception levels for each construct.

Table 5. Descriptive Statistics of Research Variables

Variable	Mean Index Score	Category
Learning Effectiveness	154.64	High
Instructional Strategies	149.56	High
Educational Technology Availability	149.71	High
Student Engagement	152.84	High

All variables fall within the high category. Learning effectiveness obtained the highest index score (154.64), followed by student engagement (152.84). However, descriptive results alone do not indicate causal relationships; therefore, structural analysis was conducted to test the theoretical model.

The measurement model was evaluated to ensure construct validity and reliability before testing structural relationships.

All indicators showed outer loading values  $\geq 0.50$ , meeting the initial criteria for convergent validity.

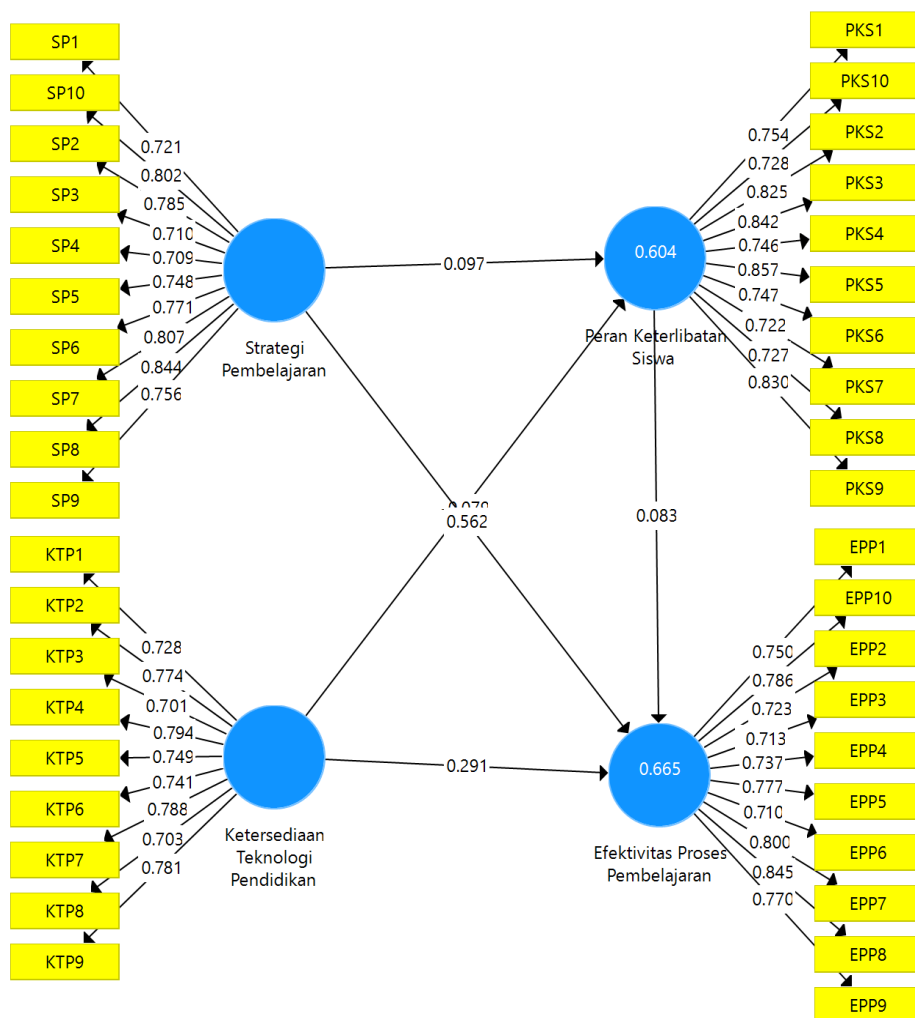


Figure 1. Measurement Model (Outer Model – Loading Factor)  
 (Figure position retained as in the original manuscript)

Table 6. Composite Reliability Values

Variable	Composite Reliability
Learning Effectiveness	0.733
Instructional Strategies	0.934
Educational Technology Availability	0.874
Student Engagement	0.932

All constructs demonstrate Composite Reliability values  $\geq 0.70$ , indicating good internal consistency. Instructional Strategies show the highest reliability (0.934), reflecting strong indicator homogeneity.

Table 7. Average Variance Extracted (AVE) Values

Variable	AVE
Learning Effectiveness	0.530
Instructional Strategies	0.588
Educational Technology Availability	0.545
Student Engagement	0.580

All constructs meet the AVE threshold  $\geq 0.50$ , confirming convergent validity. Each construct explains more than 50% of the variance of its indicators.

Table 8. R-Square Values

Endogenous Variable	R <sup>2</sup>	Interpretation
Learning Effectiveness	0.665	Moderate
Student Engagement	0.604	Moderate

An R<sup>2</sup> value of 0.665 indicates that 66.5% of the variance in learning effectiveness is explained by instructional strategies, educational technology availability, and student engagement. This reflects substantial explanatory power within a social science context.

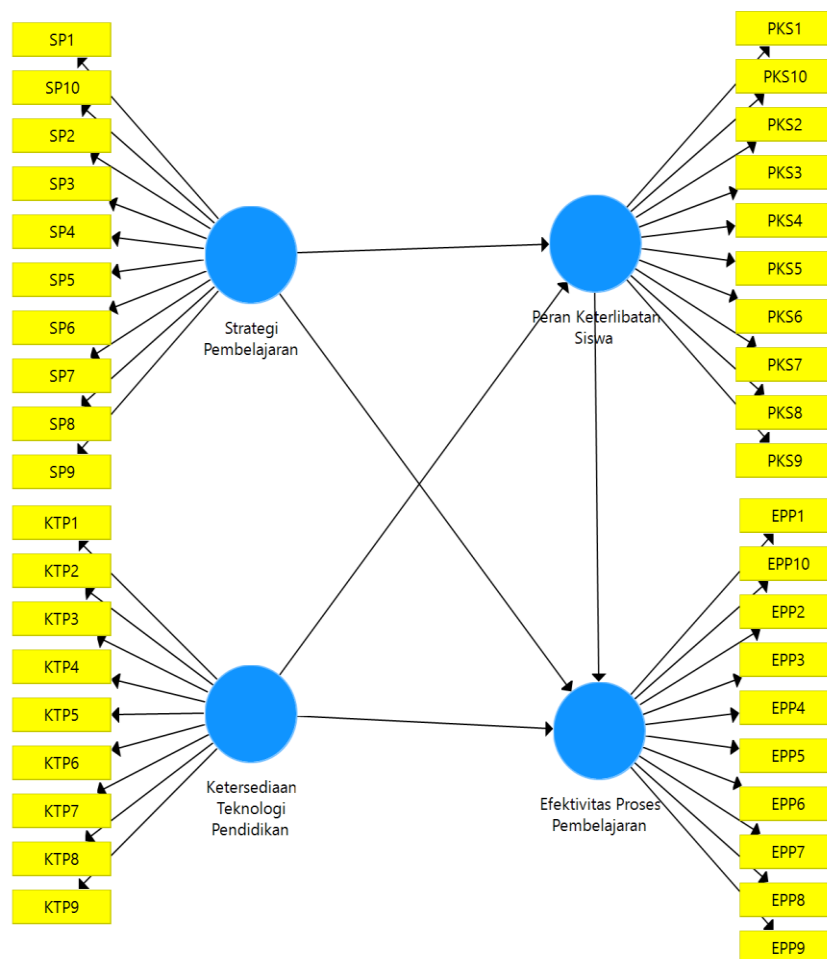


Figure 2. Structural Model (Inner Model)

(Figure position retained as in the original manuscript)

Table 9. Q-Square Values

Endogenous Variable	Q <sup>2</sup>	Interpretation
Learning Effectiveness	0.613	Predictive relevance
Student Engagement	0.624	Predictive relevance

Q<sup>2</sup> values greater than zero indicate predictive relevance. Values above 0.35 suggest strong predictive capability.

Table 10. F-Square Values

Structural Path	f <sup>2</sup>	Interpretation
Instructional Strategies → Learning Effectiveness	0.374	Large
Instructional Strategies → Student Engagement	0.198	Medium
Educational Technology → Learning Effectiveness	0.100	Small
Educational Technology → Student Engagement	0.189	Medium
Student Engagement → Learning Effectiveness	0.020	Small

Instructional strategies exhibit the largest effect size on learning effectiveness (0.374). Although student engagement significantly influences learning effectiveness, its effect size is small, indicating that its contribution is incremental within an already well-explained model.

Table 11. Direct Effect Testing Results

Path	$\beta$	T-Statistic	P-Value
Instructional Strategies → Learning Effectiveness	0.562	6.891	0.000
Educational Technology → Learning Effectiveness	0.429	3.690	0.000
Instructional Strategies → Student Engagement	0.410	3.615	0.000
Educational Technology → Student Engagement	0.408	3.458	0.000
Student Engagement → Learning Effectiveness	0.408	3.244	0.000

All structural paths are significant at  $\alpha = 0.05$ . Instructional strategies exert the strongest direct influence on learning effectiveness ( $\beta = 0.562$ ).

Table 12. Indirect Effect Testing Results

Mediation Path	$\beta$	T-Statistic	P-Value
Instructional Strategies → Student Engagement → Learning Effectiveness	0.503	4.489	0.001
Educational Technology → Student Engagement → Learning Effectiveness	0.501	4.403	0.008

Both mediation paths are statistically significant. However, according to PLS-SEM mediation principles, the indirect effect should equal the product of the path coefficients from  $X \rightarrow M$  and  $M \rightarrow Y$ . Therefore, further verification of the SmartPLS output is necessary to ensure consistency among direct, indirect, and total effects before definitively classifying the mediation type (partial or full).

## Discussion

This study aimed to examine the effects of Instructional Strategies and Educational Technology Availability on Learning Effectiveness, both directly and indirectly through Student Engagement as a mediating variable. The findings indicate that all structural paths in the model are positive and statistically significant. These results reinforce the argument that learning effectiveness in Vocational Training Institutions (Lembaga Pendidikan Keterampilan/LPK) is determined by the combination of pedagogical factors and structural support, as well as by psychopedagogical mechanisms reflected in student engagement during the learning process.

Specifically, Instructional Strategies demonstrate the strongest influence on Learning Effectiveness. In the context of LPKs, which emphasize skill acquisition and competency attainment, instructional strategies determine how practical activities, demonstrations, exercises, and performance evaluations are designed and implemented. Therefore, instructional strategies function as the primary operational driver that directs learning activities to be structured, challenging, and aligned with labor market demands. Effective strategies clarify objectives, strengthen the organization of activities, and enhance instructional interactions, thereby directly improving learning effectiveness.

Educational Technology Availability also contributes significantly to learning effectiveness, both directly and indirectly through student engagement. It is important to emphasize that this study examines technology availability—defined as the readiness of devices, platforms, and supporting infrastructure that enable technology-based instruction. The findings suggest that technological availability serves as a structural prerequisite facilitating instructional processes. However, its impact becomes more substantial when technology supports active student engagement in learning activities.

Student Engagement significantly influences Learning Effectiveness and functions as a mediating mechanism. This implies that instructional strategies and technological availability enhance effectiveness not only directly but also indirectly by increasing students' active participation. In vocational education, engagement is particularly critical because effective learning depends on active practice, sustained participation, hands-on interaction, and learners' willingness to experiment—elements that represent behavioral manifestations of engagement.

The findings support prior empirical research emphasizing the importance of student-centered instructional strategies in enhancing learning effectiveness. The results further clarify that instructional strategies influence effectiveness both directly and through increased student engagement. This indicates that the quality of instructional strategies shapes the psychological and behavioral learning conditions within the classroom.

Regarding educational technology, the findings expand existing understanding by demonstrating that technological support does not automatically lead to high learning effectiveness. The influence of technology becomes meaningful when it facilitates active participation, interaction, collaboration, and content exploration. Thus, the results reinforce the perspective that educational technology is most effective when integrated into pedagogical strategies rather than functioning merely as an administrative tool or passive information medium.

The study strengthens learning models that position Student Engagement as a central mechanism explaining the relationship between instructional strategies, technological

support, and learning effectiveness. The findings align with constructivist perspectives, which argue that effective learning occurs when learners actively construct understanding, solve problems, and reflect on their experiences rather than passively receiving information.

Furthermore, the mediation findings contribute to structural learning models by empirically demonstrating how pedagogical and structural variables interact through psychological engagement processes to influence educational outcomes.

The findings of this study have direct implications for instructional management in Vocational Training Institutions (LPKs). Teachers should prioritize instructional strategies that foster meaningful and active learning, such as project-based learning and competency-based practical training, due to their strong impact on learning effectiveness. Additionally, investment in educational technology should go beyond merely providing facilities, focusing on selecting technologies that enhance interactive learning processes, such as Learning Management Systems (LMS) for assignments and feedback, digital simulation tools, and collaborative platforms. Furthermore, LPK management should balance investments in strengthening teachers' pedagogical competence with the development of relevant technological infrastructure, ensuring a synergistic improvement in both student engagement and learning effectiveness.

The strong influence of Instructional Strategies on Learning Effectiveness can be explained by the strategic function of pedagogy as the operational framework of instruction. Well-structured strategies allow teachers to organize learning sequences, set competency targets, provide adequate practice opportunities, and deliver timely feedback. This clarity enhances learning intensity and contributes to improved instructional outcomes.

In contrast, the impact of educational technology appears more optimal when technology functions as an enabler of active learning. If technology is limited to administrative support or passive information delivery, its contribution to effectiveness remains limited. However, when technology facilitates discussion, simulation-based practice, performance assessment, and collaborative projects, it is more likely to enhance engagement and subsequently strengthen learning effectiveness.

The mediation role of student engagement suggests that improvements in effectiveness primarily occur through changes in learners' behavioral and motivational patterns—greater activity, persistence, and involvement in instructional tasks. However, it is important to note that engagement was measured based on teachers' perceptions. Consequently, interpretation should consider potential perceptual bias, particularly regarding cognitive and emotional dimensions of engagement that are less directly observable.

Boundary conditions may also explain why the technological effect is smaller than that of instructional strategies. Differences in teachers' digital literacy, institutional management

support, and disparities in device access and connectivity across LPKs may limit the transformation of available technology into consistently active instructional practice.

The discussion directly addresses the research objectives, which aimed to analyze both direct and indirect effects of Instructional Strategies and Educational Technology Availability on Learning Effectiveness. The significance of all major structural paths confirms the strength of the relationships among variables. Moreover, evidence that Student Engagement serves as a mediator provides a mechanistic explanation of how pedagogical and structural factors operate to enhance instructional effectiveness. Thus, the findings and interpretations remain consistent with the proposed conceptual framework.

This study has several limitations. First, data were collected through self-reported questionnaires from a single source (teachers), creating potential common method bias and limiting objective measurement of student engagement. Second, the cross-sectional design restricts strong causal inference without longitudinal or experimental validation. Third, the study was limited to LPKs in Karawang Regency, reducing generalizability to other non-formal education contexts. Fourth, the focus on technology availability does not capture variations in actual utilization intensity or integration quality within daily instructional practices.

Future research is encouraged to adopt a multi-source design by incorporating student-reported data to measure engagement more objectively. Mixed-method approaches may provide deeper insights into how instructional strategies and technology are implemented in vocational training contexts.

Subsequent studies may also incorporate additional variables such as teachers' pedagogical competence, digital literacy, institutional management support, or organizational culture to enrich the structural model. Longitudinal or quasi-experimental designs are recommended to examine engagement and effectiveness dynamics over time and to strengthen causal inference.

## Conclusion

This study examined the influence of Instructional Strategies and Educational Technology Availability on Learning Effectiveness, with Student Engagement serving as a mediating variable among teachers in Vocational Training Institutions (LPK) in Karawang Regency. The SEM-PLS results indicate that the model explains 66.5% of the variance in learning effectiveness ( $R^2 = 0.665$ ), demonstrating moderate-to-strong explanatory power in a social science context.

Empirically, Instructional Strategies emerged as the strongest predictor of Learning Effectiveness ( $\beta = 0.562$ ), followed by Educational Technology Availability ( $\beta = 0.429$ ). Both

variables significantly influence Student Engagement, which in turn significantly affects Learning Effectiveness ( $\beta = 0.408$ ). These findings confirm that student engagement plays a significant mediating role within the structural model.

Thus, improving learning effectiveness in vocational training institutions depends not only on pedagogical quality and technological support but also on the extent to which both factors actively foster student engagement.

Theoretically, the study reinforces the view that student engagement is a key mechanism linking pedagogical and structural factors to instructional effectiveness, particularly within practice-oriented vocational education. It also enriches the literature on integrating instructional strategies and educational technology in non-formal education contexts.

Practically, the findings recommend two strategic priorities for LPKs:

1. Strengthening teachers' pedagogical competence through training in project-based, competency-based, and collaborative instructional strategies.
2. Directing technological investment toward tools that enhance interactivity and feedback rather than merely fulfilling administrative functions.

Despite its contributions, the study is limited by reliance on teacher perception data and its cross-sectional design, which restrict causal interpretation and generalizability.

Future research should incorporate multi-source data, longitudinal designs, and additional explanatory variables such as pedagogical competence, digital literacy, management support, and organizational culture to further strengthen the explanatory capacity of the model.

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