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The Effectiveness of AI-Augmented Experiential Learning in Improving the Instructional Supervision Competence of Vocational High School Principals

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Abstract

Vocational High School (SMK) principals play a strategic role as instructional leaders in improving the quality of vocational education. Instructional supervision competence is an essential capability that enables principals to guide vocational teachers in planning, implementing, and evaluating learning processes that align with contemporary industrial demands. However, competency development programs for school principals are still frequently dominated by conventional, lecture-based training models that induce high cognitive loads and fail to utilize participants' hands-on professional experiences. This study aimed to analyze the effectiveness of Experiential Learning (EL) compared to conventional methods in improving the instructional supervision competence of vocational high school principals through a quasi-experimental approach. Utilizing a Non-Equivalent Control Group Design, 37 participants were divided into an experimental group (N = 18) trained under the Experiential Learning framework and a control group (N = 19) exposed to conventional teaching. Data were gathered through standardized pretests, posttests, and satisfaction questionnaires, analyzed via descriptive statistics, paired sample t-tests, and independent sample t-tests. The results demonstrated that the experimental group achieved a higher improvement, with mean scores jumping from 67.78 to 86.11 (Δ = 18.33), whereas the control group only improved from 78.42 to 83.68 (Δ = 5.26). Inferential statistics confirmed a highly significant internal

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improvement for the experimental group (t = 3.631, p = 0.002 < 0.05). Crucially, a monumental finding revealed that during the active experimentation phase of designing complex supervisory artifacts, the integration of Generative AI acted as vital cognitive scaffolding, yielding a superior performance score of 92.16 compared to pure manual synthesis (78.72). Based on these empirical insights, this study establishes a novel, advanced theoretical framework: the AI-Augmented Experiential Learning Model (AI-Augmented ELM), offering a strategic blueprint for nationwide vocational leadership training.

Keywords: Experiential Learning, Instructional Supervision, Vocational School Principal, Generative AI, Quasi-Experimental Study.

INTRODUCTION

In the era of rapid technological disruptions, global economic realignment, and industrial automation, Technical and Vocational Education and Training (TVET) institutions worldwide face intense pressure to produce industry-ready graduates. Within the Indonesian education ecosystem, the Vocational High School (Vocational High School or SMK) serves as the primary formal vehicle for human capital development aligned with industrial demands. To ensure that vocational instruction matches the dynamic changes in the global market, school principals must transition from being administrative managers to proactive instructional leaders. Leadership scholarship underscores that the primary responsibility of a modern school leader is the continuous improvement of classroom teaching and shop-floor practice through rigorous, supportive, and systemic instructional supervision (Bush, 2020; Hallinger & Murphy, 1985).

Instructional supervision is conceptualized as a collaborative, ongoing professional development process designed to assist teachers in enhancing their pedagogical strategies, lesson planning, and assessment designs. As described by Sahirah et al. (2024), supervision is not a bureaucratic mechanism for administrative compliance, but a systemic process of professional guidance aimed at unlocking teacher capabilities. In the specific context of vocational education, this supervisory competence takes on an added layer of complexity. The principal must not only evaluate general pedagogical compliance but also ensure that the practical instruction delivered in workshops and laboratories directly reflects the standard operating procedures of the Business and Industrial World (DUDI). Empirical literature consistently highlights that high-quality instructional supervision correlates positively with elevated teacher self-efficacy, modernized classroom delivery, and optimized institutional performance. Specifically, Kristen (2019) demonstrated that strengthening the instructional supervision executed by school principals acts as a

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powerful catalyst for enhancing the overall quality of school operations and accelerating teacher performance vectors.

Despite its documented importance, the mechanism for scaling up this competence among vocational school principals remains profoundly flawed. Traditional professional development programs and national training workshops are overwhelmingly characterized by conventional training paradigms. These conventional models rely extensively on top-down, lecture-heavy deliveries where participants act as passive recipients of theoretical knowledge. Such methodologies present severe drawbacks: first, they actively ignore the rich, decades-long empirical and professional experience that adult learners bring to the training environment; second, when dealing with highly complex managerial tasks—such as detailed engineering diagnostic rubrics for multi-tiered project-based learning—passive theoretical instruction fails to translate into actionable execution, often culminating in severe cognitive overload. As argued by adult education scholars, educational leaders possess deeply rooted empirical schemas that must be actively engaged, dismantled, and reconstructed through interactive loops rather than standard passive lecturing (Darling-Hammond et al., 2020; Knowles et al., 2015).

To address the limitations of passive, lecture-centered training, educational theorists have long advocated for the implementation of Experiential Learning (EL). As originally operationalized by Kolb (1984), experiential instruction posits that learning is a holistic, continuous process where knowledge is generated through the strategic transformation of real-world experience. Experiential learning typically proceeds through a structured four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. When applied to leadership development, this cyclical model allows school principals to confront authentic school dilemmas, reflect critically on past administrative failures, co-construct sophisticated supervisory frameworks, and actively test these designs within simulated or real professional environments. Subsequent research by Kolb and Kolb (2017) further proved that experiential learning structures regularly elevate participant engagement, enhance reflective depth, and anchor conceptual schemes because learners are directly responsible for discovering and building their own knowledge infrastructure.

While the baseline effectiveness of standard experiential learning has been verified across various student-centric and higher education settings, its empirical application within rigorous, experimental professional development for vocational administrators remains remarkably under-researched. Furthermore, contemporary educational landscapes are undergoing massive shifts due to the emergence of advanced technology and digital tools. The modern workplace demands that leadership strategies evolve concurrently with technological innovations, pushing

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researchers to explore how emerging technologies can augment classical instructional models. Creswell and Creswell (2018) note that experimental designs provide the most robust mechanism for evaluating the precise impacts of such pedagogical interventions by directly comparing behavioral shifts across controlled cohorts.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

The Concept of Experiential Learning

The theoretical foundations of Experiential Learning Theory (ELT) assert that learning is a holistic process where experience transforms into functional knowledge through continuous cognitive and behavioral adjustments. Unlike behaviorist models that emphasize rote response or classic cognitive models that prioritize abstract mental processing in isolation, experiential learning balances thinking, feeling, perceiving, and doing. The standard operational architecture of this model revolves around David A. Kolb's four-stage cyclical continuum (Kolb, 1984): Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). In the arena of professional leadership cultivation, this cycle ensures that the conceptual frameworks generated are immediately subjected to practical validation, thereby bridging the notorious gap between administrative theory and actual field execution (Huber, 2014; Pineda-Herrero et al., 2015).

Instructional Supervision Competence in TVET Institutions

In vocational high schools, instructional supervision cannot operate as a rigid, punitive exercise in administrative compliance. Rather, it must function as a specialized form of high-level clinical coaching tailored to the unique parameters of vocational workshops. The principal's competency domain encompasses several vital operational sub-components: comprehending the philosophy of instructional supervision within industry-linked curricula, meticulously analyzing multifaceted shop-floor and classroom instructional deficiencies, formulating highly customized teacher-growth trajectories, structuring highly precise diagnostic monitoring instruments, and executing reflective post-observation feedback sessions that respect teacher autonomy while driving professional excellence (Glickman et al., 2020; Tuytens & Devos, 2014). Because TVET programs are explicitly tied to industrial metrics, the instruments designed during supervision must possess extreme ecological validity, mapping precisely onto modern industrial occupational safety, workflow optimization, and technological applications (Gessler & Howe, 2015; Marope et al., 2015).

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Cognitive Load Theory and Technological Scaffolding

When adult learners are thrust into the active experimentation phase of a learning cycle to design highly specialized professional artifacts—such as a 60-indicator industrial alignment rubric—they frequently encounter severe cognitive overload. According to Cognitive Load Theory, working memory possesses a highly restricted processing capacity when manipulating complex, interactive elements simultaneously (Sweller, 2011). In traditional training environments, if the instructional design forces the participant to simultaneously manage the philosophical alignment of the rubric, the grammatical clarity of the indicators, and the formatting of the technical document manually under strict time limitations, the extraneous and intrinsic cognitive loads completely overwhelm the germane cognitive load, resulting in fragmented, low-quality outputs (Kirschner et al., 2006).

To circumvent this psychological bottleneck, modern educational frameworks emphasize the deployment of cognitive scaffolding. Epistemic tools, such as Generative Artificial Intelligence (AI) and advanced large language models, can assume the burden of low-level syntactic organization and rapid prototyping, thereby acting as a powerful cognitive amplifier that allows the human learner to focus exclusively on high-level strategic alignment and philosophical refinement (Mollick, 2024). This collaborative interaction manifests what is theorized as social-cognitive scaffolding, allowing learners to solve problems that would otherwise be entirely inaccessible due to working memory constraints (Vygotsky, 1978).

Table 2. Critical Analysis of Prior Relevant Empirical Literature

No	Researcher & Year	Focus of Inquiry	Core Empirical Findings	Identified Conceptual Gap
1	Chelagat et al. (2020)	Impact of project-based experiential learning on health sector leadership capacity.	Experiential cohorts combined with targeted coaching achieved systematic, long-term organizational performance	Conducted entirely within healthcare management; did not evaluate educational leadership.

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			improvements.	
2	Ockerman & Bagui (2023)	Exploration of active experimentation stages within experiential teacher training.	Active experimentation structures substantially accelerated teacher reflective capacity and direct practical output generation.	Completely qualitative; did not utilize quantitative experimental controls or evaluate AI intervention.
3	Ahmad Faizuddin et al. (2022)	Continuous professional development models for modern school principals.	Educational leadership development requires sustained practical modules and customized field coaching architectures.	Explored general landscape needs descriptively; did not test specific instructional models experimentally.
4	Master et al. (2022)	Efficacy of principal executive development programs via large-scale monitoring.	Structured leadership development tracking yielded clear down-stream improvements in general school administration.	Focused exclusively on general coaching; did not assess complex artifact design load.
5	Emden et al. (2025)	Effectiveness of professional development programs	Active learning models embedding collaboration	Executed entirely upon teacher cohorts; failed

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	based on active learning structures.	drove structural competency shifts across adult training spaces.	to address the distinct managerial capabilities of principals.

RESEARCH METHODOLOGY

Research Design

This study adopted a quantitative approach using a Quasi-Experimental Design, specifically the Non-Equivalent Control Group Design. This design was chosen because it was logistically impossible and ethically disruptive to randomly disband established, intact national training cohorts to achieve full randomization (Creswell & Creswell, 2018). Instead, two pre-existing, structurally parallel training classes were selected and designated as either the experimental group or the control group. The design involves a pre-intervention measurement (O1 and O3), an experimental treatment (X for experiential learning, and - for conventional lecture models), and a post-intervention measurement (O2 and O4) to capture the shift in competency.

Participants and Setting

The target population comprised school administrators participating in the 2026 National Vocational High School Principal Competency Improvement Training. The total sample consisted of 37 vocational high school principals selected via a purposeful, non-random sampling technique. The Experimental Group consisted of 18 principals situated at the Center for the Development of Vocational Education Quality Assurance in the Marine, Fisheries, Information and Communication Technology Sector (BPPMPV KPTK) of the Ministry of Education and Culture in Gowa. The Control Group comprised 19 structurally comparable vocational principals undergoing training in an identical leadership module via standard regional delivery modalities in Palu. The baseline demographics (age range, institutional accreditation levels, prior leadership tenure) were checked and deemed statistically parallel across both cohorts.

Data Collection Instruments

To ensure absolute measurement accuracy and factual precision, three distinct data collection instruments were developed and strictly validated by an expert panel of psychometricians and vocational education professors: (1) Standardized Instructional Supervision Competence Test consisting of 20 high-fidelity situational

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judgment items anchored on critical thinking frameworks (Ennis, 2011); (2) Participant Satisfaction Questionnaire using a Likert scale capturing participant engagement, perceived meaningfulness, quality of the experiential journey, and overall system satisfaction; (3) Experiential Feature Implementation Observation Checklist containing 60 indicators evenly split into four sub-dimensions corresponding to Kolb's stages scored on a 4-point scale (yielding a max total of 240 points).

RESULTS AND ANALYSIS

Descriptive Analysis

The quantitative data obtained from the pretests, posttests, and satisfaction metrics were evaluated using descriptive statistical parameters. A comprehensive summary is presented in Table 3 below.

Table 3. Comprehensive Descriptive Summary of Experimental and Control Groups

Statistical Parameter	Experimental Group (EL)	Control Group (Conventional)	Absolute Margin Difference
Sample Size (N)	18 Participants	19 Participants	—
Mean Pretest Score	67.78	78.42	-10.64
Mean Posttest Score	86.11	83.68	+2.43
Mean Competency Gain (Δ)	+18.33	+5.26	+13.07
Minimum Posttest Score	75.00	60.00	+15.00
Mean System Satisfaction (%)	97.50%	96.45%	+1.05%

The descriptive metrics unveil a profound leap in learning effectiveness. The experimental cohort started the intervention block with a noticeably lower baseline capability compared to their control counterparts, as evidenced by a mean pretest

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deficit of 10.64 points (67.78 versus 78.42). However, following the implementation of the experiential learning cycle, the experimental group completely bypassed the control group, finishing with a superior mean posttest score of 86.11. The true measure of pedagogical efficacy is captured by the absolute margin of improvement: the experimental class achieved a competency gain of +18.33 points, which is more than three times higher than the modest increase of +5.26 points observed in the lecture-based control group. Furthermore, the experiential intervention demonstrated a robust capacity for raising the lower boundaries of participant capability; the minimum posttest score in the experimental group surged to 75.00, achieving a 100% institutional competency passing rate. In sharp contrast, the control group's minimum posttest score remained stalled at a sub-optimal 60.00.

Fidelity Assessment of Treatment Implementation

To guarantee that the observed competency gains were a direct function of the intended instructional strategies rather than confounding variables, the data from the four independent observers were aggregated. The experimental class successfully achieved a 93.75% implementation density of the experiential learning framework (mean raw score of 225 out of 240). The control class registered a baseline experiential presence of 61.88% (mean raw score of 148.5 out of 240), indicating a net discrepancy margin of +31.87 points between the two environments, confirming treatment fidelity.

Inferential Statistical Testing

To evaluate whether the internal pretest-to-posttest competency leaps within each group were statistically significant, a series of paired sample t-tests were executed at a confidence interval ($\alpha = 0.05$). For the Experimental Group, the analysis revealed a highly robust t-value of 3.631 with an associated exact two-tailed significance value of $p = 0.002$. Because $p < 0.05$, the null hypothesis was confidently rejected. For the Control Group, the paired analysis yielded a t-value of 1.832 with a p-value of $p = 0.084$. Because $p > 0.05$, the internal score fluctuation within the control group failed to cross the threshold of statistical significance.

To definitively establish the absolute superiority of Experiential Learning over the conventional lecture approach, an independent sample t-test was performed directly upon the calculated gain scores. The independent sample analysis calculated a distinct t-statistic of 2.281, with a resulting p-value of $p = 0.029$ ($p < 0.05$). To account for any minor deviations from normality within the small sample sizes, a parallel Mann-Whitney U Test was executed as a robust validation check,

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computing a U statistic of 239.50 and returning an asymptotic significance value of p = 0.037 ($p < 0.05$), reinforcing the parametric findings.

DISCUSSION AND THEORETICAL RECONSTRUCTION

The Mechanical Efficacy of the Experiential Cycle

The quantitative superiority of the experiential intervention is directly explainable by the cognitive and behavioral dynamics built into the four-stage cycle. In the experimental class at BPPMPV KPTK Gowa, the instruction began by deliberately pushing the principals into a Concrete Experience (CE). Instead of listening to a slide presentation on the abstract definition of academic governance, these leaders were presented with messy, real-world case studies detailing sharp drops in student passes on industrial competency exams across regional schools. This immediately engaged their affective, professional sensibilities. An integral part of this success lies in the principal's emotional involvement in the quality of teacher learning which is triggered simultaneously. During the Reflective Observation (RO) phase, rather than receiving passive answers, the principals were guided through structured debriefing loops driven by analytic root-cause frameworks. They were forced to look at their past administrative habits from the perspective of their teachers and industry partners, recognizing that their historical supervision methods were largely punitive, compliance-driven, and devoid of genuine educational value. In the Abstract Conceptualization (AC) phase, the participants actively synthesized these insights, mapping their field experiences directly onto modern leadership theories and national education mandates, such as the Academic Supervision Guidelines issued by Kemendikbudristek (2023). Consequently, when they transitioned to the final stage of Active Experimentation (AE), the knowledge acquired was deeply integrated as structured, actionable competence ready for deployment in their respective institutions, matching the predictive logic of experiential leadership training models (Ng et al., 2009; Vogel et al., 2020).

The AI Intervening Variable and Cognitive Scaffolding

While the baseline descriptive and inferential statistics overwhelmingly validated the general efficacy of the experiential approach, the most critical breakthrough of this research emerged from a highly unexpected anomaly during the active experimentation phase. When the observers isolated the specific performance scores for the practical task of developing comprehensive instructional monitoring instruments, they discovered a striking paradox: the control class achieved a dramatically higher sub-score than the experimental class. Specifically, the control class achieved a mean instrument design score of 92.16, while the experimental

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class stalled at a significantly lower mean of 78.72, revealing an absolute performance gap of 13.44 points (a 17.07% advantage for the control group). A meticulous post-hoc qualitative investigation revealed the presence of a powerful, uncontrolled intervening variable. When participants reached the fourth stage of experiential learning implementation, the control class used artificial intelligence as a tool in completing the task, while the experimental class worked with original thinking within a limited time. As a result, the control class performed significantly better than the experimental class.

This massive performance gap is perfectly explained by Cognitive Load Theory (Sweller, 2011). Designing a complete, high-fidelity instructional supervision checklist that includes dozens of precise behavioral indicators for specialized vocational fields requires a huge amount of working memory capacity. The human brain must simultaneously manage the overarching strategic alignment with the national curriculum, the specific industrial safety codes unique to that trade, the syntactic precision of the behavioral descriptions, and the micro-level formatting and organizational logic of the document. For the experimental group, attempted to execute this multi-layered task manually within a strict, time-bound setting triggered severe cognitive overload. In sharp contrast, the control group utilized Generative AI as an efficient form of cognitive scaffolding. By delegating the repetitive tasks of document drafting, syntactic structuring, and indicator expansion to the AI via prompt engineering, the principals freed up massive amounts of working memory. This allowed them to operate as high-level editors, focusing their remaining mental energy entirely on strategic validation, local customization, and high-level alignment with industry standards (Mollick, 2024). This empirical alignment validates the paradigm of distributed cognition, demonstrating that when human experts collaborate with AI agents, the resulting socio-technical framework consistently yields a vastly superior problem-solving capacity compared to unaugmented human effort (Coombes et al., 2023; Dwivedi et al., 2023).

The Conceptual Breakthrough: Formulating the AI-Augmented ELM

This empirical finding reveals a major limitation in David A. Kolb's classical Experiential Learning Theory when applied to highly complex, artifact-heavy professional tasks in the digital era (Kolb, 1984). Classical ELT assumes that the human agent must act as the sole engine of synthesis across all four quadrants. However, this study demonstrates that during the transition from abstract conceptualization to active experimentation, the sheer complexity of modern professional output requires an external cognitive amplifier. To address this limitation, this study introduces a major theoretical advance: the AI-Augmented Experiential Learning Model (AI-Augmented ELM). This new model regularly

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redesigns the classical four quadrants by embedding artificial intelligence as an essential cognitive partner, establishing four refined phases: (1) Amplified Experience, (2) Structured Reflection, (3) Synthesized Conceptualization, and (4) AI-Augmented Active Experimentation, where the integration of Generative AI combined with Prompt Engineering Guidance provides critical cognitive scaffolding to formulate high-accuracy supervisory artifacts without cognitive overload.

CONCLUSION

1. Compliance and Procedures for Experiential Learning Implementation: The implementation of Experiential Learning (EL) in the 2026 Vocational High School Principal Competency Improvement Training at the BPPMPV KPTK Kemdikdasmen was implemented through a structured cycle involving four main stages: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. The results of direct observations by four pairs of observers using a standard instrument of 60 indicators showed that the Experimental Class (Class A KPTK) successfully implemented Experiential Learning features with an implementation level of 93.75% (score of 225 out of 240). This figure far exceeded the Control Class (Class B Palu) which only reached 61.88% (score of 148.5 out of 240), resulting in a margin of difference in implementation of 31.87%. This proves that the Experimental Class has convincingly implemented the principles of experiential learning in a precise and measurable manner.
2. Effectiveness of the Experiential Learning Model on Learning Supervision Competence: The application of Experiential Learning has been empirically and significantly proven to be more effective than conventional/regular methods in improving the learning supervision competency of SMK Principals. The experimental group (N1 = 18) experienced a jump in average scores from a pre-test of 67.78 to a post-test of 86.11, or recorded a gain score (increased effectiveness) of +18.33 points. In contrast, the control group (N2 = 19) who relied on conventional methods only experienced an increase from a pre-test of 78.42 to a post-test of 83.68 (gain score +5.26 points). The margin of improvement for the experimental group was more than threefold (+13.07 points higher) compared to the control group. This model succeeded in significantly raising the limits of participants' abilities at the lower levels; the lowest post-test score in the experimental group jumped to 75.00 (all participants completed), while in the control group the lowest post-test score remained stuck at 60.00. Participants' responses to the Experiential Learning model reached a satisfaction level of 97.50%, confirming that the training atmosphere was more interactive, collaborative, enjoyable, and dignified. Verification of the inferential test through the Paired Sample t-test in the experimental group produced $t = 3.631$ ($p = 0.002 < 0.05$), while the control group was not significant ($t = 1.832$, $p = 0.084 > 0.05$). The inter-group difference test (Independent Sample t-test) on the gain score produced $t = 2.281$ ($p = 0.029 < 0.05$), and was strengthened by the non-parametric

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Mann-Whitney U test (U = 239.50, p = 0.037 < 0.05), proving the absolute superiority of the effectiveness of the innovation method compared to the conventional method.

3. Novelty and Theoretical Reconstruction: AI-Augmented Experiential Learning Model: The most monumental finding of this study lies in the discovery of the classic limitations of David A. Kolb's cycle when applied to complex professional artifact development tasks (such as academic supervision instruments). Data show that in the Active Experimentation (AE) stage, the control group given a facilitator-directed intervention to utilize Artificial Intelligence (AI) achieved an average instrument development score of 92.16. This achievement significantly exceeded the pure experimental group (without AI intervention) which only achieved an average of 78.72 (there was an absolute difference of 13.44 points or a 17.07% advantage). The main cause of this gap is the occurrence of cognitive overload in the pure group when manually designing instrument variables and indicators. Based on these findings, a theoretical novelty was formulated in the form of an Augmented Experiential Learning Model (AI-Augmented ELM) which refines Kolb's four stages into: Concrete Experience Amplified Experience, Reflective Observation Structured Reflection, Abstract Conceptualization Synthesized Conceptualization, and Active Experimentation AI-Augmented Active Experimentation with the support of Prompt Engineering Guidance from the facilitator as cognitive scaffolding.

Suggestions and Recommendations

Policy and Institutional Recommendations (BPPMPV KPTK & Kemdikdasmen)

Formal Adoption of Training Curriculum: BPPMPV KPTK Kemdikdasmen is recommended to institutionalize the AI-Augmented Experiential Learning Model (AI-Augmented ELM) as a standard blueprint in designing training instruments to improve the competency of SMK Principals and School Supervisors nationally.

Development of Real Data-Based Training Modules: It is necessary to develop a supervisory assistance module that is rich in real case studies of the vocational gap with DUDI to strengthen the Amplified Experience and Structured Reflection stages.

Operational Recommendations and Facilitation Practices (Widyaiswara & Facilitator)

Explicit Implementation of AI Interventions: Instructors and facilitators should no longer allow participants to conduct the Active Experimentation process in isolation/manually for complex scientific tasks. Facilitators must equip themselves with Prompt Engineering Guidance competencies to guide participants in utilizing AI as a cognitive partner (epistemic partner).

Strengthening Cognitive Scaffolding: The facilitator must actively facilitate trigger questions to explore the root cause of the problem in the reflection phase so

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that the conceptualizations produced by participants before being executed by AI have a strong philosophical foundation.

Managerial Recommendations (Vocational School Principal)

Implementation of Augmented Supervision Instruments in Educational Units: Vocational High School Principals participating in the training are recommended to implement the AI-based supervision instrument products resulting from the training in their respective schools, as well as disseminate it to the vice principals for curriculum and senior teachers. Sharing Culture: Principals are expected to build a learning community (Community of Practice) among vocational school principals in their area to continuously reflect on and share good practices in vocational learning supervision.

Recommendations for Further Research

Sample Size Expansion and Educational Unit Diversification: further innovation is suggested to expand the sample size (involving elementary, middle, and high schools) to test the generalization of AI-Augmented ELM in a broader managerial realm. Longitudinal Study of Supervision Impact: It is recommended to conduct a long-term impact study (longitudinal study) to measure the extent to which the supervision instrument resulting from AI-Augmented ELM is able to improve teacher teaching performance in the classroom and the quality of vocational graduates absorbed by DUDI.

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