

The relationship between artificial intelligence use and pedagogical practice innovation among vocational college lecturers

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Abstract

This study examined the critical relationship between artificial intelligence (AI) usage and pedagogical innovation among 292 lecturers across 11 vocational colleges in Johor, Malaysia. Amidst the ongoing digital transformation of higher education, this research specifically investigated how lecturer attitudes influence the adoption of AI technologies in classroom settings. Utilizing a quantitative correlational survey design, data were gathered through a robust 47-item questionnaire, which demonstrated excellent psychometric properties, including expert-validated content (S-CVI 0.99) and high internal consistency (Cronbach's $\alpha > 0.90$). Statistical analyses performed via SPSS v27.0 revealed that while educators possess positive attitudes and high perceptions of AI's potential impact, their actual implementation and innovation levels remain only moderate. Independent samples t-tests indicated no statistically significant gender-based differences regarding AI usage ($t=-0.735$, $p>0.05$) or professional attitudes ($t=-1.055$, $p>0.05$). Most notably, the study identified a strong, significant positive correlation between AI usage and pedagogical innovation ($r=0.883$, $p<0.05$). Regression analysis further confirmed that AI usage serves as a powerful predictor of innovation variance, accounting for 78% of the change ($R^2=0.780$). In conclusion, the findings suggest that AI integration is a fundamental catalyst for evolving vocational teaching practices. To maximize these benefits, stakeholders must balance technical skills training with infrastructure improvements and the cultivation of positive educator mindsets. These insights are essential for developing comprehensive digital competency frameworks and specialized training programs, directly aligning with the aspirations of the National TVET Policy 2030 to significantly elevate the standard of technical education across Malaysia for future growth, global competitive success, prosperity, and national excellence.

Keywords: *Artificial Intelligence, Pedagogical Practice Innovation, Lecturer Attitudes, TVET, Vocational College, Digital Transformation*



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INTRODUCTION

In the contemporary international education system, the rapid advancement of Artificial Intelligence (AI) has significantly transformed the Technical and Vocational Education and Training (TVET) ecosystem. Rather than functioning merely as a supplementary teaching tool, AI serves as a primary driver for innovation in pedagogical practices (Ali et al., 2025; Abbas et al., 2024; Mohd Khairul & Luqman, 2024). Within the Malaysian context, the National TVET Policy 2030 underscores the critical importance of technological integration to elevate the quality of vocational education (Jabatan Pendidikan Teknik dan Vokasional [JPT], 2023). Consequently, the overall readiness of educators to accept AI, alongside their openness toward pedagogical transformation, represents a critical cornerstone in this digital transition (Balogh, 2024; Shahrar, 2024). This comprehensive digital transformation demands a holistic approach encompassing robust infrastructure development, shifts in educator perspectives, and systematic cultural adaptations (Mohamed Ali et al., 2024). While positive attitudes toward technology have been shown to systematically enhance lecturers' inclinations

to embed AI within their instructional workflows (Niam & Shukri Nordin, 2024), several persistent barriers such as structural confusion regarding AI functionalities, expanding digital competency gaps, and widespread concerns regarding the professional implications of automated technologies continue to challenge the vocational ecosystem (Ridzuan, 2025; Ejjami, 2024; Mansor, 2023).

In alignment with national educational mandates, the implementation of the National Digital Education Policy actively seeks to elevate the global competitiveness of graduates by fostering the mastery of emerging technologies (Kementerian Pendidikan Malaysia, 2021). In modern education, AI creates extensive opportunities for automating intensive administrative tasks, personalizing individual student learning trajectories, and interpreting complex academic performance data (Ali et al., 2025; binti Kamdani, 2024; Mohamed Ali et al., 2024). Despite these systemic benefits, recent investigative reports reveal that the actual routine deployment of digital platforms within vocational education remains low due to inadequate technological competencies (Shahran, 2024; Jam, 2023). Transforming TVET instructional delivery requires a comprehensive framework that explicitly integrates AI tools (Kuznetsov & Kuznetsova, 2024; Labyad et al., 2024; Qi, 2023), the success of which depends heavily on educators' psychological reception of pedagogical changes (Ejjami, 2024; Ridzuan, 2025). Comparative international insights from nations such as China and the United States further highlight significant variations in AI acceptance among vocational educators, heavily contingent upon institutional support mechanisms and deep-rooted organizational cultures (Yan, 2024; Yu & Wang, 2024; Zhang, 2024). Because technical instructors require a baseline of technological self-efficacy to optimize AI functionalities, those with limited exposure frequently resist adoption, whereas educators who directly experience the empirical benefits of AI demonstrate greater adaptability (Mohamed Ali et al., 2024; Mohd Khairul & Luqman, 2024). Therefore, rather than viewing technology as a threat to human professionalism, AI must be structurally positioned as a strategic facilitator to cultivate a dynamic, interactive, and student-centered learning environment (Ali et al., 2025).

Despite proactive government campaigns promoting artificial intelligence, its actual assimilation within Malaysian vocational colleges has not yet achieved the expected benchmarks. Analytical indicators reveal that only approximately 30% of TVET lecturers routinely deploy digital tools within their classrooms (Niam & Shukri Nordin, 2024; Yuan, 2024; Mansor, 2023). This low adoption rate stems from three dominant, interconnected barriers: fragile technological infrastructure, non-holistic professional training programs, and a skeptical attitude among technical educators who fear that automated systems might eventually replace human instructional roles (Ridzuan, 2025; Balogh, 2024; Ejjami, 2024; Shahran, 2024; Jam, 2023). A profound limitation of existing literature is that past studies have focused predominantly on the technical dimensions of AI implementation, leaving the vital psychosocial dynamics and lecturer attitudes under-researched (Ridzuan, 2025; Aliksieieva, 2024; Thakur et al., 2024). Furthermore, a major practical issue is the lack of a clear framework for effective AI application, leaving many lecturers confused about whether AI functions as a collaborative instructional assistant or a replacement system (Mohamed Ali et al., 2024). Resolving this issue requires strong institutional commitment to supply sustained technical support and continuous professional training to foster a progressive mindset toward technological change (Shahran, 2024).

The scientific merit and novelty of this study lie in addressing these literature gaps by providing a robust inferential baseline that uncovers the precise mathematical relationship between AI usage, pedagogical practice innovation, and the structural influence of lecturer attitudes ($R^2=0.780$). By exploring the extent to which AI utilization directly drives changes in vocational instructional strategies (Qi, 2023), and examining lecturer attitudes as a psychological catalyst or barrier within established pedagogical readiness frameworks (Abbas et al., 2024), this study bridges abstract technological capability with applied vocational instruction. Grounded in a holistic conceptual framework (Ridzuan, 2025), these empirical findings contribute to the development of practical guidelines designed to enhance educators' technological proficiency. Ultimately, this research provides

critical empirical support that aligns directly with the national aspirations of the National TVET Policy 2030 to elevate Malaysian technical education (JPT, 2023). To address these priorities, the specific objectives of this study are to determine the level of AI usage and pedagogical practice innovation, evaluate the influence of lecturer attitudes toward AI acceptance, investigate technology usage and attitude differences based on gender, and analyze the direct relationship and predictive influence of AI usage on pedagogical practice innovation within the vocational college ecosystem.

Research Objectives:

The persistence of instructional barriers, such as fragmented digital competency infrastructure and uneven technology deployment, underscores the urgent need to evaluate how vocational educators navigate emerging technologies. While artificial intelligence offers substantial potential to modernize Technical and Vocational Education and Training (TVET), a clear empirical gap remains regarding how actual classroom tool adoption systematically interacts with educator attitudes and structural teaching variations. To resolve these empirical uncertainties and address the core limitations identified within the technical education framework, this study outlines the following research objectives:

1. To determine the levels of artificial intelligence (AI) usage and pedagogical practice innovation among vocational college lecturers.
2. To assess the influence of lecturer attitudes toward the acceptance and implementation of artificial intelligence in pedagogical practice innovation.
3. To examine the differences in artificial intelligence usage and lecturer attitudes toward enhancing the quality of teaching and learning between male and female lecturers.
4. To analyze the relationship between artificial intelligence usage and pedagogical practice innovation among vocational college lecturers.
5. To evaluate the predictive influence of artificial intelligence usage on pedagogical practice innovation among vocational college lecturers.

LITERATURE REVIEW

The literature review functions as the theoretical core of this study, providing a critical synthesis of the nexus between Artificial Intelligence (AI) utilization, pedagogical innovation, and vocational lecturers' professional practices. Rather than providing a superficial summary, this section critically assesses how AI acts as a transformative catalyst, moving vocational instruction from traditional methods to a more dynamic, industry-aligned pedagogical model. By grounding the analysis in the Technology Acceptance Model (TAM) by Davis (1989), Rogers' (1983) Diffusion of Innovations, and the SAMR Model by Puentedura (2006), this review reconstructs how institutional and individual factors interact to facilitate technological adoption.

Digital transformation in Malaysia, supported by the National TVET Policy 2030 (JPT, 2023) and the Malaysia Education Blueprint (KPM, 2021), necessitates a shift toward AI-enhanced teaching. Empirical evidence reveals that AI supports vocational training through interactive modules, such as 3D simulations and content adaptation, which directly address technical skill requirements (Abbas et al., 2024). Research indicates that when AI is utilized for dynamic data visualization, student achievement in complex subject such as thermodynamics shows significant improvement. However, this study identifies persistent barriers that hinder these innovations, specifically infrastructure deficits like limited 5G access (Yan, 2024), a notable digital skills gap among educators (Shahran, 2024), and the high operational costs associated with maintaining AI-standard laboratories (Thakur et al., 2024), all of which necessitate strategic public-private partnerships.

Innovation in vocational settings is characterized by the strategic integration of technology to foster critical thinking and industrial relevance. Scholarly discourse highlights that collaborative project-based learning and scenario-based industrial simulations effectively enhance student engagement and academic outcomes (Mohamed Ali et al., 2024). Innovations such as pedagogical chatbots (Bayaga, 2024) and digital twins for industrial maintenance (Labyad et al., 2024) have successfully bridged the divide between theoretical knowledge and practical application. Furthermore, the TVET transformation emphasizes human capital development, where the implementation of "Digital Badges" and industry-aligned curricula developed alongside multinational corporations like Intel Malaysia reflects a shift toward competency-based, innovative teaching models that prepare students for global market competitiveness (KPM, 2021).

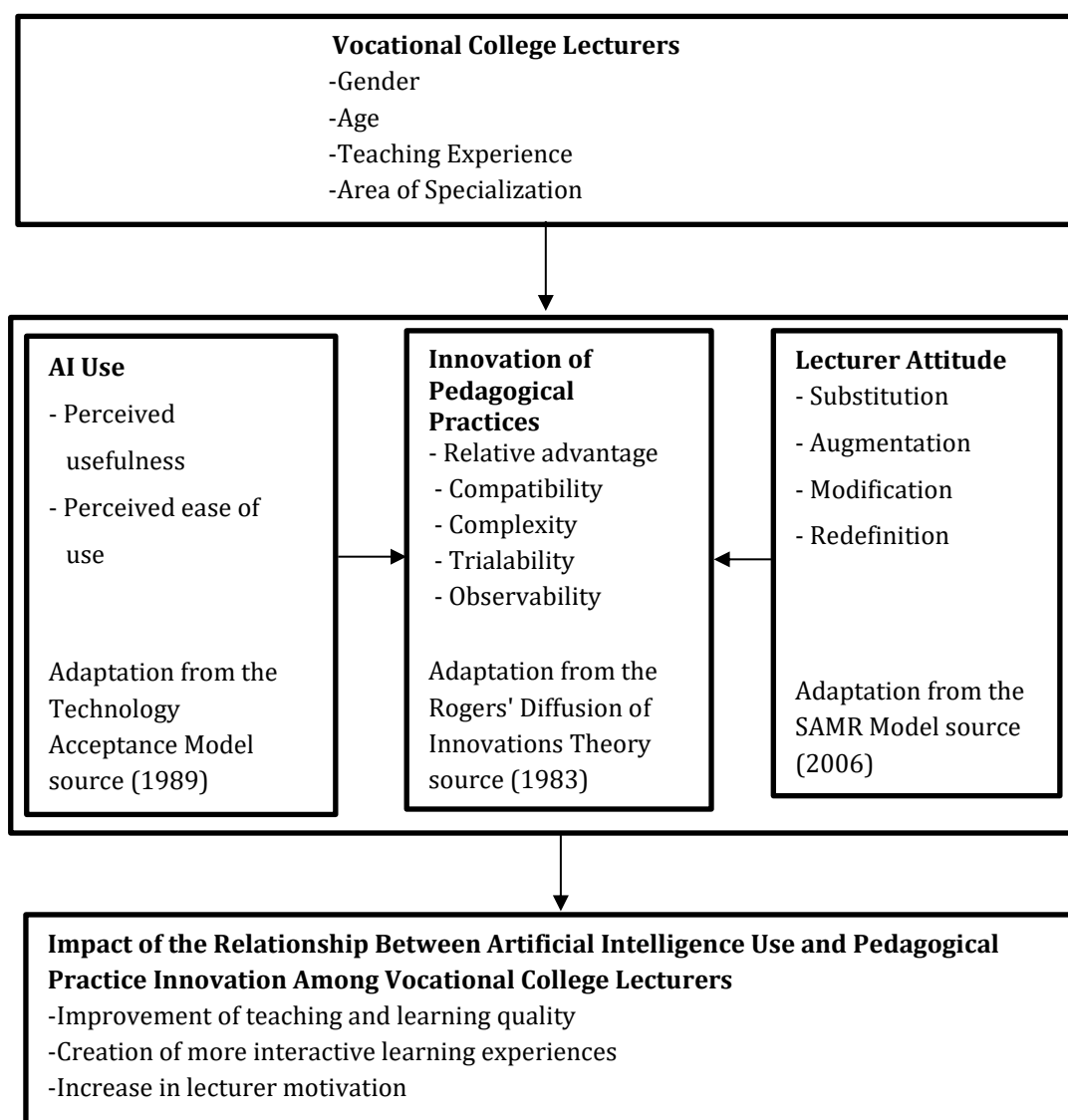


Figure 1. Conceptual Framework of the Study on the Relationship Between Artificial Intelligence Use and Innovation of Pedagogical Practices Among Vocational College Lecturers

The conceptual framework illustrated in Figure 1 serves as the blueprint for this study, depicting the systematic interplay between the variables influencing the innovation of pedagogical practices among vocational college lecturers. This framework is structured into three primary dimensions: the Input Dimension, which encompasses the foundational elements such as demographic profiles, digital competencies, and institutional infrastructure; the Process Dimension, driven by the TAM, Rogers' Diffusion of Innovations, and the SAMR Model, which examines how lecturer attitudes and professional development facilitate the shift from traditional to AI-integrated pedagogy; and the Output Dimension, which focuses on the realization of pedagogical innovation and the production of highly competent, globally competitive graduates in alignment with the National TVET Policy 2030.

The successful implementation of these innovations is fundamentally linked to the psychological readiness and attitude of the educator. Research demonstrates that lecturers who perceive AI as useful and easy to use are more likely to integrate these tools into their daily teaching (Mohamad @ Razak, 2024). To mitigate resistance and address skills gaps, the literature advocates for continuous professional development through hands-on mentorship (Mohd Khairul & Luqman, 2024), the cultivation of an organizational culture that incentivizes innovation (Ridzuan, 2025), and the leveraging of industrial partnerships (Thakur et al., 2024). Synthesizing these perspectives confirms that while AI remains a potent tool for pedagogical evolution, its integration in Malaysia requires moving beyond tool substitution to the systemic redefinition of the learning experience (Balogh, 2024; Puentedura, 2006).

RESEARCH METHOD

Research Design

The study adopts a correlational quantitative survey design to rigorously examine the interrelationships between AI integration, pedagogical innovation, and lecturer attitudes within the vocational college ecosystem. This design is selected for its capacity to provide objective, numerical measurements and facilitate statistical testing of hypothesized relationships, thereby ensuring a high degree of precision in findings. Furthermore, the study utilizes a cross-sectional approach, where data is systematically collected at a specific point in time to provide a snapshot of current digital technology integration trends. This framework is grounded in the Technology Acceptance Model (TAM) as modified by Davis (1989), which posits that lecturer attitudes serve as a critical determinant of technology acceptance and the subsequent transformation of teaching practices.

Population and Sampling

The study focuses on the population of lecturers across 11 vocational colleges (KV) in Johor, encompassing a total of 1,041 educators as recorded by the Johor State Education Department on February 28, 2026. To ensure the research findings are representative and possess high generalizability, a simple random sampling technique was employed, granting every member of the population an equal probability of selection. Based on the Krejcie and Morgan (1970) formula, a minimum sample size of 278 is required for this population; however, to maximize statistical power and minimize sampling error, the researcher established a target of 292 respondents. Consequently, the study successfully achieved 292 complete and valid responses, ensuring a robust dataset that reflects the diverse technical fields and geographical distribution of the target institutions.

Research Instruments

The instrument consists of a 47-item self-administered questionnaire, systematically developed to measure the core constructs of the study. The content validity of the instrument was rigorously verified by a panel of three subject matter experts, resulting in an excellent Content Validity Index (S-CVI) of 0.99. The following table summarizes the distribution and structure of the instrument:

Table 1. Content of the Questionnaire

Section	Construct Aspect	Number of Items	Scale Type
A	Respondent Profile	7	Nominal/Ordinal
B	Level of AI Usage	10	Level Scale (1-5)
C	Innovation in Pedagogical Practices	10	Frequency Scale (1-5)
D	Attitude Toward AI	10	Agreement Scale (1-5)
E	Impact of AI on Teaching Quality	10	Impact Scale (1-5)
Total		47	

Data Analysis

Data processing and statistical analysis were performed using the Statistical Package for the Social Sciences (SPSS) software version 27.0. This process involved a two-tiered analysis: descriptive statistics were first utilized to map the respondents' demographic profiles and ascertain the prevailing levels of AI adoption, while inferential statistics were employed to test the study's hypotheses regarding relationships and influence. The methodological rigor of the analysis is outlined in the table below:

Table 2 Data Analysis Methods

Analysis Type	Purpose	Method/Metric
Descriptive	Summarize demographics and adoption levels	Mean, SD, Frequency
Inferential	Measure strength of relationships	Pearson Correlation (r)
Predictive	Model influence of AI on pedagogy	Simple Regression (R ²)
Comparative	Assess demographic differences	t-test and ANOVA

FINDING AND DISCUSSION

In The descriptive analysis reveals that the level of Artificial Intelligence (AI) usage among lecturers at vocational colleges is at a moderate stage (M=3.09), suggesting a developmental phase that requires ongoing guidance from relevant stakeholders. Although lecturers demonstrate a highly positive attitude toward AI (M=3.63), particularly regarding their willingness to undergo professional training and their belief in the technology's professional value, the practical implementation currently focuses more on administrative assistance and reference searching than on radical pedagogical transformation. This finding aligns with the Technology Acceptance Model (TAM), where perceived usefulness drives usage, yet technical complexity remains a barrier to more advanced integration. Furthermore, these results are consistent with research by Luo et al. (2024), Yu and Wang (2024), and Qi (2023), who emphasize that pedagogical reform in vocational settings necessitates a stable and inclusive digital ecosystem to ensure the sustainability of innovation.

The inferential analysis provides robust evidence regarding the impact of AI on educational practices. The null hypothesis (H_{03}) was rejected with a very strong correlation ($r=0.883$, $p < 0.05$), proving a significant, positive linear relationship between AI usage frequency and pedagogical innovation. Moreover, regression analysis confirmed a dominant influence, with $R^2=0.780$, signifying that AI application accounts for 78.0% of the variance in lecturers' pedagogical innovation. This degree of influence suggests that lecturers in Johor are experiencing a period of accelerated digital adoption, reinforcing the theories of Rogers and the SAMR model demonstrating that when AI is utilized beyond peripheral support, it acts as an agent of redefinition, fundamentally altering instructional methodology.

Beyond the statistical correlations, a critical observation from the data is the "innovation-practice gap." While lecturers possess the cognitive readiness to embrace AI, the moderate score in pedagogical innovation ($M=2.93$) indicates that the transition from theory to practice is hindered by infrastructural limitations. Specifically, the qualitative feedback embedded within the instrument suggests that the absence of high-speed, reliable networks and advanced GPU-enabled hardware prevents lecturers from engaging with more sophisticated AI tools, such as real-time 3D simulation or immersive Digital Twins. This confirms the concern raised by Shahrar (2024), who posited that even with high personal motivation, the absence of an integrated, responsive institutional infrastructure creates a "technological ceiling" that stifles creative pedagogical design.

Moreover, the findings highlight a significant psychological dimension regarding the role of AI in vocational assessment. The data shows that AI integration is notably lower in competency-based psychomotor evaluation ($M=2.78$) compared to lecture-based information processing. This discrepancy suggests that, despite the push for digital transformation, there remains a deep-seated professional conviction that vocational proficiency must be verified through physical, human-led assessment. This "traditionalist bias" acts as a protective mechanism for professional identity, as described by Kuznetsov and Kuznetsova (2024), where educators fear that over-automation might erode the essential human-to-human mentorship that defines the TVET experience. Consequently, future interventions must not only focus on technical upskilling but also on the *ethico-pedagogical* integration of AI, ensuring that technology acts as a partner in assessment rather than a replacement for professional judgment.

Table 3 Summary of Quantitative Findings

Variable / Indicator	Mean (M)	Significance / Impact	Theoretical Alignment
AI Usage Frequency	3.09	Moderate; focus on administrative/reference tasks	Aligns with Luo et al. (2024); requires a stable ecosystem
Lecturer Attitude	3.63	Positive; high readiness for professional training	Supported by TAM (Davis, 1989); early adopter profile
Pedagogical Innovation	2.93	Moderate; in transition/substitution phase	Aligns with SAMR model stages
Correlation (r)	0.883	Very strong, positive, and significant relationship	Consistent with Ridzuan (2025) and Bayaga (2024)
Predictive Power (R^2)	0.780	AI accounts for 78% of innovation variance	Indicates accelerated digital adoption in Johor

In summary, while lecturer attitudes toward AI are highly positive ($M=3.63$), actual integration remains at a moderate developmental stage ($M=3.09$) due to infrastructure and training requirements. The study confirms that AI is a significant driver of pedagogical reform, contributing to 78% of the variance in innovation ($R^2=0.780$). Despite the high correlation ($r=0.883$), pedagogical innovation ($M=2.93$) is currently constrained by technical infrastructure gaps and a lingering psychological preference for traditional psychomotor evaluation

methods. Moving toward the 'Redefinition' phase of the SAMR model requires focused intervention in high-performance computing resources and AI-specific professional development to meet the aspirations of the National TVET Policy 2030.

CONCLUSION

In conclusion, this research has successfully provided a comprehensive and holistic overview of the dynamics of Artificial Intelligence (AI) integration within the vocational education ecosystem in Johor. By synthesizing empirical data with established theoretical frameworks such as the Technology Acceptance Model (TAM), Rogers' Diffusion of Innovations, and the SAMR model, the study has illuminated both the potential and the inherent challenges of digital transformation in TVET. The findings confirm that while lecturers possess a strong, positive cognitive disposition toward adopting AI technologies, the actual translation of this attitude into advanced pedagogical practice is currently in a transitional state. This research serves as a critical bridge between policy aspirations specifically the National TVET Policy 2030 and the realities of classroom instruction, underscoring that infrastructure stability and professional digital literacy are non-negotiable prerequisites for reform.

The empirical evidence, particularly the strong correlation ($r=0.883$) and the dominant predictive influence of AI application on pedagogical innovation ($R^2=0.780$), provides a compelling argument for the institutionalization of AI as a core component of vocational instruction. However, the study also highlights a necessary nuance: technology cannot replace the essential human-led mentorship and psychomotor evaluation that define vocational expertise. Instead, AI must be positioned as a powerful pedagogical partner that enhances human capability rather than replacing it. The evidence suggests that for Kolej Vokasional to reach the "Redefinition" phase of the SAMR model, strategic interventions ranging from high-performance digital infrastructure to bespoke AI training modules must be prioritized to overcome current technical and psychological barriers.

Ultimately, this study contributes to the corpus of knowledge by demonstrating that digital transformation is not merely a technical migration but a multi-dimensional cultural shift. The high level of readiness among educators is a promising "fertile ground" for further innovation. It is expected that the findings and recommendations presented here will serve as a foundational guide for the Ministry and institutional leaders to refine digital strategies that are not only efficient but also inclusive and sustainable. As the education sector continues to navigate the complexities of the Fourth Industrial Revolution, this research advocates for a balanced approach one that embraces the rapid evolution of AI while maintaining the rigor, integrity, and ethical standards required to produce a world-class, globally competitive TVET workforce.

LIMITATION & FURTHER RESEARCH

This study is specifically focused on teaching staff within Malaysian vocational colleges (Niam & Shukri Nordin, 2024; Yan, 2024), which renders the generalization of findings to other institutions, such as universities or secondary schools, less relevant. Variations in academic background, teaching experience, and organizational culture among lecturers further limit the comprehensive representation of the sample. This research prioritizes three core aspects: AI usage, pedagogical innovation, and lecturer attitudes (Ali et al., 2025; Yuan, 2024; Qi, 2023). Conversely, supporting elements such as infrastructure availability, organizational support, and skill enhancement programs are excluded from the scope of analysis. Regarding methodological limitations, there is a risk of social desirability bias, where data collection via questionnaires may be influenced by respondents' tendencies to provide "desirable" answers (Alieksieieva, 2024; Mansor, 2023). For example, lecturers might

overstate their AI usage to align with institutional expectations. Furthermore, there is an issue of imbalanced engagement, where lecturers with lower technological literacy may be less inclined to participate in the study, potentially skewing the results (Mohd Khairul & Luqman, 2024). Additionally, the observation period is limited; this study does not cover the long-term impact of AI on teaching culture (Balogh, 2024; Thakur et al., 2024), necessitating further research to assess changes in attitude progressively. The findings may have limited applicability in other countries due to differences in educational systems, levels of technological convenience, and cultural norms (Yan, 2024; Zhang, 2024). For comparison, lecturers in developed nations such as the United States or Japan may possess broader access to advanced AI platforms compared to their counterparts in Malaysia (Yu & Wang, 2024).

Based on the limitations and findings of this study, several directions are proposed to extend the research and further test the current theoretical framework. Future research should involve multi-sectoral investigations to compare findings across vocational institutions, polytechnics, and universities. Additionally, further research should analyze the specific roles of administrative support and the effectiveness of periodic training programs on AI adoption. Finally, it is recommended to monitor the evolution of lecturers' attitudes toward AI progressively over a period of 3 to 5 years.

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