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Reimagining Teacher Education in the Age of Generative AI: TVET Pre-Service Teachers' Perspectives on Digital Pedagogical Competence

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Abstract: Over the past decade, the rapid advancement of educational technologies—most notably Generative Artificial Intelligence (GenAI) has reshaped the global teaching and learning landscape. Tools such as ChatGPT and other Large Language Models (LLMs) have demonstrated transformative potential in enabling personalised learning, automating assessment, generating context-specific teaching resources, and fostering inclusivity for diverse learners. Despite these advancements, concerns remain regarding educators' preparedness, particularly among pre-service teachers, to integrate GenAI effectively and ethically into pedagogy. This study aimed to assess the levels of participation, perceived usefulness, perceived ease of use, AI-TPACK understanding, and behavioural intention towards GenAI adoption among pre-service teachers in the Technical and Vocational Education and Training (TVET) context. Employing a quantitative survey design, data were collected from 61 pre-service teachers enrolled in the Bachelor of Teaching Degree Program (PISMP), June 2022 Intake (Year 3, Semester II), specialising in Design and Technology (RBT) at the Institute of Teacher Education, Technical Education Campus (IPGKPT). A 36-item questionnaire based on a 5-point Likert scale was administered, and descriptive statistics (mean and standard deviation) were computed using SPSS Version 30. Findings indicate a high level of behavioural intention to adopt GenAI (M = 3.89, SD = 0.92), with moderate perceptions of ease of use (M = 3.10, SD = 1.01) and average perceptions of usefulness (M = 3.36, SD = 1.03), reflecting existing gaps in AI literacy. These results hold important implications for policy-makers, curriculum designers, and teacher educators, underscoring the need for targeted GenAI-integrated training, practice-based learning opportunities, and ethical competency frameworks. Aligned with Malaysia's Digital Education Policy 2023–2030, this research contributes to the literature on technology acceptance by providing empirical evidence of GenAI readiness in specialised teacher education, offering insights to support national and global educational transformation agendas.

Keywords: Generative Artificial Intelligence (GenAI), pre-service teachers, AI-TPACK, teacher education, Technology Acceptance Model (TAM), educational technology

1. Introduction

1.1 Background of Study

Generative Artificial Intelligence (GenAI) has established itself as a central catalyst in the ongoing technological transformation, exerting a substantial and far-reaching impact on contemporary educational systems worldwide. As has

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been widely acknowledged in recent literature, these technologies have the potential to redefine pedagogical approaches by enabling personalised learning trajectories, automating and adapting assessment systems, generating context-specific instructional content, and fostering inclusivity for diverse learner populations. In line with this, global frameworks such as the OECD Learning Compass 2030 have underscored the necessity for educational systems to evolve in response to technological acceleration, while the United Nations Sustainable Development Goal 4 (SDG4) explicitly advocates for inclusive and equitable quality education for all learners (Wang et al., 2025; Allen et al., 2024). At the national level, Malaysia's Digital Education Policy 2023–2030 articulates a strategic commitment to embedding digital innovation within teacher education and classroom practice. It is important to note that the accelerated adoption of GenAI not only offers unprecedented opportunities but also presents significant challenges for teacher readiness. This, in turn, highlights the need for sustained and systematic professional development initiatives designed to cultivate the pedagogical, technical, and ethical competencies required for the effective integration of GenAI into diverse educational contexts (Sandhu et al., 2024; Baskara et al., 2024).

Against this backdrop, the integration of the Technology Acceptance Model (TAM) and the AI-TPACK framework provides a comprehensive and theoretically grounded approach for understanding the factors influencing technology adoption in education, particularly within pre-service teacher training. The TAM, through its core constructs of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), offers critical insights into how educators form intentions to adopt new technologies (Alnagrat et al., 2023; Tian & Wu, 2023). Complementing this, the AI-TPACK framework extends the established Technological Pedagogical Content Knowledge model by embedding Generative Artificial Intelligence competencies, thereby emphasising the centrality of integrated technological, pedagogical, and content knowledge for effective AI integration in teaching practice (Mahafdah et al., 2024; Mustafa et al., 2021; Alfadda et al., 2021). Taken together, these models not only enable a multidimensional analysis of educators' technological readiness but also reinforce the need for targeted, evidence-based training interventions that develop both pedagogical and technical expertise. Such a combined perspective is particularly relevant in specialised contexts such as Technical and Vocational Education and Training (TVET) and Design and Technology (RBT), where the convergence of applied technical skills and emergent digital tools demands innovative, contextually responsive educational strategies (Morales-Cevallos et al., 2025; Cabreros & Barbacena, 2024).

Building on this theoretical foundation, the Technology Acceptance Model (TAM) remains one of the most widely applied and empirically validated frameworks for examining technology adoption, with its core constructs, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) shaping users' attitudes and ultimately their Behavioural Intention (BI) to adopt technology (Raes & Depaepe, 2020; Malatji et al., 2020). While successive refinements have incorporated external variables such as social influence, self-efficacy, and institutional support to address earlier limitations, critiques persist regarding TAM's limited consideration of structural constraints and technology rejection, prompting the integration of complementary frameworks. In this regard, the Artificial Intelligence Technological Pedagogical Content Knowledge (AI-TPACK) model extends the established TPACK framework by integrating AI-specific competencies into technological, pedagogical, and content knowledge, thereby equipping educators with the expertise to effectively embed AI tools into instructional practice. Recent studies demonstrate that higher levels of AI-TPACK are strongly associated with greater teacher readiness, improved training effectiveness, and enhanced capacity to design pedagogically sound AI-supported learning experiences (Karatas & Atac, 2025; Ning et al., 2024). In the context of teacher education, global research highlights that well-structured GenAI training programs can significantly improve competence beliefs, foster more favourable perceptions of PU and PEOU, and strengthen intentions for classroom use, although challenges remain regarding equitable access, ethical considerations, workload implications, and the translation of technical proficiency into pedagogical innovation. These insights underscore the value of a consolidated TAM and AI-TPACK approach, particularly within practice-intensive domains such as Technical and Vocational Education and Training (TVET) and Design and Technology (RBT), where targeted, evidence-based professional development and supportive institutional conditions are essential for sustainable GenAI integration in teaching and learning (Fakhar et al., 2024; Celik et al., 2022).

Extending from the consolidated TAM and AI-TPACK perspective, pre-service teachers constitute a critical population for investigation, as they represent the future implementers of Generative Artificial Intelligence (GenAI) in classroom practice and will be instrumental in shaping the pedagogical norms of the next generation of schooling (Guan et al., 2025; Kohnke et al., 2025) Their readiness, attitudes, and competencies will directly influence the depth, breadth, and sustainability of GenAI adoption in education, making their preparation a matter of both institutional and policy significance for teacher trainee institutions (Yu et al., 2025; Mohebi, 2025). Given Malaysia's strategic focus on digital transformation in education, insights into pre-service teachers' capacity to integrate GenAI hold substantial implications for multiple stakeholder groups. For policy-makers, the findings can guide the refinement of national digital competency frameworks, ensure alignment with the Digital Education Policy 2023–2030, and support targeted resource allocation for AI integration at scale (Boyraz & Ruzgar, 2024). For curriculum designers, the evidence provides a robust basis for embedding GenAI literacy, pedagogical strategies, ethical frameworks, and inclusive practices into teacher training programmes, ensuring that curricula remain responsive to technological advancements. For teacher educators, the study offers a practical roadmap for aligning instructional approaches with the capabilities and affordances of GenAI tools, bridging the gap between technological proficiency and sound pedagogical application. Addressing these dimensions

through sustained, evidence-based training, immersive practice opportunities, and supportive institutional ecosystems will be essential to ensure that pre-service teachers are not only technically adept but also pedagogically agile in deploying GenAI technologies (El Din, 2025). In doing so, teacher education institutions can better position future educators to engage with GenAI responsibly, ethically, and effectively, in ways that advance both Malaysia's national priorities and broader global educational transformation agendas.

Expanding upon the earlier discussion on the pivotal role of pre-service teachers in advancing GenAI adoption, the integration of the Technology Acceptance Model (TAM) with the GenAI-enhanced Technological Pedagogical Content Knowledge (AI-TPACK) framework within Malaysian TVET teacher education constitutes a significant theoretical contribution (Al-Abdullatif, 2024). TAM provides a well-established basis for understanding how perceived usefulness and perceived ease of use influence technology adoption, while GenAI-TPACK expands this foundation by embedding GenAI literacy and intelligent technology competencies into the broader interplay of technological, pedagogical, and content knowledge. This synthesis offers a comprehensive framework for strengthening teachers' technical proficiency alongside GenAI-informed pedagogical strategies, thereby enabling the design of personalised, adaptive, and impactful learning environments (Kaliappan et al., 2025). Practically, the study advances evidence-based recommendations for integrating GenAI into teacher training programmes, including the use of GenAI to conduct learning analytics, customise instructional interventions, and enhance teaching methodologies, while automating routine administrative tasks to allow greater focus on pedagogical quality and student engagement (Alsbou & Alsaraireh, 2024; Widono et al., 2024). At the policy level, the study aligns closely with Malaysia's Digital Education Policy 2023–2030 and global educational transformation agendas, promoting responsible GenAI literacy, embedding ethical safeguards, and addressing pressing concerns such as data privacy and algorithmic bias (Agarwal et al., 2024). Additionally, its emphasis on sustained professional development, institutional capacity-building, and infrastructure readiness provides policymakers with a robust blueprint for implementing sustainable, equitable, and contextually attuned GenAI-driven educational reforms. In sum, the integration of TAM and GenAI-TPACK not only deepens theoretical understanding of technology adoption in teacher education but also delivers actionable pathways for responsible and effective GenAI implementation in Malaysian TVET contexts, firmly situating its outcomes within both national priorities and international educational imperatives (Mohebi, 2025).

1.2 Objectives and Research Questions

The specific objective of this study is to investigate the acceptance of AI generative tools among pre-service teachers in Institute of Teacher Education, Technical Education Campus. Information gained on pre-service teachers' views pertaining to AI generative tools is fundamental as it identifies gap in AI-related training, ensuring that policies address both technical and pedagogical competencies required for integrating AI generative tools.Moreover, the information obtained from this study could be useful for policy-makers, Design and Technology learning program designers and lecturers to design targeted strategies for AI adoption in teacher education. In order to address the aforementioned research objective, this paper attempts to answer the following research questions:

i. What is the level of participation in GenAI-related courses among pre-service teachers in Institute of Teacher Education, Technical Education Campus?
ii. What is the level of perceived GenAI-related usefulness among pre-service teachers in Institute of Teacher Education, Technical Education Campus?
iii. What is the level of perceived GenAI-related ease of use among pre-service teachers in Institute of Teacher Education, Technical Education Campus?
iv. What is the level of GenAI-TPACK understanding among pre-service teachers in Institute of Teacher Education, Technical Education Campus?
v. What is the level of behavioral intention for GenAI usage among pre-service teachers in Institute of Teacher Education, Technical Education Campus?

2. Methodology

The present study adopts a quantitative research design grounded in a descriptive approach, formulated to address specific and focused research questions concerning pre-service teachers' acceptance of AI generative tools among pre-service teachers in Institute of Teacher Education, Technical Education Campus (Creswell, 2008). Data collection was conducted through a structured survey, a method widely recognized in the literature as an efficient tool for administering questionnaires to targeted samples, thereby facilitating the identification of patterns and trends in attitudes, opinions, behaviours, and characteristics that may be generalised to a broader population (Ghazali & Sufean, 2018; Creswell, 2008; Wiersma, 1991). The survey approach was selected for its methodological advantages, including cost-effectiveness, scalability, and reduced administrative demands compared to population-wide investigations (Malhotra & Birks, 2007). All responses were subjected to rigorous statistical analysis to ensure the objectivity, reliability, and validity of the findings.

In alignment with the study objectives, a survey was conducted to investigate the acceptance of AI generative tools among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT). The target

population comprised 73 pre-service teachers enrolled in the Bachelor of Teaching Degree Program (PISMP), June 2022 intake (Year 3, Semester II) with specialization in Design and Technology (RBT). The sample size was established using the Krejcie and Morgan (1970) sampling framework, applying a 5% margin of error and a 95% confidence level to ensure statistical robustness (Bukhari, 2021). Based on this calculation, 61 participants were selected through simple random sampling, thereby ensuring that each individual in the population had an equal probability of inclusion. Data were collected through a structured questionnaire administered via Google Forms, a digital platform chosen for its demonstrated advantages over traditional paper-based approaches, including expedited data processing, minimized risk of data loss or entry errors, and enhanced operational feasibility (Drummond et al., 1995).

Data were obtained using a structured questionnaire administered online via Google Forms, a method widely acknowledged for its efficiency in eliciting valid, reliable, and quantifiable data from large respondent groups (Christopher & Bruce, 1985). Invitations containing the survey link were disseminated via email, mobile messaging, and social media, with an estimated completion time of 10–15 minutes. To enhance participation, follow-up reminders were issued, and respondent anonymity was safeguarded to promote candid and unbiased feedback. The instrument comprised six sections: demographic information, participation in GenAI -related courses (9 items), perceived GenAI -related usefulness (7 items), perceived GenAI -related ease of use (8 items), GenAI-TPACK (5 items), and behavioral intention for GenAI usage (7 items). In total, 36 items were developed in direct alignment with the study's objectives.

Table 1: Cronbach Alpha's reliability according to construct

Construct	Number of items	Cronbach Alpha	Interpretation
Participation in GenAI-related Courses	9	0.92	Excellent
Perceived GenAI-related Usefulness	7	0.87	Good
Perceived GenAI-related Ease of Use	8	0.91	Excellent
GenAI-TPACK	5	0.92	Excellent
Behavioral Intention for GenAI Usage	7	0.86	Good
Total	**36**	**0.90**	**Excellent**

The questionnaire underwent pilot testing with a cohort of 30 pre-service teachers to evaluate its clarity, reliability, and validity. Insights from this preliminary phase informed minor refinements, thereby enhancing the precision, coherence, and overall robustness of the final instrument. Reliability was assessed using Cronbach's alpha (Table 1), with all constructs exceeding the threshold value of 0.80, signifying strong internal consistency. Content validity was established through expert review by two specialists in Design and Technology, whose recommendations ensured item relevance, conceptual alignment, and linguistic precision in accordance with the study's objectives. A 5-point Likert scale was adopted, consistent with evidence indicating that such scaling does not compromise the statistical integrity of results (Rasmussen, 1989). Interpretation of mean scores followed the framework proposed by Tschannen-Moran and Gareis (2004) to determine the acceptance of AI generative tools among pre-service teachers at the Institute of Teacher Education, Technical Education Campus (IPGKPT) (Table 2). Data analysis employed descriptive statistical techniques, namely mean and standard deviation (SD), using the Statistical Package for the Social Sciences (SPSS) version 30. The systematic instrument development process—encompassing pilot testing, expert validation, and rigorous reliability assessment—ensured the generation of accurate, consistent, and contextually relevant data, thereby providing a robust basis for addressing the study's research questions.

Table 2: Interpretation of mean value

Mean Value	Interpretation of Mean Value
1.00 - 1.80	Very Low
1.81 - 2.60	Low
2.61 - 3.40	Average
3.41 - 4.20	High
4.21 - 5.00	Very High

3. Results

This study involved 61 pre-service teachers enrolled in the Bachelor of Teaching Degree Program (PISMP), June 2022 intake, Year 3, Semester II, majoring in Design and Technology (RBT) at the Institute of Teacher Education, Technical Education Campus (IPGKPT). Respondents were selected using a simple random sampling approach to ensure representativeness. As presented in Table 3, the sample comprised 14 male participants (23%) and 47 female participants (77%), indicating a predominance of female respondents. In terms of class distribution, participants were relatively evenly allocated across three groups: RBT1 (n = 21, 34%), RBT2 (n = 20, 33%), and RBT3 (n = 20, 33%). This balanced distribution across classes supports the robustness of group-level comparisons within the study.

Table 3: Respondents' demographic information (n=61)

Profile	Category	Frequency	Percentage (%)
Gender	Male	14	23
	Female	47	77
Class	RBT1	21	34
	RBT2	20	33
	RBT3	20	33

3.1 Participation in GenAI-related Courses among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 4 demonstrates the mean value and level of pre-service teachers' participation in GenAI -related courses in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level (M=3.56, SD=1.20). Based on the normality test conducted using the Kolmogorov-Smirnov test, the data of participation in GenAI -related courses (df = 61, sig. > 0.05) were not significant. Hence, this indicates that the data is normally distributed. Findings revealed, most respondents agreed that the AI-related courses they joined were relevant to their professional development as future teachers (M=3.98). The lowest mean was recorded in item B01, where respondents indicated they have attended GenAI -related courses as part of their teacher training program (M=3.33). Based on Table 4 as shown below, the descriptive analysis found that the overall mean of pre-service teachers' participation in GenAI -related courses is at a high level. Therefore, this finding suggests that the level of participation in GenAI -related courses among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level.

Table 4: Participation in GenAI-related Courses among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

	Item	Mean	SD	Level
B01	I have attended GenAI-related courses as part of my teacher training program.	3.33	1.29	Average
B02	The GenAI-related courses I joined were relevant to my professional development as a future teacher.	3.98	0.90	High
B03	These courses provided clear objectives related to GenAI integration in teaching.	3.48	1.22	High
B04	The training sessions were well-structured and easy to follow.	3.60	1.24	High
B05	The GenAI-related courses offered opportunities to learn about AI applications in education.	3.60	1.20	High
B06	I have actively participated in GenAI -related courses during my teacher training program.	3.56	1.22	High
B07	I attended all sessions of the GenAI -related courses offered.	3.60	1.22	High
B08	I completed all tasks, activities, and assignments given in the GenAI -related courses.	3.56	1.39	High
B09	I sought additional learning resources beyond the course materials to deepen my understanding of GenAI.	3.37	1.15	High
		3.56	**1.20**	**High**

3.2 Perceived GenAI-related Usefulness among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 5 demonstrates the mean value and level of pre-service teachers' perceived GenAI -related usefulness in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at an average level (M=3.36, SD=1.03). Based on the normality test conducted using the Kolmogorov-Smirnov test, the data of perceived GenAI-related usefulness (df = 61, sig. > 0.05) were not significant. Hence, this indicates that the data is normally distributed. Findings revealed, most respondents agreed that the courses showed them practical ways in which GenAI can support inclusive classroom practices (M=3.68). The lowest mean was recorded in item C15, where respondents indicated that GenAI can help them deliver lessons more effectively in their teaching role (M=3.11). Based on Table 5 as shown below, the descriptive analysis found that the overall mean of pre-service teachers' perceived GenAI-related usefulness is at an average level. Therefore, this finding suggests that the level of perceived GenAI-related usefulness among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at an average level.

Table 5: Perceived GenAI-related Usefulness among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

	Item	Mean	SD	Level
C10	The GenAI -related courses demonstrated how AI can increase teaching efficiency.	3.24	1.05	Average
C11	The training helped me understand how GenAI can improve student engagement in my subject area.	3.23	1.05	Average
C12	I believe the GenAI -related training has prepared me to use GenAI to enhance learning outcomes.	3.44	1.04	High
C13	The courses showed me practical ways in which GenAI can support inclusive classroom practices.	3.68	0.99	High
C14	Integrating GenAI into my teaching practice will enhance my professional performance.	3.52	0.99	High
C15	GenAI can help me deliver lessons more effectively in my teaching role.	3.11	1.07	Average
C16	I consider GenAI to be a valuable resource for my work as a teacher.	3.32	0.99	Average
		3.36	**1.03**	**Average**

3.3 Perceived GenAI-related Ease of Use among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 6 demonstrates the mean value and level of pre-service teachers' perceived GenAI-related ease of use in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at an average level (M=3.10, SD=1.01). Based on the normality test conducted using the Kolmogorov-Smirnov test, the data of perceived GenAI-related ease of use (df = 61, sig. > 0.05) were not significant. Hence, this indicates that the data is normally distributed. Findings revealed, most respondents agreed that they can readily apply the GenAI knowledge and skills gained from the courses in their teaching practice (M=3.17). The lowest mean was recorded in item D23, where respondents indicated that the training provided sufficient hands-on activities to strengthen their technical skills in using AI (M=3.01). Based on Table 6 as shown below, the descriptive analysis found that the overall mean of pre-service teachers' perceived GenAI-related ease of use is at an average level. Therefore, this finding suggests that the level of perceived GenAI-related ease of use among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at an average level.

Table 6: Perceived GenAI-related Ease of Use among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

	Item	Mean	SD	Level
D17	GenAI teaching systems are easy for me to operate.	3.24	1.03	Average
D18	I find GenAI teaching systems straightforward to use.	3.08	1.04	Average
D19	I can quickly develop the skills needed to use GenAI teaching systems effectively.	3.03	0.99	Average
D20	The operation of GenAI teaching systems is intuitive and easy to understand.	3.08	1.03	Average
D21	The GenAI -related courses made it easier for me to learn and operate AI tools.	3.12	0.99	Average
D22	I can readily apply the GenAI knowledge and skills gained from the courses in my teaching practice.	3.17	1.03	Average
D23	The training provided sufficient hands-on activities to strengthen my technical skills in using GenAI.	3.01	0.98	Average
D24	I feel confident in resolving basic technical issues related to GenAI tools after completing the training.	3.04	0.97	Average
		3.10	**1.01**	**Average**

3.4 GenAI-TPACK Understanding among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 7 demonstrates the mean value and level of pre-service teachers' GenAI-TPACK understanding in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level (M=3.91, SD=0.91). Based on the normality test conducted using the Kolmogorov-Smirnov test, the data of GenAI-TPACK understanding (df = 61, sig. > 0.05) were not significant. Hence, this indicates that the data is normally distributed. Findings revealed, most respondents agreed that they know how to use appropriate strategies to provide students with opportunities to use their skills with the help of GenAI (M=4.37). The lowest mean was recorded in item E27, where respondents indicated that they know how

to use appropriate strategies with GenAI to help students learn better (M=2.93). Based on Table 7 as shown below, the descriptive analysis found that the overall mean of pre-service teachers' GenAI-TPACK understanding is at a high level. Therefore, this finding suggests that the level of GenAI-TPACK understanding among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level.

Table 7: GenAI-TPACK Understanding among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

	Item	Mean	SD	Level
E25	I know how to use appropriate strategies with AI to help students learn.	4.30	0.80	Very High
E26	I know how to use appropriate strategies with AI to help students better practice their skills.	3.96	0.95	High
E27	I know how to use appropriate strategies with AI to help students learn better.	2.93	1.15	Average
E28	I know how to use the strategy of personalized guidance to improve students' skills with the help of AI.	4.00	0.81	High
E29	I know how to use appropriate strategies to provide students with opportunities to use their skills with the help of AI.	4.37	0.86	Very High
		3.91	**0.91**	**High**

3.4 Behavioral Intention for GenAI Usage among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 8 demonstrates the mean value and level of pre-service teachers' behavioral intention for GenAI usage in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level (M=3.89, SD=0.92). Based on the normality test conducted using the Kolmogorov-Smirnov test, the data of behavioral intention for GenAI usage (df = 61, sig. > 0.05) were not significant. Hence, this indicates that the data is normally distributed. Findings revealed, most respondents agreed that they are willing to explore new opportunities for integrating GenAI into teaching and learning processes (M=4.35). The lowest mean was recorded in item F36, where respondents indicated that they intend to use GenAI for creating exam questions (M=3.29). Based on Table 8 as shown below, the descriptive analysis found that the overall mean of pre-service teachers' behavioral intention for GenAI usage is at a high level. Therefore, this finding suggests that the level of behavioral intention for GenAI usage among pre-service teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at a high level.

Table 8: Behavioral Intention for GenAI Usage among Pre-service Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

	Item	Mean	SD	Level
F30	I am willing to use GenAI in my teaching practice.	3.83	0.85	High
F31	I am willing to explore new opportunities for integrating GenAI into teaching and learning processes.	4.35	0.71	Very High
F32	I would love to be able to use GenAI in my work as a teacher.	3.88	1.06	High
F33	I intend to use GenAI for preparing teaching materials.	4.30	0.65	Very High
F34	I plan to use GenAI to recommend relevant teaching materials for my lessons.	3.67	1.06	High
F35	I will use GenAI to assist in planning teaching units.	3.90	0.98	High
F36	I intend to use GenAI for creating exam questions.	3.29	1.16	Average
		3.89	**0.92**	**High**

4. Discussion

This study set out to examine the acceptance of Generative Artificial Intelligence (GenAI) tools among pre-service teachers within the Technical and Vocational Education and Training (TVET) context at the Institute of Teacher Education, Technical Education Campus (IPGKPT), drawing upon the Technology Acceptance Model (TAM) and the GenAI-enhanced Technological Pedagogical Content Knowledge (GenAI-TPACK) framework (Alagoz Hamzaj, 2025; Zheng et al., 2024). The results indicate that participants demonstrated a high level of behavioural intention to integrate GenAI into their future teaching practices, signalling a strong predisposition towards the adoption of emerging educational technologies. Consistent with prior research on technology acceptance, perceived usefulness was found to be moderately high, suggesting that pre-service teachers recognised GenAI's potential to improve instructional efficiency, foster student engagement, and support inclusive pedagogical approaches (Wang et al., 2024). However, the findings also

revealed that perceived ease of use was only at an average level, implying that technical proficiency and operational confidence remain areas requiring further development. Moreover, the analysis identified notable gaps in AI literacy, underscoring the imperative for structured, practice-based training and sustained professional development to ensure that pre-service teachers are fully prepared to leverage GenAI tools effectively in TVET contexts. These outcomes collectively emphasise the need for targeted interventions that address both the cognitive and practical dimensions of GenAI adoption in teacher education.

Extending the narrative from these findings, the integration of the Technology Acceptance Model (TAM) with the GenAI-enhanced Technological Pedagogical Content Knowledge (GenAI-TPACK) framework in this study pushes the frontiers of current understanding by transcending the cognitive determinants traditionally emphasised in technology adoption research to encompass the intertwined pedagogical and content-specific dimensions essential for meaningful integration (Blonder et al., 2024; Jumaah et al., 2022). As has been widely acknowledged in the literature, TAM offers a robust and empirically grounded foundation through its focus on perceived usefulness and perceived ease of use; yet, the incorporation of GenAI-TPACK enriches this perspective by embedding AI literacy, adaptive pedagogical strategies, and subject-matter alignment into the adoption equation (Chukwuere et al., 2021). In doing so, the combined framework delivers a more nuanced and holistic account of GenAI adoption in specialised teacher education contexts such as Technical and Vocational Education and Training (TVET), where the demands of modern classrooms require both technical fluency and pedagogical dexterity. The outcomes of this research indicate that the integrated model is not merely a theoretical exercise but a practical instrument capable of predicting adoption trajectories while shaping targeted, evidence-based training interventions. Situated within the Malaysian context, this approach resonates strongly with the aspirations of the Digital Education Policy 2023–2030 and the national TVET transformation agenda, offering a timely and context-sensitive lens for policy-makers, curriculum architects, and teacher educators. Ultimately, by weaving together cognitive-behavioural acceptance factors with pedagogical readiness, this study advances technology acceptance theory and equips stakeholders with actionable strategies to promote the sustainable, responsible, and pedagogically sound adoption of GenAI in education (Kartal, 2024).

5. Conclusion

In conclusion, this study has deepened the understanding of Generative Artificial Intelligence (GenAI) adoption among pre-service teachers in the Technical and Vocational Education and Training (TVET) field through the integration of the Technology Acceptance Model (TAM) and the GenAI-enhanced Technological Pedagogical Content Knowledge (GenAI-TPACK) framework. The findings highlight a high behavioural intention to use GenAI, moderate perceptions of ease of use, and existing gaps in AI literacy. By uniting TAM's cognitive-behavioural constructs with the pedagogical and content-specific dimensions of GenAI-TPACK, this research advances theoretical discourse on technology acceptance in specialised teacher education contexts. Furthermore, the study offers practical guidance for policy-makers in refining digital competency frameworks, for curriculum designers in embedding AI literacy and ethics into teacher training, and for teacher educators in aligning pedagogy with GenAI's capabilities, thereby supporting Malaysia's Digital Education Policy 2023–2030 and the national TVET transformation agenda.

More broadly, the study underscores that the successful integration of GenAI into education hinges not solely on the availability of advanced tools but on the preparedness, adaptability, and ethical grounding of future educators. Equipping pre-service teachers with the technical skills, pedagogical strategies, and reflective capacities needed to use GenAI responsibly is essential for ensuring that technological adoption enhances not replaces the human elements of teaching. As education systems worldwide navigate the opportunities and challenges of intelligent technologies, it is worth remembering the words of Albert Einstein: "It has become appallingly obvious that our technology has exceeded our humanity." This sentiment serves as both a caution and a call to action urging educators and policymakers alike to ensure that innovation in education is always guided by humanity, purpose, and wisdom.

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