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Research Article

Exploring the Adoption of Generative Artificial Intelligence by TVET Students: A UTAUT Analysis of Perceptions, Benefits, and Implementation Challenges

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ABSTRACT

Background: This research investigates the perceptions, benefits, and challenges of generative artificial intelligence (AI) tools among students of Technical and Vocational Education and Training (TVET). A sample of 200 students from various institutions in Malaysia including Technical and Vocational Education and Training (TVET) institutions and universities in the fields of engineering, information technology, business studies and hospitality were surveyed for this study. You were selected for this study due to your experience with generative AI in your academic and real-world learning experiences. Based on the Unified Theory of Acceptance and Use of Technology (UTAUT), the study addresses whether performance expectancy, effort expectancy, social influence and facilitating conditions are key factors in students' intentions to adopt and use generative AI. The findings demonstrate the importance of generative AI in improving TVET education but also spotlight challenges to its mainstream implementation. The study then draws recommendations for educators and policymakers, on how to ensure informed and effective AI use in TVET settings based on these findings.

Objectives: The purpose of this research was to investigate the factors affecting the implementation of Generative AI among TVET students using UTAUT model, its advantages and disadvantages, as well as the role of institutional support and ethical concerns such as plagiarism and data privacy.

Methods: Quantitative survey approach applied to collect comprehensive data on the adoption of generative AI among TVET students. A total of 200 students across multiple disciplines, including engineering, IT, and hospitality participated in this study. The participants were selected based on their exposure on generative AI tools to ensure relevance in assessing adoption factors. Data collection was conducted through a structured questionnaire based on the UTAUT model, covering constructs key such as performance expectancy, effort expectancy, social influence, and facilitating conditions. The survey aimed to capture students' perceptions, experiences, and challenges related to AI adoption in their fields of study. Additionally, regression technique was used to analysed the data and identify relationships between UTAUT constructs and adoption behaviour.

Results: The findings of the study focus on the validation of the UTAUT constructs and the analysis of survey responses. The descriptive statistics (mean, standard deviation) and inferential statistics (correlation, regression analysis) were applied to understand the impact of various factors on AI adoption.

Conclusions: This study highlights the potential of generative AI tools to change the landscape of TVET education. These tools can make the learning experience richer by improving the learning efficiency, enhancing creativity and improving problem-solving skills. Nevertheless, successful adoption is contingent on overcoming major obstacles, including technological literacy gaps, institutional support, and ethical considerations. The statistical analysis showed that performance expectancy and facilitating conditions were significant determinants of students' behavioral intention to adopt AI. It further stresses the importance of organized policies and training programs to promote responsible AI use. They can help facilitate an

environment where generative AI can be maximized for TVET, ultimately ensuring that students are being equipped with essential digital skills necessary for a technology-driven future.

Keywords: AI, ethical concerns, facilitating conditions, TVET, UTAUT, AI Tools

BACKGROUND

Technical and vocational education and training (TVET) has been shown to prepare students with real technical skills and knowledge that meets industry demands, according to global consulting group, the United Nations Educational, Scientific and Cultural Organization [13]. Technical and vocational education and training (TVET) centres on practical learning experiences, equipping students for niche careers in fields including engineering and information technology, business studies, and hospitality 8. In Malaysia, Technical and Vocational Education and Training (TVET) is integral to the national education sector; there are more TVET institutions and TVET universities in Malaysia that provide various courses targeted at preparing individuals for the workforce and stimulating economic growth [3]. The Malaysian government has consistently highlighted the role of TVET in promoting innovation and tackling skill gaps in crucial sectors [8].

Students today are increasingly eager to adopt generative artificial intelligence (AI) tools like ChatGPT, DeepSeek, and similar tools to provide them with enhanced learning opportunities. These tools are designed to adapt study materials to individual needs, provide immediate feedback, and facilitate problem-solving processes, and are especially valuable in TVET. By automating content creation, producing personalized study recommendations, and assisting students in honing their practical skills, generative AI can serve as an invaluable resource for students, enabling them to better understand difficult concepts [16]. Education studies have shown that AI-based solutions significantly facilitate coursework, encourage independent study, and enhance long-term information retention [9]. Yet, these potential advantages can be negated by barriers that students and educators face in effectively using generative AI, including digital literacy gaps, access obstacles, and limited awareness of how AI can be applied in an academic context [11].

LITERATURE REVIEW

AI in Vocational Education

Vocational education has been considerably impacted by artificial intelligence (AI) by improving training methods, redefining learning outcomes and narrowing the skill gap between academia and industries [4] [12]. AI applications in TVET such as adaptive learning systems, automated grading, real time feedback mechanisms, and competency-based assessments help ensure acquisition of job ready skills [9][10]. AI-driven tools, including chatbots, virtual labs, and AI-assisted simulations, have been found to enhance engagement and promote customized learning experiences [16][15]. For instance, research shows that using AI techniques for skill assessments and industry-based AI sound training modules improve employment readiness of TVET graduates [7]. These benefits still come with caveats, such as ethical concerns, online privacy issues, as well as lack of digital literacy creating barriers to AI adoption (Rahimi & Shute, 2023; European Commission, 2024). Tackling such issues is a collective responsibility of educators, policymakers, and industry stakeholders to design AI literacy programs and ethical AI guidelines specific to vocational education [1].

The UTAUT Framework

The Unified Theory of Acceptance and Use of Technology (UTAUT) has become one of the most widely adopted theory for the purposes of understanding adoption of technologies, especially in contexts such as education and workforce training. Venkatesh et al. who originally developed Based on social science research and models (2003), UTAUT proposes four constructs that affect technology adoption: performance expectancy, effort expectancy, social influence, and facilitating conditions. This model includes four constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) which are illustrated in Figure 1. A range of studies have utilized the UTAUT framework to investigate the adoption of new educational technologies, such as AI-based learning tools, among students and educators [2]. Indeed, perceived usefulness has been identified as an important factor underpinning the uptake of AI in education, as have both social influence and institutional support in informing individuals behaviour [4].

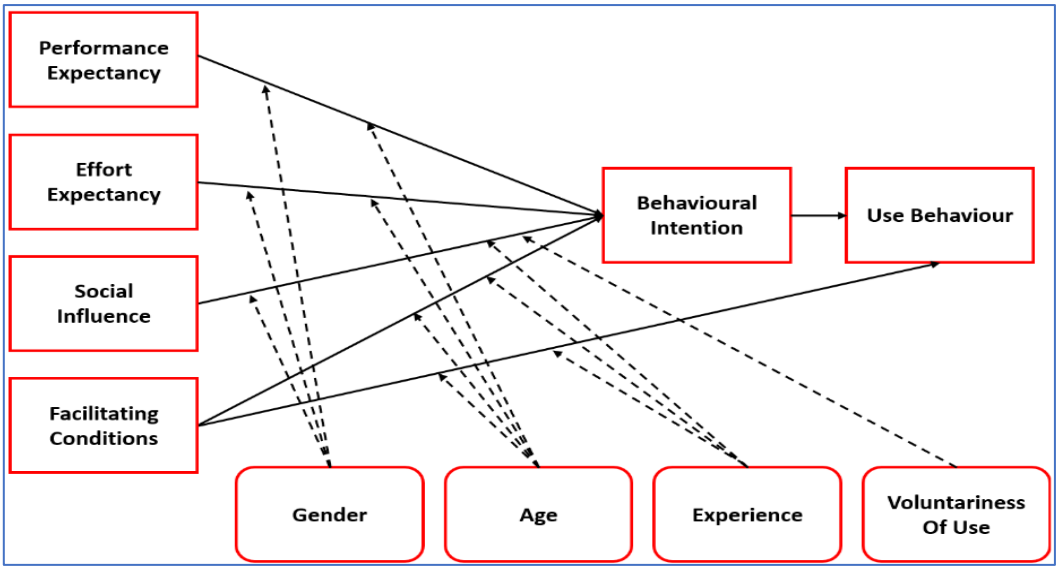

Figure 1. *UTAUT Framework by Venkatech et.al (2003).*

AI Adoption in Education

Over the last ten years, researchers have published studies reflecting the growing use of AI in education, as well as the opportunities and challenges associated with it. Recent research aimed at exploring AI integration in social development organizations using the Unified Theory of Acceptance and Use of Technology (UTAUT) model argues that the key determinants of AI tool usage are performance expectancy, effort expectancy, social influence, and facilitating conditions [6][4]. Then, research on the motivations and enabling factors for AI adoption in the higher education institutions further indicates that ease of use and perceived usefulness drives AI implementation, while ethical concerns and a lack of training serve as restrictions to AI utilization [11][12]. The needs and challenges of the organization would then inform what kinds of institutional policies, structured AI literacy programs and regulatory compliance are necessary within the institution to ensure its seamless adoption, as the comparative research highlighting AI adoption in the healthcare, business and government services sectors demonstrates [9][5][7]. Moreover, the application of AI-powered learning analytics and tailored tutoring systems has proved effective in enhancing pupil engagement and learning outcomes at different levels of education [15] [1].

METHODS

Quantitative survey approach applied to collect comprehensive data on the adoption of generative AI among TVET students. A total of 200 students across multiple disciplines, including engineering, IT, and hospitality participated in this study. The participants were selected based on their exposure on generative AI tools to ensure relevance in assessing adoption factors. Data collection was conducted through a structured questionnaire based on the UTAUT model, covering constructs key such as performance expectancy, effort expectancy, social influence, and facilitating conditions. The survey aimed to capture students' perceptions, experiences, and challenges related to AI adoption in their fields of study. Additionally, regression technique was used to analysed the data and identify relationships between UTAUT constructs and adoption behaviour.

RESULTS

The findings of the study focus on the validation of the UTAUT constructs and the analysis of survey responses. The descriptive statistics (mean, standard deviation) and inferential statistics (correlation, regression analysis) were applied to understand the impact of various factors on AI adoption.

Validation of UTAUT Constructs

Confirmatory factor analysis (CFA) and reliability testing using Cronbach's alpha was used in validation of UTAUT Constructs. The validity and reliability of the four main constructs were assessed to ensure the consistency and accuracy in measuring AI adoption among TVET students. The results, shown in Table 1, confirmed that the values of all constructs were above 0.80, confirming the reliability of the instrument for measuring AI adoption among TVET students. CFA was conducted to assess the factor loadings of the survey items under each UTAUT construct,

with all factor loadings exceeding the recommended threshold of 0.70, confirming strong construct validity. The average variance extracted (AVE) values for each construct were above 0.50, ensuring convergent validity, while discriminant validity was confirmed as the square root of the AVE for each construct was greater than its correlation with other constructs. Additionally, reliability analysis using Cronbach's alpha showed that all constructs achieved values above 0.80, indicating strong internal consistency [14]. These findings confirm that the survey instrument was both valid and reliable for measuring AI adoption in TVET institutions.

UTAUT Construct	Cronbach's Alpha (α)
Performance Expectancy	0.85
Effort Expectancy	0.83
Social Influence	0.81
Facilitating Conditions	0.87

Table 1. *Reliability Analysis Using Cronbach Alpha.*

Analysis

The quantitative findings provide an overview of the adoption of generative AI among TVET students. This analysis includes descriptive statistics (mean, standard deviation), inferential statistics (correlation, regression analysis), and hypothesis testing.

Age distribution

The survey found that the majority of respondents (57.8%) were between 24-25 years old, followed by 21-23 years old (21.4%) and 18-20 years old (20.9%). A one-way ANOVA test revealed no statistically significant difference in AI adoption rates across different age groups ($p > 0.05$), suggesting that AI adoption is not strongly influenced by age.

Familiarity with AI

The mean familiarity level was 3.7/5 (SD = 0.91), with 57.3% of students reporting that they were "somewhat familiar" and 39.8% indicating they were "very familiar." A Pearson correlation analysis showed a moderate positive relationship ($r = 0.42$, $p < 0.05$) between AI familiarity and frequency of use, suggesting that students with higher exposure to AI are more likely to adopt it.

AI Tools usage

ChatGPT emerged as the most widely used AI tool (82.5%), followed by GitHub Copilot (9.7%). A chi-square test ($\chi^2 = 15.89$, $p < 0.01$) confirmed that ChatGPT's adoption rate was significantly higher than other tools. The study found, Data of AI tool usage percentages with standard deviation values are displayed in Table 2, and χ^2 test results indicating that ChatGPT's adoption rate was significantly higher than for the other tools.

AI Tool	Usage Percentage (%)	Standard Deviation (SD)	Chi-Square (χ^2)
ChatGPT	82.5	4.3	15.89
GitHub Copilot	9.7	3.1	9.72
Gemini	5.3	2.8	5.30
Cohere Generate	1.2	1.1	1.75
Cloud AI	0.8	0.9	1.42
DALL-E 2	0.3	0.6	0.85
Synthesia	0.2	0.5	0.72
EnGenius	0.1	0.4	0.58

Table 2. *List of AI tools and usage.*

Perceived benefit

Regression analysis demonstrated that performance expectancy significantly predicted AI adoption ($\beta = 0.53$, $p < 0.01$), with over 75% of students agreeing that AI enhances learning efficiency. Table 3 shows the mean scores for perceived benefits of AI along with the regression coefficients, emphasizing the importance of performance expectancy in AI adoption.

Perceived Benefit	Mean Score (Out of 5)	Standard Deviation (SD)	Regression Coefficient (β)	p-value
AI improves learning efficiency	4.1	0.78	0.53	< 0.01
AI assists in completing assignments efficiently	4.3	0.82	0.47	< 0.05
AI aids in generating creative solutions	4.0	0.75	0.49	< 0.05

Table 3. *Perceived Benefit.*

Institutional support and facilitation Conditions

The study found that while students had access to the necessary resources (mean = 3.7/5, SD = 0.92), institutional support for AI adoption was relatively low (mean = 3.2/5, SD = 1.1). Multiple regression analysis confirmed that facilitating conditions significantly influenced AI adoption ($\beta = 0.48$, $p < 0.01$). Table 4 shows the mean scores for each factor in terms of availability of resources and institutional support and their effect on AI adoption through multiple regression analysis.

Institutional Factor	Mean Score (Out of 5)	Standard Deviation (SD)	Regression Coefficient (β)	p-value
Access to resources	3.7	0.92	-	-
Institutional support	3.2	1.1	0.48	< 0.01

Table 4. *Perceived Benefit.*

Behaviour intention

Students exhibited a strong intent to continue using AI, with mean scores above 4.2/5. Social influence ($\beta = 0.38$, $p < 0.05$) significantly impacted students' behavioral intention to use AI. As shown in Table 5, indicating the effect of social-related factors on students' intention to adopt AI in academic endeavours.

Behavioral Intention	Mean Score (Out of 5)	Standard Deviation (SD)	Regression Coefficient (β)	p-value
Intent to use AI frequently	4.2	0.75	0.38	< 0.05
Plan to explore AI further	4.3	0.78	0.41	< 0.05

Table 5. *Behavioral Intention.*

Ethical concern

The study identified three major ethical concerns: plagiarism, data privacy, and misinformation. The percentage of students concerned about each issue as well as their mean scores for concern level are shown in Table 6.

Ethical Concern	Mean Score (Out of 5)	Standard Deviation (SD)	Percentage of Concerned Students (%)
Plagiarism	3.8	0.91	57.3

Ethical Concern	Mean Score (Out of 5)	Standard Deviation (SD)	Percentage of Concerned Students (%)
Data Privacy	3.6	0.88	53.1
Misinformation Risks	3.4	0.85	48.7

Table 6. *Ethical Concern.*

These findings highlight the nature of generative AI in TVET education, it serves as a powerful educational tool while presenting challenges that must be addressed through structured policies, ethical guidelines, and institutional training programs.

DISCUSSION

Implications for TVET

Data for this research are based on an agreed set of articles predominantly published in English, however, since access to literature on generative AI in TVET is still at its early stage, this study attempts to review the existing trends of literature based on their influence on TVET debate in systematic approaches at the current moment. Generative AI tools can improve the efficiency and effectiveness of vocational education through automating routine tasks, providing real time feedback, and facilitating skills development [9]. Research indicates that when integrated into education, AI has proven to increase both student engagement and learning outcomes through the provision of personalized support [11]. Yet, its widespread adoption rests on key barriers such as technological literacy gaps, ethical concerns and institutional readiness [4]. Implementing structured training programs, robust ethical guidelines, and enhanced infrastructure support can help address these challenges, leading to greater acceptance and use of generative AI technologies within TVET contexts [14]. Additionally, UTAUT-based research emphasizes the importance of social influence and behavioural intention in the adoption of technology in educational institutions [2].

Ethical and Practical Concerns

Ensuring ethical use of generative AI tools and protecting sensitive student information [11] Students and educators can navigate the ethical implications of AI tools with clear institutional guidelines, awareness programs, and AI literacy training [4]. Furthermore, policymakers can adopt policies that set the stage for a responsible AI adoption ecosystem within TVET education, including regulatory policies to manage risk linked to AI content origination, plagiarism, and data security breaches [16].

Alignment with UTAUT

These findings are consistent with the predictions of UTAUT, where effort expectancy and facilitating conditions are among key determinants of technology adoption [14]. A positive correlation was found between perceived ease of use and AI adoption, suggesting that students who find AI tools more user-friendly and intuitive are more inclined to adopt them in their academic routines [2]. Moreover, the significance of facilitating conditions, including access to resources and institutional support, emphasizes the need for well-designed AI literacy programs and sufficient technological infrastructure in TVET institutions [4]. Combined, these rank pivotal in catalyzing students' proactive approach towards the inclusion and effective utilization of AI tools, marking the need for strategic formulation of educational policies that can promote greater sustenance and assimilation of AI paradigms in TVET syllabi [11].

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APPENDIX

Survey Questionnaire

The following is the survey questionnaire used in this study for measuring TVET students' adoption of generative AI tools. To survey the potential of generative AI in education, the questionnaire was adapted from the Unified Theory of Acceptance and Use of Technology (UTAUT) model [14] and included additional ethical consideration items based on established AI ethics literature [11][16].

The questionnaire consists of four sections:

1. Demographic Information
2. UTAUT Constructs for AI Adoption
3. Behavioral Intention and Actual Usage
4. Ethical Considerations

All Likert scale questions were measured using a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).

Section A: Demographics

Question	Adapted From
Age	Venkatesh et al. (2003)
Gender	Venkatesh et al. (2003)
Field of Study	Dwivedi et al. (2023)
Familiarity with Generative AI Tools	Ng et al. (2024)

Section B: UTAUT Constructs for AI Adoption

Performance Expectancy

Question	Adapted From
I believe using generative AI will improve my learning outcomes.	Venkatesh et al. (2003)
Generative AI can help me complete my assignments more efficiently.	Dwivedi et al. (2023)
Generative AI can assist in generating creative solutions for my coursework.	Ng et al. (2024)

Effort Expectancy

Question	Adapted From
Learning to use generative AI is easy for me.	Venkatesh et al. (2003)
I find generative AI tools intuitive and user-friendly.	Dwivedi et al. (2023)

Social Influence

Question	Adapted From
My peers encourage me to use generative AI.	Ng et al. (2024)
My instructors recommend using generative AI in our studies.	Rahimi & Shute (2023)

Facilitating Conditions

Question	Adapted From
I have the necessary resources (e.g., devices, internet) to use generative AI.	Zawacki-Richter et al. (2024)
My institution provides adequate support for using generative AI.	Rahimi & Shute (2023)

Section C: Behavioral Intention and Actual Usage

Behavioral Intention

Question	Adapted From
I intend to use generative AI in my studies frequently.	Venkatesh et al. (2003)
I plan to explore more applications of generative AI in my field.	Dwivedi et al. (2023)

Actual Usage

Question	Adapted From
How often do you currently use generative AI tools?	Ng et al. (2024)

Question	Adapted From
What type of tasks do you most frequently use generative AI tools for?	Zawacki-Richter et al. (2024)

Section D: Ethical Considerations and Risks

Question	Adapted From
I am concerned about ethical issues (e.g., plagiarism, misuse) related to generative AI tools.	Rahimi & Shute (2023)
I believe generative AI tools require better guidelines for ethical usage in education.	Zawacki-Richter et al. (2024)
Using generative AI might pose risks to data privacy and security.	Dwivedi et al. (2023)