

RESEARCH ARTICLE

Exploring ChatGPT utilisation and ethical awareness in TVET education through the ABCE framework

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Abstract - This study explores TVET students' use of ChatGPT, its relationship with their problem-solving abilities, and their ethical awareness. A quantitative cross-sectional survey was conducted with 381 students at the Polytechnic Ungku Omar (PUO). Convenience sampling was used to select participants. The data were analysed using descriptive statistics and correlation analysis. The findings show that students often use ChatGPT to understand complex concepts. Higher levels of use were positively related to self-reported problem-solving skills ($r = 0.729$, $p < 0.01$). This study contributes to the literature by using the Affective, Behavioural, Cognitive, and Ethical (ABCE) framework in the Malaysian TVET context. The framework demonstrates the connection between behavioural engagement and cognitive development. However, the use of convenience sampling and data from only one institution limits the generalisability of the findings. The results emphasise the need for AI ethics workshops, responsible AI use guidelines, proper citation practices, and digital literacy training in educational institutions to prevent academic dishonesty.

Article History

Received : 13 April 2026

Revised : 13 July 2026

Accepted : 14 August 2026

Published : 09 September 2026

Keywords

ChatGPT

Problem solving

Ethical awareness

TVET

ABCE framework

1. Introduction

In education, the incorporation of Artificial Intelligence (AI) has revolutionised the way students interact with learning materials, tackle educational challenges, and cultivate their problem-solving abilities. Interestingly, one of the most widely used AI tools for student learning is ChatGPT. It is a generative language model designed by OpenAI that can generate human-like responses. In that regard, this evolution has had a tremendous effect on the Technical and Vocational Education and Training (TVET) sector, which combines theoretical and practical instruction. Although ChatGPT use has surged in Malaysian higher education, empirical studies on its use among TVET students remain scarce. Therefore, these problems are highly relevant to TVET contexts because students' success in TVET institutions depends on their problem-solving skills and ability to apply knowledge to industry-relevant situations. The use of ChatGPT in learning has had both positive and negative impacts, with the Malaysian Qualifications Agency (MQA) issuing Advisory Note No. 2/2023, which underscores the importance of responsible and ethical use. It offers on-demand explanations, examples, and feedback, allowing students to learn independently. At the same time, questions have been raised about academic dishonesty, increased dependency, and a lack of original thinking [1]. Thus, this study seeks to understand how TVET students in Malaysia use ChatGPT and examine their perceptions of the ethical issues involved. Moreover, this study has profound implications, offering insights into the role of AI in academic performance and ethical digital literacy. In conclusion, this study advances the ongoing conversation about the responsible use of AI in education, especially in TVET settings, where practical abilities and ethical awareness are equally essential for students to meet the changing needs of the modern workforce.

The Behavioural, Cognitive, and Ethical (ABCE) framework [2] was used to explore learners' perceptions and attitudes toward using ChatGPT. The Research Objectives (ROs) are as follows: (i) to examine students' ChatGPT utilisation in their academic tasks, (ii) to investigate the relationship between students' utilisation of ChatGPT and their problem-solving skills, and (iii) to analyse students' perceptions of ethical awareness in the use of ChatGPT. To achieve this, this study uses the Affective, Behavioural, Cognitive, and Ethical framework [2] as a guiding model to comprehensively explore learner perceptions and attitudes regarding ChatGPT. The Research Objectives (ROs) are as follows: (i) to examine students' ChatGPT utilisation in their academic tasks, (ii) to investigate the relationship between students' utilisation of ChatGPT and their problem-solving skills, and (iii) to analyse students' perceptions of ethical awareness regarding ChatGPT use. The research model shown in Figure 1 was used to evaluate ChatGPT use among TVET students. In this model, ChatGPT usage represents behavioural and affective domains. Problem-solving ability represents the cognitive domain, whereas ethical awareness represents the ethical domain. This study aims to provide useful insights into ChatGPT adoption in Malaysian TVET and support its responsible development.

This paper is divided into five sections. Section 2 provides critical reviews of related research and theory that guide this study, and Section 3 explains the study's methodology, including instrument validation and the techniques used to analyse the generated data. The results and discussion are presented in Section 4, and the implications and directions for future research are concluded in Section 5.

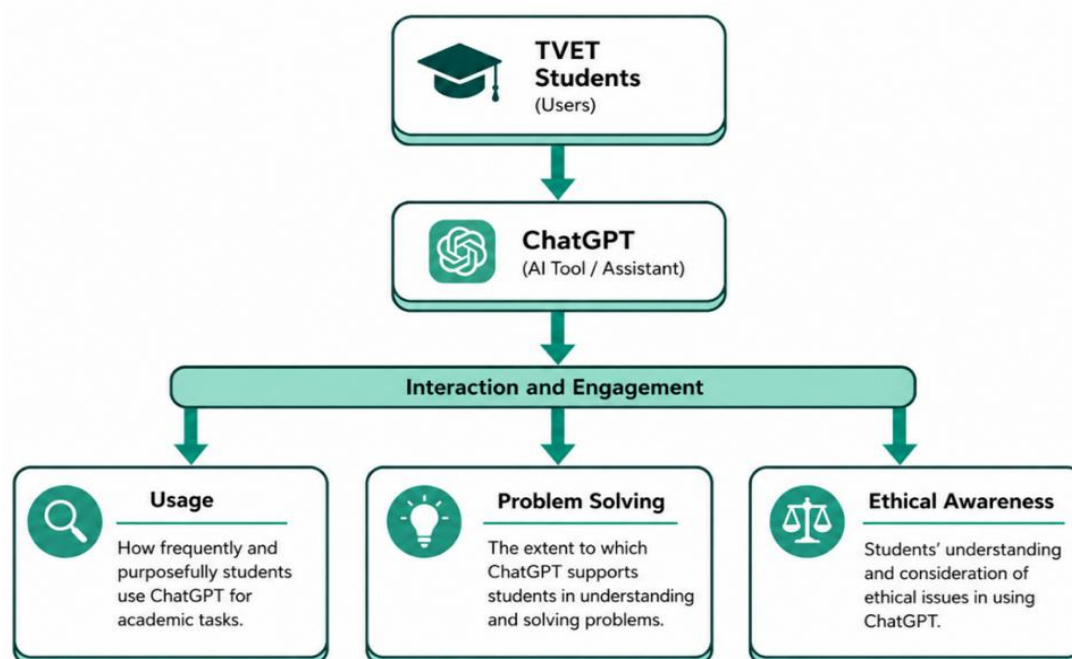


Figure 1. Study framework

2. Related Work

This section presents the theoretical frameworks suitable for this study and analyses the previous literature on ChatGPT's role in education. In addition, it reviews previous studies to evaluate the educational and ethical implications of adopting ChatGPT, analyses updated models of technology acceptance, and addresses the theoretical basis for ChatGPT adoption: the ABCE framework. It also explains the unexamined research gap, which guides the current findings.

2.1 ChatGPT and AI Tools in Education

With the advent of AI tools such as ChatGPT, students' approach to academic work, from writing to research and problem-solving, has been revolutionised [3]. In recent years, systematic reviews have shown that ChatGPT is increasingly used in academic settings as a cognitive scaffold to help students grasp complex concepts, generate ideas, and increase engagement [4]–[5]. Although empirical data on how TVET students use it in actual academic contexts are limited, ChatGPT has the potential to increase productivity and learning efficiency [6]. However, its use raises concerns such as over-reliance, superficial learning, and reduced critical thinking without proper pedagogical guidance [7]–[8]. Moreover, while ChatGPT is associated with accessibility and efficiency, it cannot fully replace human pedagogical interaction, especially in developing contextual understanding and higher-order reasoning [8]. Recent studies have shown that ChatGPT has both benefits and risks. These include greater learning efficiency. However, it may also create problems involving academic integrity, misinformation, and unethical use [7].

2.2 Existing Frameworks for Technology Adoption

To date, many theoretical frameworks have explained users' acceptance and adoption of technology across educational and organisational contexts. The Technology Acceptance Model (TAM), first proposed by Davis [9], has been widely used in educational technology studies to predict students' behavioural intention to use new technology [3], [6]. However, TAM has been criticised for its narrow focus on the emotional and ethical aspects of technology use, particularly in the context of generative AI [2]. The Unified Theory of Acceptance and Use of Technology (UTAUT) introduces additional factors, such as social influence and facilitating conditions [10], but still focuses on behavioural intentions and excludes moral agency and emotions toward AIs [11]. Similarly, the Theory of Planned Behaviour (TPB) [12] and Diffusion of Innovations (DOI) theory [13] provide valuable explanations for individual intentions and innovation diffusion, respectively. Nevertheless, they lack a focus on moral and affective commitment to technology adoption. While these frameworks have limitations, the need for more holistic frameworks that consider cognition, emotions, and ethics, among other factors, is important for capturing the latest advancements in AI literacy research [14]. However, incorporating AI into learning presents socio-technical challenges, including bias, transparency, accountability, and responsible use. Accordingly, ethical issues have emerged as key concerns in recent studies [15]–[16], including academic honesty and the trustworthiness of AI-generated content. These limitations indicate the value of the ABCE framework [2] in addressing these challenges. This framework provides a more holistic perspective. It integrates affective involvement, behavioural actions, cognitive learning and moral awareness into a single structure. However, empirical research using the ABCE framework is limited. This is particularly evident in the TVET settings. Therefore, the framework should be applied as a guiding model to explore its usefulness in diverse educational contexts.

2.3 Ethical and Cognitive Domains of AI Use

ChatGPT's convenience comes with numerous potential risks. Ethical issues, including plagiarism, academic dishonesty, excessive reliance on AI-generated answers, and failure to disclose AI assistance, have raised global concerns about the potential undermining of academic integrity and critical thinking skills [17]– [19]. However, some studies suggest that AI tools can foster creativity and support complex thought, while others argue that AI can supercharge superficial knowledge [11]. The MQA released Advisory Note No. 2/2023 to address the rise of AI in education, highlighting the ethical and responsible application of generative AI technologies in higher education [20]. Therefore, educational institutions must establish clear rules, foster academic integrity, and embrace AI tools to support self-learning and meet these requirements. In this context, it is crucial to educate students about the ethical aspects of AI use, including plagiarism. Given its popularity, research on TVET students' awareness of the ethics of ChatGPT use remains scarce. Moreover, most existing studies in higher education are conducted in general student contexts, with little research specifically in the TVET context, warranting further exploration. Consequently, a lack of understanding of students' ethical concerns and awareness levels can hinder institutions from formulating effective guidelines or educational interventions. Hence, it is critical to understand the nature and extent of ChatGPT use among TVET students and assess their ethical concerns and awareness regarding its use for academic purposes.

2.4 Summary of Research Gap

As noted in the literature review above, sufficient studies examine AI adoption and technology acceptance. However, few empirical studies have examined students' perceptions of ABCE domains. Only a few studies have examined these factors among Malaysian TVET students, particularly in the context of ChatGPT-assisted learning. To address this gap, this study employed the ABCE framework to explore TVET students' use of ChatGPT, its connection to problem-solving, and their ethical understanding of academic work. Figure 2 summarises the related work: (2.1) ChatGPT and AI tools in education; (2.2) existing technology adoption models (TAM and UTAUT); and the ABCE framework, including its domains. It stresses the ethical and cognitive issues of AI utilisation (2.3) and reveals a clear research gap on the comprehensive use of AI in the Malaysian TVET setting (2.4).

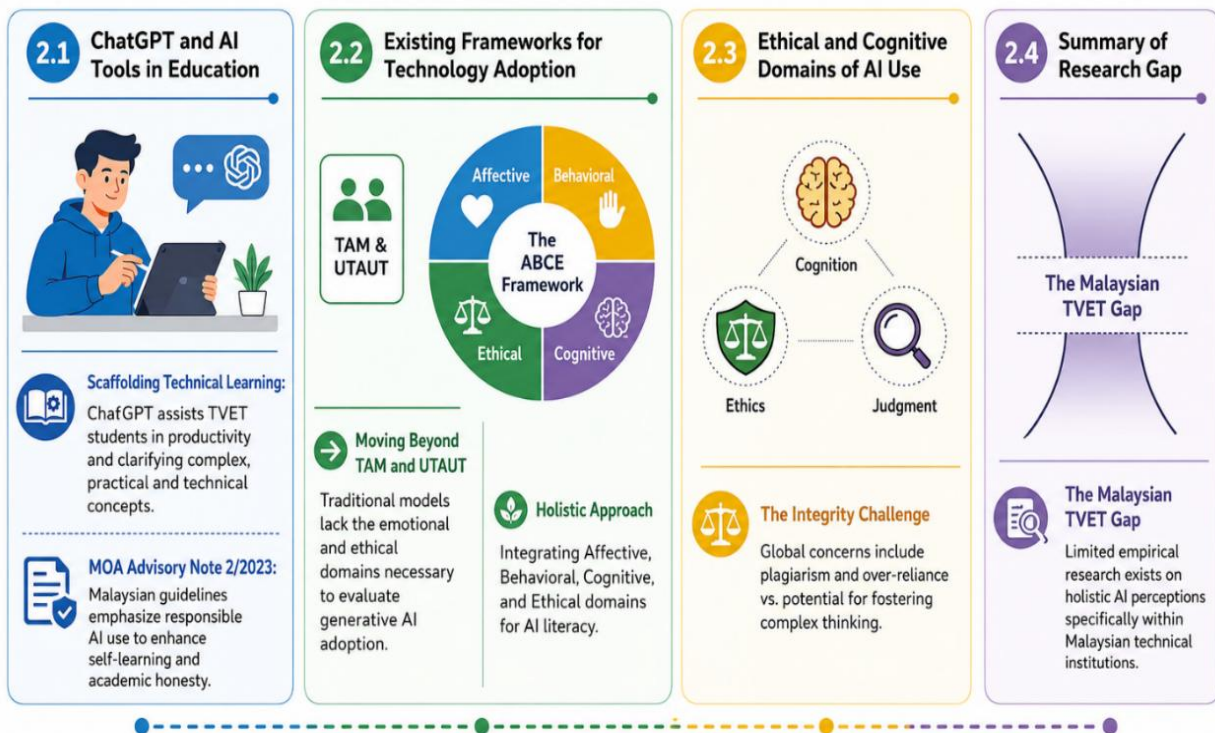


Figure 2. Summary of related works

3. Materials and Methods

3.1 Research Design

This study employed a quantitative, cross-sectional survey design to collect and analyse numerical data at a single point in time. This enables the observation of relationships between variables [21]. This design aligns with the study's objectives: i) to measure and analyse the extent of using ChatGPT for academic tasks and problem-solving among TVET students and ii) to explore their knowledge about related ethical issues. The questionnaire and analysis structure were developed using the ABCE framework. A quantitative approach was chosen to evaluate the adopted frameworks and examine relationships among several variables, enabling the researchers to conduct the study effectively [21]. In addition, thematic alignment ensured strong conceptual coherence between the ROs and the measurement instrument. The questionnaire and analysis structure were designed using the ABCE framework. Based on this, a series of questionnaire

items was developed to capture each domain and used as variables in the data analysis. These steps enabled the study to compare a large sample, extrapolate findings to TVET students more broadly, and achieve the study objective. Moreover, many existing studies have adopted this design, particularly in educational technology, students' perceptions, and ethical awareness [22], which justifies its use. In addition to this theoretical structure, the items were aligned with the study's specific thematic constructs: ChatGPT usage, problem-solving, and ethical awareness. This double coding allowed items to be coded both within the psychological domain and for their thematic relevance to the study. The behavioural and affective domains were used together to measure ChatGPT use. Simultaneously, the cognitive domain was correlated with problem-solving abilities, and the ethical domain was correlated with ethical awareness items. Likewise, the focus on thematic alignment in the design of the educational instrument [21] reflects its construct validity and that it measures what was intended in both theoretical and applied aspects.

3.2 Population and Sample

This study involved 4,723 students enrolled in foundation, diploma, and degree courses at Polytechnic Ungku Omar (PUO). The researchers determined an appropriate sample size by consulting [23], and considered a range of 354–400 respondents satisfactory. The study used convenience sampling to collect 381 valid responses from accessible students. Although this method facilitated efficient data collection, reliance on convenience sampling and single-institution data limits the findings' generalisability. Consequently, these findings may not accurately represent the broader population of Malaysian TVET students.

3.3 Research Instrument

A structured questionnaire was designed based on the ABCE framework [2]. The instrument was adapted from a prior validation study tailored to the Malaysian TVET context [24]. Content validity was established through expert review using Aiken's V, resulting in a highly reliable 27-item instrument ($\alpha = 0.945$). The instrument was previously validated through expert review, Aiken's V assessment, and a pilot test [24]. Because this validation was conducted recently and tailored to the Malaysian TVET context, it provides a strong and reliable foundation for its use in this study. As the instrument's structural integrity has already been established for this specific demographic, Exploratory Factor Analysis and Confirmatory Factor Analysis were not performed in the current study [25]. Rather, Cronbach's alpha was used to assess the instrument's reliability for the present sample. Thus, the entire sample was used for the final 27-item instrument in this preliminary study. The survey instrument included structured Likert-scale items grouped into four key sections aligned with the study objectives. A four-point Likert scale was used, with the following response options: (1) Strongly Disagree, (2) Disagree, (3) Agree, and (4) Strongly Agree. Following experience and guidance from previous studies, such as [26], which suggested using a four-point Likert scale to elicit a clear stance from respondents and avoid more decisive responses due to even-numbered scales. This design also meets the recommendation for instruments in educational settings, where clear opinions are needed for data interpretation.

3.4 Data Collection Procedure

This study used a self-administered online questionnaire to collect the data. This approach enabled efficient distribution to a wide range of students in an academic setting, where they were digitally connected [27]. The survey link was initially sent via email to the PUO Academic Advisor Coordinators for systematic dissemination. The coordinators then shared the link with the Department Academic Advisors, who in turn shared it with the Academic Advisors of their respective departments. Finally, Academic Advisors sent the survey link to their respective student groups via WhatsApp or Telegram to maximise and optimise outreach to the target population. The form included an informed consent statement explaining the purpose of the study, the voluntary nature of participation, and assurances of anonymity and confidentiality. Please note that no personally identifiable information was collected. This procedure adhered to the accepted ethical guidelines. [28]. Data collection took place from 28th May to 9 June 2025, with 392 responses received. As mentioned in Section 3.2, 381 valid responses remained after data cleaning.

3.5 Data Analysis Techniques

We used descriptive statistics to analyse the collected data. To assess the instrument's reliability, we estimated the internal consistency of each section using Cronbach's alpha [29]. Table 1 presents the interpretation of the Cronbach's alpha values. The online questionnaire responses were analysed quantitatively for the items in sections B, C, and D. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 21. Table 2 summarises the data analysis methods employed to address each RO in this study.

Table 1. Interpretation of Cronbach's alpha

Cronbach's Alpha (α) value	Reliability interpretation
0.8 to 1.0	Very good and effective with a high degree of Consistency
0.7 to 0.8	Good and acceptable
0.6 to 0.7	Acceptable
< 0.6	Items need to be repaired
< 0.5	Items need to be dropped

RO1 focused on how students used ChatGPT in their academic tasks. The affective domain captures students' attitudes, interests, and willingness to use ChatGPT for learning, while the behavioural domain reflects the frequency, manner, and purpose of its use (e.g., for assignments, idea generation, or revision). Meanwhile, RO2 investigates the relationship between students' utilisation of ChatGPT and their problem-solving abilities. Problem-solving ability is a main aspect of the cognitive domain, as it demonstrates students' thinking, reasoning, and decision-making abilities. Specifically, this RO investigates how students' behavioural use of ChatGPT is connected to their cognitive engagement in solving academic problems. Moreover, to measure ChatGPT's impact on problem-solving, which encompasses essential higher-order thinking skills, including analysis, evaluation, reflection, and strategic decision-making, the cognitive component of the ABCE framework was applied [2]. Empirical studies consistently supported this conceptualisation, showing that ChatGPT-generated prompts stimulate metacognitive critique and the development of analytical skills in problem-solving workshops [30]. Similarly, [31] posited that the critical evaluation of AI-generated essays enhanced students' cognitive evaluative capabilities. Collectively, these studies support including cognitive domain items to evaluate ChatGPT's impact on problem-solving skills. In contrast, RO3 aligns directly with the ethical domain, as it explores students' awareness of responsible AI use, academic honesty, concerns about plagiarism, and adherence to institutional guidelines when using ChatGPT.

Table 2. Summary of data analysis methods aligned with research objectives

Research objective	Data analysis method	Item section
RO1: To examine how students utilise ChatGPT for academic tasks.	Descriptive statistic (mean score and standard deviation)	Section B
RO2: To investigate the relationship between students' utilisation of ChatGPT and problem-solving.	Pearson correlation	Sections B and C
RO3: To analyse students' perceptions of ethical awareness in their use ChatGPT.	Descriptive statistics (mean score and standard deviation)	Section D

Table 3 presents the interpretation of the mean score for the four-point Likert scale. This interpretation framework was adapted from [32], who used it to evaluate preschool teachers' knowledge, attitudes, and practices toward active learning. This study used the same framework to address RO1 and ethical awareness in RO3. Items related to frequency, comfort, and attitude towards using ChatGPT were mapped to the affective domain to reveal students' emotional engagement with ChatGPT. This method was proven, and the constant interval interpretation was used to analyse the data of the Likert scale, which was accurate and reliable. The Standard Deviation (SD) data were analysed according to the classification in [33], as shown in Table 4. Respondents showed strong agreement when the SD values were less than 0.50. Similarly, variation was significant when values were above 1.50. Pearson's correlation analysis examined the relationship between students' use of ChatGPT and their problem-solving abilities, addressing Research Question 2. This technique is best suited to assessing the strength and direction of linear relationships between two continuous variables. Table 5 summarises the interpretation of the correlation [34]. Figure 3 depicts the research methodology in two phases. Phase 1 explains the study design and instrumentation, while Phase 2 describes the data collection and analysis processes.

Table 3. Interpretation of the mean score of a four-point Likert scale

Mean score	Interpretation of mean RO1	Interpretation of mean RO3
1.00–1.74	Very Low Usage	Very Low Awareness
1.75–2.49	Low Usage	Low Awareness
2.50–3.24	Moderate Usage	Moderate Awareness
3.25–4.00	High Usage	High Awareness

Table 4. Interpretation of standard deviation

SD range	Interpretation	How it aligns
0.00–0.50	Very low variability	A small spread around the mean implies consistent responses
0.51–1.00	Low variability	Responses are consistent with some variation
1.01–1.50	Moderate variability	Responses show a moderate spread, indicating some diversity in opinions
>1.50	High variability	Wider dispersion

Table 5. Interpretation of correlation

Pearson's r	Strength of correlation
0.10 to 0.29	Small/Weak
0.30 to 0.49	Medium/Moderate
0.50 to 1.00	Large/Strong
0	No correlation

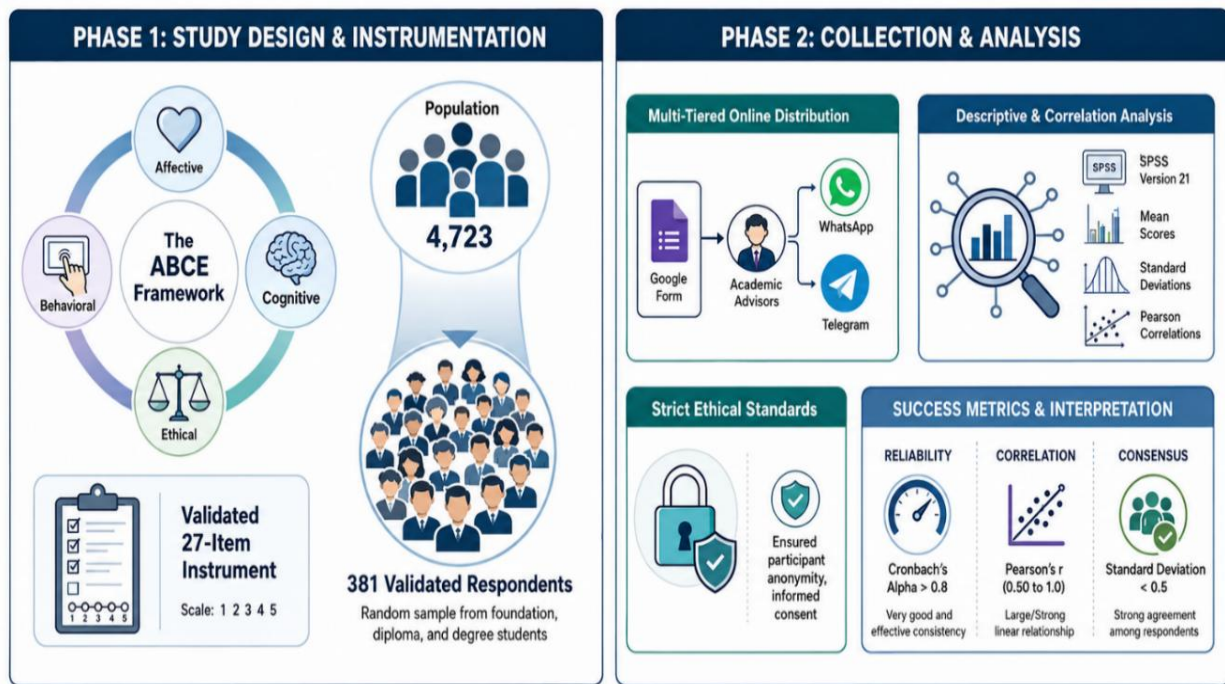


Figure 3. Research design, data collection and analysis overview

4. Results and Discussion

Results and discussion can be presented either as separate subsections or combined into one, based on what best enhances This section explains the results and analysis based on the data collected from 381 respondents. The results are presented based on the three ROs and the related questionnaire sections: (i) Section A: Demographic; (ii) Section B: ChatGPT Usage; (iii) Section C: Impact on Problem-Solving Skills; and (iv) Section D: Ethical Awareness.

4.1 Demographic Data

The characteristics of the respondents' backgrounds are explained below, based on the collected demographic data. The variables were respondents' gender, program level, field of study, and frequency of ChatGPT usage. The findings provide useful preliminary insights into ChatGPT usage among TVET students, but generalisation to the wider TVET population should be approached with caution because the data were collected from only one institution. Table 6 shows the distribution of respondents by gender, age, race, and academic level. Of the 381 respondents, 227 (60%) were male and 154 (40%) were female. Most students were Malay (79%), Indian (17%), Chinese (3%), or of other ethnicities (1%). Most respondents (89%) were aged between 18 and 22 years. By academic level, 294 (77%) were diploma students, 50 (13%) were degree students, and 10% were foundation students. The Department of Information and Communication Technology had the most participants (144, 38%). This was followed by 74 (19 %) from Mechanical Engineering, 45 (12 %) from Commerce, 43 (11%) from Civil Engineering, 35 (9 %) from Mathematics, Science, and Computer 25 (7%) from Electrical Engineering, 25 (7%), and 15 (4 %) from Marine Engineering. Demographic information was used only in a descriptive manner in this study. However, it did not explore gender differences, differences by academic level, or differences by field of study, as these differences were not part of the preliminary investigation.

Table 6. Respondent's demographic details

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	227	60
	Female	154	40
Race	Malay	301	79
	Indian	64	17
	Chinese	12	3
	Others	4	1
Age	18–22 years	339	89
	23–27 years	42	11
Academic Level	Diploma	294	77
	Degree	50	13
	Foundation	37	10

4.2 Reliability Analysis

Cronbach's alpha was computed for each section to assess the instrument's internal consistency. As shown in Table 7, each section exceeded the recommended minimum of 0.80 [29], indicating high reliability across all sections.

4.3 Research Objective 1

The results and discussion of RO1 are as follows and include an analysis of students' responses regarding the use of ChatGPT for academic tasks. As shown in Table 8, students' utilisation of ChatGPT was in the moderate to high range, particularly for comprehending the ideation process (B1 = 3.31) and advanced concepts (B3 = 3.36). However, students showed less dependence on ChatGPT for traditional study methods (B6 = 2.71), indicating that they maintained a traditional learning approach while using ChatGPT.

Both the behavioural and affective domains support RO1 and provide a holistic view of students' use of ChatGPT in academic tasks. The behavioural domain describes actions students can perform with ChatGPT, such as idea generation, problem-solving, and content revision, while the affective domain summarises students' attitudes, motivation, and emotional reactions to its use. Based on the analysis, students actively used ChatGPT across various learning activities. For example, students reported high mean scores for understanding difficult concepts (B3 = 3.36), generating ideas for assignments (B1 = 3.31), solving course-related problems (B2 = 3.26), and finding information (B4 = 3.29). In contrast, the findings indicate that while students broadly use ChatGPT for academic activities, its specific functional role is evident in how often they use it for routine learning. The highest mean ($M = 3.36$, $SD = 0.544$) was for Item B3, indicating that students viewed ChatGPT as a useful explanatory tool for clarifying difficult concepts. This further supports the idea that ChatGPT could be a significant figure in technical contexts, which are usually prevalent in traditional instruction. Simultaneously, Item B7 (editing writing) scored 2.86, indicating careful use for tasks that require more accountability, perhaps because of ethical issues (e.g. plagiarism) or the necessity of direct human feedback. In contrast, the lower mean reflects the voluntary restriction of AI use for assessment tasks.

Table 7. Internal consistency of the instrument

Section	N of items	Cronbach's Alpha
B: ChatGPT Usage	9	0.890
C: Impact on Problem-solving	6	0.920
D: Ethical Awareness	12	0.896
Overall Instrument	27	0.940

Table 8. Mean and standard deviation for Section B

Item Number	Item	Mean	Standard Deviation
B1	I use ChatGPT to help generate ideas for my assignments.	3.31	0.597
B2	I use ChatGPT to solve specific problems related to my courses.	3.26	0.571
B3	I use ChatGPT to understand difficult concepts related to my courses	3.36	0.544
B4	I use ChatGPT to find information related to my academic course.	3.29	0.628
B5	ChatGPT supports my self-learning by providing personalised feedback.	3.23	0.592
B6	I rely on ChatGPT more than traditional study resources (books, lectures)	2.71	0.785
B7	I used ChatGPT to edit my writing.	2.86	0.780
B8	I use ChatGPT as a study tool during revision or exam preparation.	3.13	0.657
B9	I use ChatGPT to clarify instructions or questions regarding assignments.	3.16	0.624

Students' responses to ChatGPT in the affective domain generally showed positive emotions. Students recognised it as a motivator for their academic development; the item "ChatGPT supports my self-learning" (B5 = 3.23). However, ChatGPT is not a substitute for traditional learning, such as textbooks or class-based instruction. Instead, it is merely an optional tool. This is evident in the lower mean score for "I rely on ChatGPT more than traditional study" (B6 = 2.71). This counter concerns about overdependence on AI. The SD (0.785) was relatively high, suggesting variation in student attitudes, likely due to differences between departments. This aligns with previous studies [19], which showed that students often know what they need to do to use AI tools confidently, namely, self-regulation and critical thinking. Additionally, the collective findings across the two domains suggest that TVET students had developed an appropriate way of using ChatGPT, demonstrating both practical (behavioural) and emotional (affective) awareness in a self-regulated manner. This clearly demonstrates the relevance of applying the ABCE framework to reveal students' interactions with AI tools, particularly in settings where self-learning and tool-assisted engagement are increasingly encouraged. Furthermore, these results indicate that AI is a working tool and not a mere passive reliance. ChatGPT's main purpose is to scaffold cognitive bridging and clarify complex technical concepts, rather than to create content. This aligns with the

conclusions of [35], who found that students used chatbots to understand difficult coding concepts. Nevertheless, a tension remains between the belief that AI is completely taking over traditional study habits and students' declining scores. Because TVET assessment is practical and hands-on, students take a blended learning approach with AI support, not fully relying on AI while still using traditional pedagogical materials.

4.4 Research Objective 2

The analysis and discussion of RO2 results are presented below, focusing on the relationship between students' use of ChatGPT and their problem-solving abilities. To examine students' perceptions of ChatGPT and its impact on their problem-solving skills, descriptive statistics were first used. According to Table 9, students generally recognised that using ChatGPT improved their problem-solving skills. The highest agreement was for C1 ($M = 3.18$) and C6 ($M = 3.18$), indicating that ChatGPT helped them refine complex issues and promote cognitive diversity. However, responses were consistent, with SDs ranging from 0.55 to 0.60, suggesting a shared understanding of ChatGPT's role in cognitive tasks and a similar level of students' experience or confidence. Pearson's correlation analysis was conducted between Section B (ChatGPT Usage - Behavioural and Affective domain) and Section C (Impact on Problem-Solving - Cognitive domain) to examine the relationship.

Table 9. Mean and standard deviation for Section C

Item Number	Item	Mean	Standard Deviation
C1	ChatGPT helps me solve complex problems by breaking them down into smaller, more manageable parts.	3.18	0.569
C2	Using ChatGPT allows me to consider a wider range of potential solutions to problems.	3.14	0.572
C3	I used ChatGPT to generate different approaches to solving a problem.	3.17	0.557
C4	Using ChatGPT has improved my critical thinking skills in terms of problem-solving.	3.17	0.557
C5	ChatGPT encourages me to approach problems from various perspectives.	3.18	0.591
C6	Using ChatGPT provides me with relevant technical skills for the current job market.	3.09	0.608

4.5 Research Hypothesis

H₁: There is a significant positive relationship between students' utilisation of ChatGPT and their problem-solving abilities.

H₀: There is no significant relationship between students' utilisation of ChatGPT and their problem-solving abilities.

Table 10 shows a significant positive correlation between ChatGPT use and students' problem-solving abilities ($r = 0.729$, $p < 0.01$), suggesting that students feel more confident solving academic problems when they use ChatGPT frequently. Nonetheless, this observation is correlational and must not be interpreted as evidence that ChatGPT directly causes or improves problem-solving skills. The alternative hypothesis is supported, suggesting a positive correlation between higher self-reported problem-solving skills and increased ChatGPT usage.

Table 10. Correlation between ChatGPT usage and impact on problem-solving

		ChatGPT usage	Problem-solving
ChatGPT usage	Pearson correlation	1	.729**
	Sig. (2-tailed)		.000
	N	381	381
Problem-solving	Pearson Correlation	.729**	1
	Sig. (2-tailed)	.000	
	N	381	381

**Correlation is significant at the 0.01 level (2-tailed).

To address RO2, Pearson's correlation analysis was employed to determine the association between students' use of ChatGPT (Behavioural and Affective domain – Section B) and their self-reported problem-solving ability (Cognitive domain – Section C). ChatGPT supports students' cognitive processes, such as understanding questions, brainstorming ideas, and improving answers. This is primarily because real-time interactivity may help develop metacognition, as users can explore multiple points of view and strengthen their reasoning. In addition, the Pearson correlation coefficient was 0.729 ($p < 0.01$), indicating a strong positive relationship. In other words, increased cognitive performance correlates with students' attitudes, analysis, and problem-solving when they are more engaged with ChatGPT. Furthermore, the alternative hypothesis, consistent with the findings, posits a positive correlation between improvements in students'

problem-solving skills and increased ChatGPT use. These results align with the cognitive aspect of the ABCE framework, which relates to understanding, reasoning, and problem-solving skills. Responses from students to the items in Section C, including the use of ChatGPT to decompose complex problems (C1), develop alternative ways of solving the problem (C3), and complete the problem through critical thinking (C5), indicate that ChatGPT encourages cognitive processes. For example, students indicated in their Section B responses that they interacted behaviourally with ChatGPT to support this development. These findings align with [35], which reports that AI tools like ChatGPT can boost learners' cognitive engagement and help them decompose problems and think reflectively. On this basis, [31] argues that ChatGPT promotes learning environments that support students' higher-order thinking skills, especially when students actively engage with ChatGPT content. This noteworthy correlation indicates a significant relationship between behavioural engagement and perceived cognitive development. This is corroborated by [19], which advocates developing active learning through dialogue with generative AI. However, the cross-sectional design prevents causal inferences. Students' problem-solving skills improved (C1; $M = 3.18$), but were assessed using a self-report measure. [31] found no significant difference between the essays produced by AI and those produced by students, suggesting that a sense of capability does not necessarily lead to better academic results unless critically evaluated by a human. The high correlation suggests that the relationship between tool use and academic skill development is statistically significant and practically meaningful; however, further longitudinal or experimental studies are warranted to explore this association.

4.6 Research Objective 3

This subsection presents the findings and discusses the results (RO3), which analyse students' perceptions of ethical awareness when using ChatGPT. Table 11 shows a moderate to high level of ethical awareness among students who used ChatGPT. Most students understand the need to rework and the difference between learning support and cheating. However, D12 ($M = 2.92$) indicated a lack of formal training, suggesting a gap in institutional support. Students showed moderate to high levels of ethical awareness. The means for ethical understanding were consistently high, reflecting this finding. Item D5 ($M = 3.45$, $SD = 0.549$) and Item D6 ($M = 3.38$, $SD = 0.569$) differ sharply from the lowest-scoring item regarding actual training obtained in Item D12 ($M = 2.92$, $SD = 0.728$). This creates a worrying illusion of competence, with a 0.53-point difference, where students think they know more about ethical use than they are taught. In addition, a large gap between the training received (Item D11; $M = 2.92$, $SD = 0.728$) and perceived needs (Item D12; $M = 3.28$, $SD = 0.565$) appears to reflect a failing in institutional ChatGPT ethics education programs. This aligns with the findings of [1], which indicate that positive attitudes do not guarantee effective or ethical AI adoption. This creates opportunities for further research into institutional gaps, with [2] noting the need for AI literacy and ethics training in education to prevent exploitation and promote responsible AI use. Conversely, even if students are aware of the potential dangers (e.g., plagiarism, misinformation), academic institutions could support them through formal awareness campaigns or policy dissemination initiatives. Overall, the results show that institutions must act proactively. They should address the gap between basic awareness and responsible ethical practices. This can be achieved by offering AI ethics workshops, creating clear guidelines for responsible AI use, requiring proper citation of AI-generated content, and including digital literacy training in curricula.

Table 11. Mean and standard deviation for section d

Item Number	Item	Mean	Standard Deviation
D1	I avoid using ChatGPT to copy answers directly into my assignments.	3.10	0.721
D2	I checked the accuracy of ChatGPT's responses before using them.	3.34	0.576
D3	I am concerned that using ChatGPT too much might reduce my learning and critical thinking skills.	3.24	0.697
D4	I always review and verify the information provided by ChatGPT based on my learning and experience before using it for my academic work.	3.30	0.577
D5	I understand that ChatGPT is a learning support tool and not a replacement for my own work.	3.45	0.549
D6	I know the difference between using ChatGPT for learning support and using it to cheat on academic tasks.	3.38	0.593
D7	I believe that using ChatGPT without proper citation is a form of plagiarism.	3.23	0.592
D8	I am aware that ChatGPT may provide inaccurate information.	3.34	0.588
D9	I am aware of my institution's policies regarding the use of AI tools such as ChatGPT.	3.19	0.575
D10	I am aware that ChatGPT could interpret my question incorrectly, which will end up giving the wrong answer/solution.	3.30	0.595
D11	I have received training on the effective and ethical use of ChatGPT in education.	2.92	0.728
D12	Students should receive training on the responsible use of AI tools.	3.28	0.565

**Correlation is significant at the 0.01 level (2-tailed).

5. Conclusions

This study explored how TVET students engaged with ChatGPT using the ABCE framework. Students showed moderate to high behavioural engagement with ChatGPT for academic work. They viewed it as useful for generating ideas, explaining concepts, and supporting independent learning. ChatGPT use was also strongly and positively related to students' confidence in solving problems. This suggests that ChatGPT may support cognitive learning processes. Although students were generally aware of accuracy problems and possible misuse, institutional support for AI ethics remains limited. This reflects a significant gap in formal AI education. This study contributes to the literature by applying the ABCE framework in a Malaysian TVET setting. The findings show that affective and behavioural factors are closely linked to perceived cognitive outcomes. These dimensions do not operate independently. Therefore, the results support using the ABCE framework to study engagement with AI tools in technical and vocational education. They also help educators understand how students use generative AI.

This study had several limitations. First, all data were collected using self-reported questionnaires at a single time point. This may have caused a common method bias. Second, the cross-sectional design does not allow firm conclusions about whether using ChatGPT improves problem-solving. Third, we used convenience sampling, and we collected data from only one institution. These factors limit the generalisability of our findings. Therefore, the results may not represent all Malaysian TVET students' perspectives. Future studies should include more institutions and a wider range of students. This would improve the generalisability of our findings. Longitudinal or experimental designs should examine whether using AI tools leads to actual cognitive skill development. Researchers should also study demographic factors such as gender, academic level and field of study. This may reveal differences in AI adoption. Cross-cultural studies using the ABCE framework among TVET students in different countries are recommended to further confirm these findings.

Acknowledgements

The author would like to express sincere gratitude to the TVET students from PUO who participated in this and the pilot study and provided valuable feedback. Special thanks are also extended to the expert reviewers for their constructive insights during the instrument design and validation phases, which significantly enhanced the quality of this study.

Funding

This study was not supported by any grants from funding bodies in the public, private, or nonprofit sectors.

Declaration of Competing Interests

The authors declare no conflict of interest.

CRedit Author Contribution Statement

Mariadass, M: Conceptualization; Methodology; Validation; Writing - original draft; Analysis; Visualization.
Raja Gobal, N; Methodology; Investigation; Writing – review & revise.

Availability of Data and Materials

Data sharing is not applicable to this article, as this study generated or analysed no new datasets.

Ethics Statement

This study did not involve human participants or animal subjects. Therefore, this study did not require ethical approval.

Generative Artificial Intelligence Disclosure

The authors declare that artificial intelligence-assisted technologies, such as generative AI, were not used to generate content, ideas, or theories. We have utilised AI to enhance readability and refine the language. We used it under strict human control and supervision. The authors take full responsibility for reviewing and approving the manuscript content.

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