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RESEARCH ARTICLE

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

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1. Introduction

In the field of education, the incorporation of Artificial Intelligence (AI) has revolutionized 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 students to support their learning is ChatGPT. It is a generative language model designed by OpenAI capable of generating human-like responses. In that regard, this evolution has had a tremendous effect on the Technical and Vocational Education and Training (TVET) sector, which has a mix of theoretical and practical instruction.

While there has been a surge in the use of ChatGPT in Malaysian higher education settings, empirical studies dedicated to the use of ChatGPT among TVET students are still scarce. Therefore, the problems are highly relevant to TVET contexts because the success of students in TVET institutions is based on their problem-solving skills and their ability to apply knowledge to industry relevant situations. The use of ChatGPT in learning has sparked both positive and negative impacts, with the Malaysian Qualifications Agency (MQA) issuing Advisory Note No. 2/2023 that firmly highlights the importance of responsible and ethical employment. It offers on demand explanations, examples, and feedback, which can allow students to learn on their own. At the same time, questions have been asked about academic dishonesty, increased dependency, and lack of original thinking [1]. Thus, this study seeks to understand the use of ChatGPT by TVET students in Malaysia and to look at their perception of the ethical issues involved in using ChatGPT. Moreover, this research has profound implications, with its findings offering insights into the role of AI in academic performance and ethical digital literacy. In conclusion, the 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.

Behavioral, Cognitive, and Ethical (ABCE) framework [2] was utilized to comprehensively explore the perception and attitude of learners in the use of 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 analyze students' perceptions of ethical awareness in the use of ChatGPT.

To realize this purpose, this study uses the Affective, Behavioral, Cognitive, and Ethical (ABCE) 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 utilization in their academic tasks, (ii) to investigate the relationship between students' utilization of ChatGPT and their problem-solving skills, and (iii) to analyze students' perceptions of ethical awareness regarding ChatGPT use.

The research model shown in Figure 1 is used to evaluate ChatGPT usage among TVET students. In this model, ChatGPT usage represents the behavioral and affective domains. Problem-solving ability represents the cognitive domain, while ethical awareness represents the ethical domain. The study aims to provide useful insights into the adoption of ChatGPT in Malaysian TVET and to support its responsible development.

This paper is divided into five sections. Section 2 provides critical reviews of related research write-ups and theory that will guide this study, and Section 3 provides a detailed explanation of the methodology of this study, including instrument validation and the techniques that will be used to analyze the data generated in this study. The results and

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discussion are the findings are then presented in Section 4, and the implications and directions for future research are concluded in Section 5.

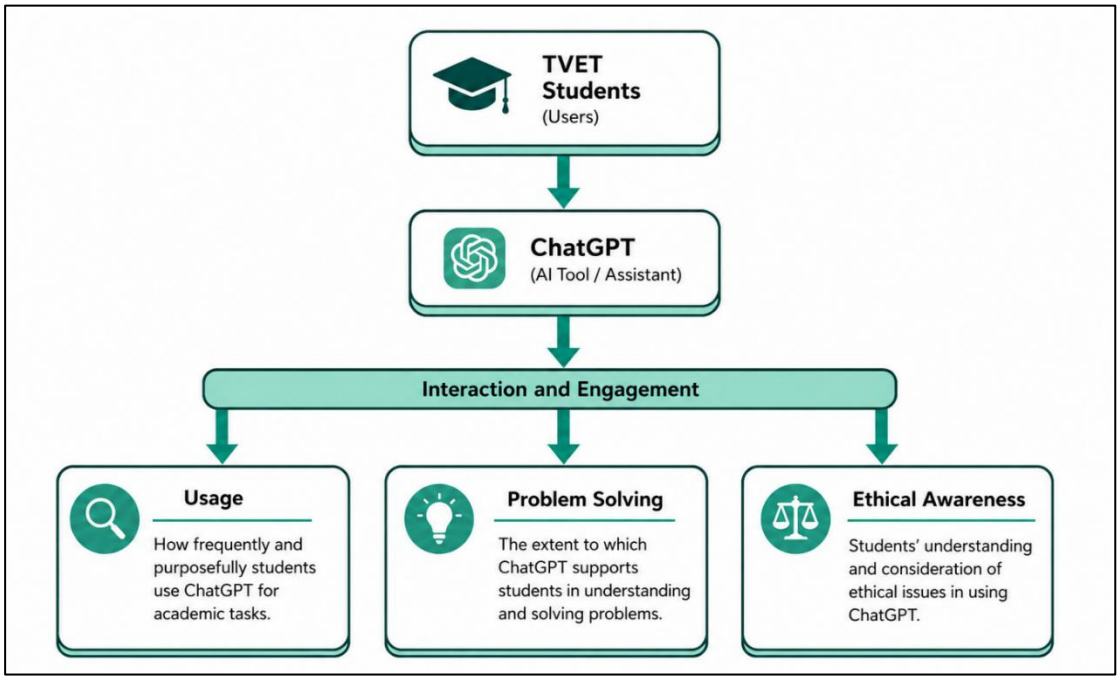

Figure 1. Study framework

2. Related Works

The purpose of this section is to choose the theoretical frameworks that are suitable for this study and analyze the previous literature regarding ChatGPT's role in the education field. Besides, it reviews previous studies to evaluate the educational and ethical implications of the adoption of ChatGPT, analyzes the updated models of technology acceptance, and addresses the theoretical basis for ChatGPT adoption, the ABCE framework. It also explains the unexamined area of research interest like this, which guides the current findings.

2.1 ChatGPT and AI Tools in Education

With the advent of AI tools like ChatGPT, students' approach to academic work, from writing to research and problem-solving, has been revolutionized [3]. In recent years, systematic reviews have shown that ChatGPT is being used more in academic settings as a cognitive scaffold to help students grasp complex concepts, to help them generate ideas, and to increase student engagement [4]-[5].

Although the 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]. At the same time, its use raises concerns such as over-reliance, superficial learning, and reduced critical thinking when there is no 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 show that ChatGPT has both benefits and risks. It is associated with greater learning efficiency. However, it may also create problems involving academic integrity, misinformation, and unethical use [7].

2.2 Existing Frameworks for Technology Adoption

There are many theoretical frameworks that explain the users' acceptance and adoption of technology across educational and organizational contexts to date. The Technology Acceptance Model (TAM), first proposed by Davis [9], has been widely used in studies in education technology for the prediction of students' behavioural intention to use new technology [3, 6]. However, TAM has been criticized for its narrow focus on emotional and ethical aspects of technology use, especially for generative AI [2]. The Unified Theory of Acceptance and Use of Technology (UTAUT) introduce other factors like social influence and facilitating conditions [10] but still focuses on behavioral intentions and excludes moral agency and emotion toward AIs [11]. Similarly, the Theory of Planned Behavior (TPB) [12] and Diffusion of Innovations (DOI) theory [13] provide valuable explanations for individual intentions and innovation diffusion, respectively. Nevertheless, they are lacking in terms of their focus on moral and affective commitment in the adoption of technology.

While these frameworks have their own limitations, the need for more holistic frameworks that consider cognition, emotions, and ethics, among other factors, are important to capture the latest advancements in AI literacy research [14]. On the other hand, incorporating AI into learning presents socio-technical challenges such as bias, transparency, accountability, and responsible use. Based on this, ethical issues have emerged as key 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]. The framework provides a more holistic perspective. It integrates affective involvement, behavioral actions, cognitive learning, and moral awareness into a single structure. However, empirical research using the ABCE framework remains limited. This is particularly evident in TVET settings. Therefore, the framework should be applied as a guiding model to explore its usefulness across diverse educational contexts.

2.3 Ethical and Cognitive Domains of AI Use

The convenience that ChatGPT offers comes with numerous potential risks. Ethical issues, including plagiarism, academic dishonesty, excessive reliance on AI-generated answers, and neglecting to mention AI assistance, have raised concerns globally on undermining academic integrity and critical thinking skills [17–19]. However, there are studies suggesting that AI tools could foster creativity and assist in complex thought, and others believe that AI can be used to supercharge superficial knowledge [11].

The MQA released Advisory Note No. 2/2023 to respond to the rise of AI in education, where they highlighted the ethical and responsible application of the generative AI technologies in higher education [20]. Therefore, it is essential to have clear rules, foster academic integrity, and embrace the use of AI tools to facilitate self-learning in educational institutions to meet the requirements. In this context, it is crucial to educate students about the ethical aspects of AI usage, including the problem of plagiarism.

Given its popularity in the field of study, research studies on TVET students' awareness of the ethics of ChatGPT use are scarce. Moreover, most of the existing studies within higher education are largely conducted in general student contexts with little research conducted specifically in the TVET context that would need to be explored and better understood. Consequently, a lack of understanding of students' ethical concerns and awareness levels can hinder institutions in formulating effective guidelines or educational interventions. Hence, it is critical to understand the nature and extent of ChatGPT usage among TVET students and to assess their ethical concerns and awareness regarding the use of ChatGPT for academic purposes.

2.4 Summary of Research Gap

As mentioned in the literature review above, there are sufficient studies regarding the adoption of AI and technology acceptance. However, not many empirical studies have been conducted on students' perceptions in ABCE domains. Only a few studies have investigated these factors together among Malaysian TVET students, especially in relation to ChatGPT-assisted learning. To address this gap, this study employed the ABCE framework to explore the use of ChatGPT by TVET students, its connection to problem-solving, and their ethical understanding about academic work.

The related work is summarized in Figure 2: (2.1) ChatGPT and AI tools in education; (2.2) existing technology adoption models (TAM and UTAUT); and the ABCE framework, which includes ABCE domains. It stresses the ethical and cognitive issues of AI utilization (2.3) and reveals a clear research gap on the comprehensive use of AI in the Malaysian TVET setting (2.4).

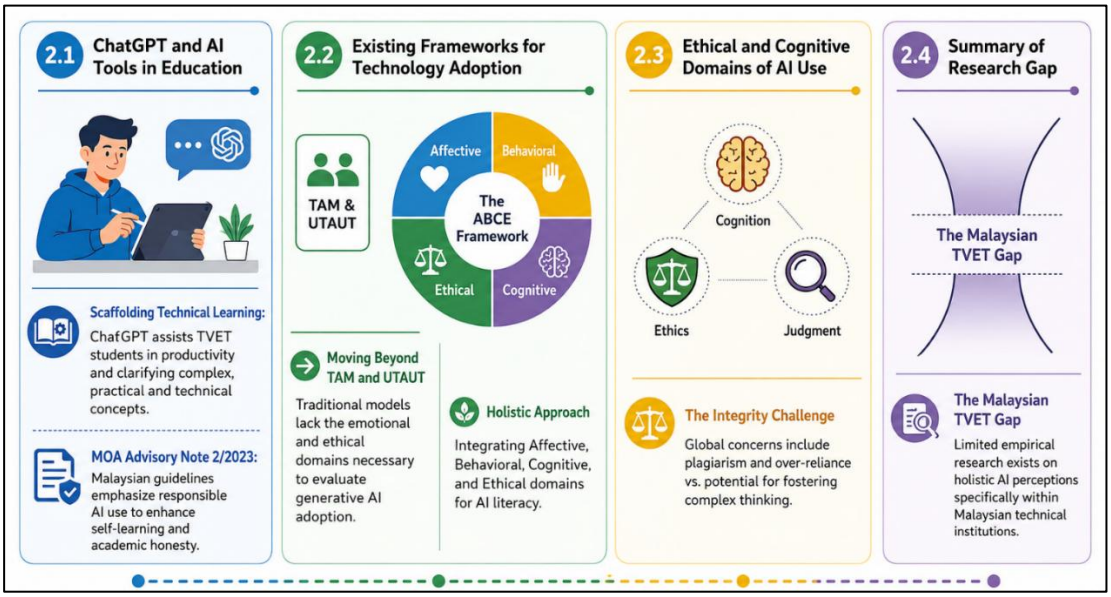

Figure 2. Summary of related works

3. Materials and Methods

3.1 Research Design

This study employs a quantitative, cross-sectional survey design to collect and analyze numerical data at single point in time. It enables the observation of relationships between variable [21]. This design aligns with the study's objectives: i) to measure and analyze the extent of ChatGPT use for academic tasks and problem-solving among TVET students and

ii) to explore their knowledge about ethical issues. The questionnaire and analysis structure were developed using ABCE framework as a guide.

The quantitative approach was chosen to evaluate the adopted frameworks and to study the relations between several variables that allowed the researchers to carry out the study in an effective way [21]. In addition, thematic alignment was used to guarantee a high 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 these were used as variables in the data analysis. The above steps facilitated this study to perform a comparison of a large sample and extrapolate the findings to the general TVET students and to achieve the objective of this study. Moreover, many existing studies have adopted this design, particularly regarding the adoption of educational technology, students' perceptions, and ethical awareness [22], which provides justification to use this design. In addition to this theoretical structure, the items designed were also aligned with the specific thematic constructs of this study, which are ChatGPT usage, problem-solving, and ethical awareness. This double coding allowed the items to be coded both within the psychological domain and with respect to their thematic relevance. The behavioral and affective domains are used to complement each other to measure the usage of ChatGPT. At the same time, the cognitive domain was correlated with the problem-solving abilities, and the ethical domain with the ethical awareness items. Likewise, the focus on the thematic alignment in the design of the educational instrument [21] reflects the construct validity of the instrument and even that the instrument measures what was intended in both theoretical and applied aspects.

3.2 Population and Sample

This study involved a total of 4,723 students from foundation, diploma, and degree courses at Polytechnic Ungku Omar (PUO). An appropriate sample size was ensured by referring to [23], and a range of 354 to 400 respondents was established as satisfactory. A convenience sampling technique was utilized to collect 381 valid responses from accessible students. Although this method facilitated efficient data collection, the reliance on convenience sampling and single-institution data limits the generalizability of the findings. Consequently, it must be explicitly stated that these findings may not accurately represent the broader population of all Malaysian TVET students.

3.3 Research Instrument

A structured questionnaire was designed drawing on the ABCE framework [2]. The instrument was adapted from a prior validation study tailored for the Malaysian TVET context [24]. Content validity was rigorously established via expert review using Aiken's V, culminating in a highly reliable 27-item instrument ($\alpha = 0.945$). The instrument had been previously validated by expert review, Aiken's V assessment, and pilot test [24]. Because this past validation was conducted recently and specifically tailored to the Malaysian TVET context, it provides a strong and reliable foundation for its application in this research. As the instrument's structural integrity has already been established for this specific demographic, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were not performed in the current study [25]. Rather, Cronbach's alpha was used to ensure the reliability of the instrument for the present sample. Thus, the entire sample size was used for the finalized 27-item instrument for the current preliminary study

The survey instrument included structured Likert-scale items grouped into four key sections according to the objectives of the study. The four-point Likert scale was used, with response options: (1) Strongly Disagree; (2) Disagree; (3) Agree; and (4) Strongly Agree. Following the experience and guidance from previous studies, such as [26], which suggested that a four-point Likert scale could be used to gain 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 for the clarity of opinion needed for data interpretation.

3.4 Data Collection Procedure

This study used a self-administered online questionnaire as the method of data collection. This approach allowed for efficient distribution to a wide range of students in an academic setting, where students are digitally connected [27]. The survey link was initially sent by email to the PUO Academic Advisor Coordinators to use systematic dissemination. The coordinators then shared the link with the Department Academic Advisors, who in turn shared it with the Academic Advisors in their respective departments. Lastly, Academic Advisors sent out the survey link to their respective student groups through WhatsApp or Telegram for maximum and optimized outreach to the target population.

The form included an informed consent statement to inform the participants about the purpose of the study, the voluntary nature of participation, and the guarantee of anonymity and confidentiality. Please note that no personally identifiable information was gathered. This procedure adhered to the accepted ethical guidelines for research [28]. Data collection took place from 28th of May to 09th of June 2025, with 392 responses received. As mentioned in Section 3.2, there were 381 valid responses left after data cleaning for the analysis.

3.5 Data Analysis Techniques

Descriptive statistics were used to analyze the collected data. To test the instrument's reliability, the internal consistency of each instrument section was tested using Cronbach's alpha [29]. Table 1 presents the interpretation of Cronbach's alpha values. The responses from the online questionnaire were analyzed quantitatively according to the items in sections B, C, and D. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 21. Table 2 summarizes 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

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

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

RO1 focuses on how students make use of ChatGPT in their academic tasks. The affective domain records students' attitudes, interests, and willingness to use ChatGPT in learning, while the behavioral domain demonstrates the actual frequency, manner, and purpose of their usage (e.g., for assignments, idea generation, or revision). Meanwhile, RO2 investigates the relationship between students' utilization 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 skills. Specifically, this RO investigates how their behavioral usage of ChatGPT is connected to their cognitive engagement in solving academic problems. Moreover, to measure ChatGPT's impact on problem-solving, as it encompasses essential higher-order thinking skills, including analysis, evaluation, reflection, and strategic decision-making, the cognitive component of the ABCE framework was applied [2]. This conceptualization was consistently supported by empirical studies, which highlighted that ChatGPT-generated prompts stimulate metacognitive critique and the development of analytical skills in problem-solving workshops [30]. Similarly, [31] posited that critical evaluation of AI-generated essays enhanced students' cognitive evaluative capabilities. Collectively, these studies justified the inclusion of cognitive-domain items to evaluate the impact of ChatGPT on problem-solving skills. On the other hand, RO3 is directly in tune with the ethical domain, as it explores students' awareness of using AI responsibly, academic honesty, concerns about plagiarism, and adherence to institutional guidelines when using ChatGPT.

Table 3 presents the interpretation of the mean score for the four-point Likert scale. This interpretation framework is adapted from [32], as it was used in their study to evaluate preschool teachers' knowledge, attitudes, and practices toward active learning. The same framework was used in this study to deal with RO1 and ethical awareness in RO3. Items related to frequency, comfort, and attitude towards using ChatGPT were mapped into the affective domain to reveal students' emotional engagement with ChatGPT. This method was proven, and the constant interval interpretation was used to analyze the data of the Likert scale, which was accurate and reliable. The data of the Standard Deviation (SD) are analyzed based on the classification of [33], as shown in Table 4. Respondents were found to have strong agreement when SD values were less than 0.50. Similarly, there was also significant variation when the values were above 1.50.

A Pearson correlation analysis was performed to understand the relationship between students' ChatGPT usage and their problem-solving ability, aiming to answer Research Question 2. This technique is deemed the best fit for assessing the strength and direction of linear relationships between two continuous variables. Table 5 summarizes the interpretation of correlation [34]. Figure 3 depicts the research methodology execution in two main phases. Phase 1 explains the study design and instrumentation, while Phase 2 puts forward 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

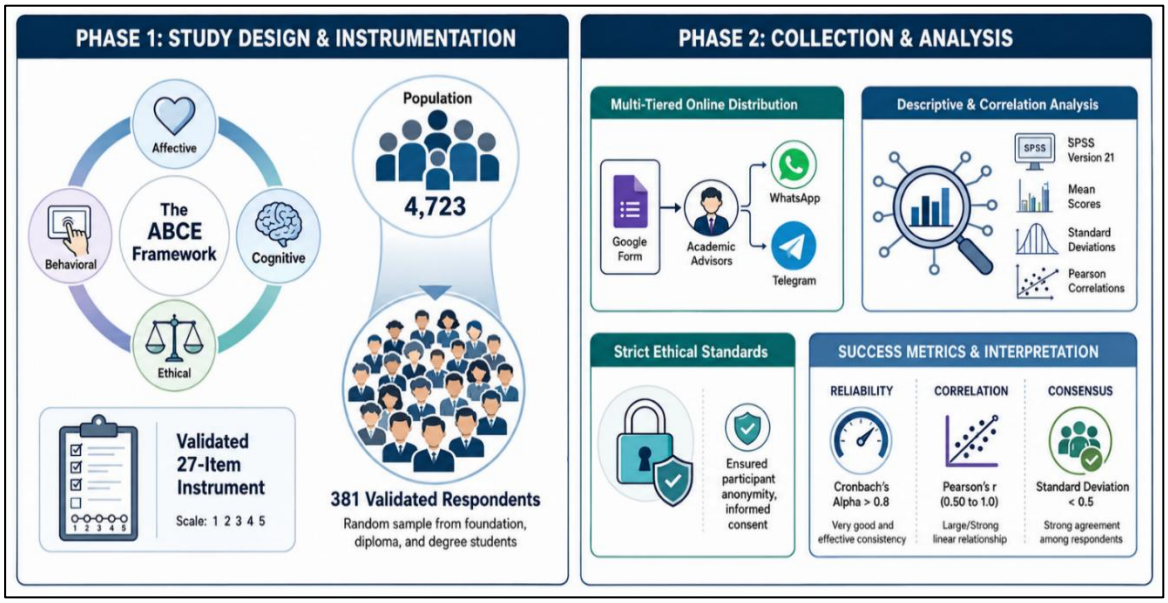

Figure 3. Research design, data collection and analysis overview

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 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 respondents' backgrounds are explained below based on the collected demographic data. The variables were respondents' gender, program level, field of study, and regularity of ChatGPT usage. The findings provide useful preliminary insights into ChatGPT usage among TVET students, but generalization to the wider TVET population should be made cautiously because the data were collected from a single institution. This is the distribution of respondents by gender, age, race, and academic level, as shown in Table 6. From the total of 381 respondents, 227 (60%) were male, and 154 (40%) were female. Most students were Malay (79%), Indian (17%), Chinese (3%), and others (1%). Most respondents (89%) were between the ages of 18 and 22. As for the 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 highest number of participants (144 or 38%). It is followed by Mechanical Engineering 74 (19%), Commerce 45 (12%), Civil Engineering 43 (11%), Mathematics, Science, and Computer 35 (9%), Electrical Engineering 25 (7%), and Marine Engineering 15 (4%). Demographic information was only used in a descriptive manner for this study. It did not, however, explore gender differences, differences by academic level, or differences by field of study, as these differences were not a part of the preliminary investigation.

Table 6. Respondents' 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

To check the internal consistency of the instrument, Cronbach's alpha was computed for each section. As shown in Table 7, the values of each section were higher than the recommended minimum of 0.80 [29], giving a high level of reliability for all sections.

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

4.3 Research Objective 1

The result and discussion of RO1 are as follows, which includes the analysis of the students' responses regarding the use of ChatGPT in academic tasks. As shown in Table 8, the students' utilization of ChatGPT was in the moderate to high range, particularly in comprehending the process of ideation (B1 = 3.31) and advanced concepts (B3 = 3.36). Students, however, showed less dependence on ChatGPT for traditional study methods (B6 = 2.71), showing that students have a traditional learning approach while using ChatGPT.

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 personalized responses.	3.23	0.592
B6	I rely on ChatGPT more than traditional study resources (books, lectures)	2.71	0.785
B7	I use ChatGPT to help edit my writing.	2.86	0.780
B8	I use ChatGPT as a study tool during revisions or exam preparations.	3.13	0.657
B9	I use ChatGPT to clarify instructions or questions in assignments.	3.16	0.624

Both behavioural and affective domains were used to support RO1 and provide a holistic view of students' use of ChatGPT in academic tasks. The behavioral domain depicts actions that can be performed while using ChatGPT, such as idea generation, problem-solving, and content revision, while the affective domain summarises students' attitudes, motivation, and emotional reactions to ChatGPT usage. Based on the analysis, it can be concluded that students actively use ChatGPT in various learning activities. For example, 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) were obtained. In contrast, the findings indicate that, while students broadly use ChatGPT in academic activities, its specific functional role is evident in how often it is used for routine learning activities. The highest mean (M = 3.36, SD = 0.544) for this statement is Item B3, which means students consider ChatGPT as a desirable explanatory tool for clarifying difficult concepts. This further supports that ChatGPT could be a significant figure in a technical context that is usually prevalent in traditional instruction. At the same time, 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 because of the necessity of direct human feedback. On the other hand, the lower mean here reflects the voluntary restriction of AI use for tasks that need to be assessed.

The affective domain of students' responses to ChatGPT generally showed positive emotions. Students recognize 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, like textbooks or class-based instruction. Instead, it is merely an optional instrument. This is evident in a lower mean score for "I rely on ChatGPT more than traditional study" (B6 = 2.71). This is a counterpoint to concerns about overdependence on AI. The SD (0.785) is relatively high, suggesting variation in student attitudes, but this is likely due to variation between departments. This aligns with previous studies by

[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 students in TVET had developed a proper way of using ChatGPT, demonstrating both practical use (behavioral) and emotional awareness (affective) 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.

Further, these results indicate that AI is a working tool and not a mere passive reliance. The main purpose of ChatGPT is to act as a scaffolding tool for cognitive bridging, clarifying more complex technical concepts, not for content creation. This aligns with the conclusions of [35], who claimed students use chatbots to understand difficult coding ideas. Nevertheless, there is a tension between the belief that AI is completely taking over traditional study habits and the decreased scores. Since TVET assessment is a practical and hands-on assessment, students are taking a blended learning approach with AI support but not fully relying on AI and still using the traditional pedagogical materials.

4.4 Research Objective 2

The analysis and discussion of the results of RO2 are presented below with a focus on the relationship between students' use of ChatGPT and their problem-solving abilities. To examine the perceptions and impact of ChatGPT on students' problem-solving skills, descriptive statistics were first employed. As per the findings of Table 9, students generally recognized the use of ChatGPT in improving their problem-solving skills. The highest agreement occurred for C1 (M = 3.18) and C6 (M = 3.18), indicating that ChatGPT assists them in refining complex issues and promoting cognitive diversity. However, there were consistent responses, albeit with some variation: the SD ranged from 0.55 to 0.60, indicating a shared understanding of ChatGPT's function with cognitive tasks and some level of students' experience or confidence. A Pearson correlation analysis was conducted between Section B (ChatGPT Usage - Behavioral 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 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 use ChatGPT to generate different approaches to solving a problem.	3.17	0.557
C4	Using ChatGPT has improved my critical thinking skills in problem-solving.	3.17	0.557
C5	ChatGPT encourages me to approach problems from different perspectives.	3.18	0.591
C6	Using ChatGPT gives me relevant tech skills for the current job market.	3.09	0.608

4.5 Research Hypothesis

H_1: There is a significant positive relationship between students' utilization of ChatGPT and their problem-solving abilities.

H_0: There is no significant relationship between students' utilization of ChatGPT and their problem-solving abilities.

Table 10 depicts a significant positive correlation between ChatGPT use and students' problem-solving abilities ($r = 0.729$, $p < 0.01$), suggesting that students have greater confidence in 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, positing a positive correlation between higher self-reported problem-solving skills and increased usage of ChatGPT.

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 correlation analysis was employed to determine the association between students' use of ChatGPT (Behavioral and Affective domain – Section B) and their self-reported problem-solving ability (Cognitive domain – Section C). ChatGPT assists students in cognitive processes like comprehending questions, brainstorming ideas, and improving answers. This is attributed primarily to the fact that the real-time interactivity may help to develop metacognition as the user can explore multiple points of view and enhance their reasoning. In addition, there is a Pearson correlation coefficient of 0.729 ($p < 0.01$) that shows a strong positive relationship. In other words, there is a correlation between increased cognitive performance and students' attitudes, analysis, and problem solving in solving academic problems when they are more engaged with ChatGPT. Furthermore, the alternative hypothesis, consistent with the findings, posits that there is a positive correlation between the improvement of students' problem-solving skills and the increase in their use of ChatGPT. Interestingly, such results are consistent with the cognitive aspect of the ABCE framework, relating to the skills of understanding, reasoning, and solution finding. Responses from students for the items of Section C, including the use of ChatGPT to decompose complex problems (C1), to develop alternative ways of solving the problem (C3), and to complete the problem through critical thinking (C5), show that ChatGPT encourages cognitive processes. For example, students indicate in their responses in Section B that they interact behaviourally with ChatGPT to enable this development. The findings are like those reported in [35], that AI tools like ChatGPT can boost the cognitive engagement of learners and help them to decompose problems and think in reflection. On this basis, [31] continued to argue 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 behavioral engagement and perceived cognitive development. This is corroborated by [19], who argue for the development of active learning by means of a dialogue with generative AI. However, due to the cross-sectional design, no causal inferences can be made. Students' problem-solving skills were improved (C1; M = 3.18) but were measured using a self-reported measure. [31] found no significant difference between the essays produced by AI and those produced by students, suggesting that the 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, yet further longitudinal or experimental studies are warranted to explore this association.

4.6 Research Objective 3

This sub-section presents the findings and provides a discussion of the results (RO3), which analyzes the students' perceptions of the ethical awareness in using ChatGPT. Table 11 shows the moderate to high level of ethical awareness recorded among the students using ChatGPT. Most students know about the need to rework and know the difference between learning support and cheating. However, there was a lack of formal training, as denoted by D12 (M = 2.92), which could represent a gap in institutional support.

A moderate to high level of ethical awareness was found among the students. The means for ethical understanding are consistently high, reflecting the 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). There is a worrying illusion of competence, with a difference of 0.53 points, where students think they know more about ethical use than they are taught. In addition, a high difference 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 be a failing institutional ChatGPT ethics education. This is in line with the findings by [1], that positive attitudes do not guarantee effective or ethical adoptions. This creates opportunities for further research into institutional gaps, with [2] noting the necessity of AI literacy and ethical training in education to avoid exploitation and promote responsible use. Conversely, even if students know about the potential dangers (e.g., plagiarism, misinformation), they could be supported by formal awareness campaigns or policy dissemination initiatives from academic institutions.

Overall, the results show that institutions need to take proactive action. They should address the gap between basic awareness and responsible ethical practice. 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 the curriculum.

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 check 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.	3.24	0.697
D4	I always review and verify the information provided by ChatGPT based on my learning and experience before using it in my academic work.	3.30	0.577
D5	I understand ChatGPT is a learning support, 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 in academic tasks.	3.38	0.593
D7	I believe 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 like ChatGPT.	3.19	0.575
D10	I am aware that ChatGPT could interpret my question wrongly, which will end up giving the wrong answer/solution.	3.30	0.595
D11	I have received training on using ChatGPT effectively and ethically in education.	2.92	0.728
D12	I think 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 engage with ChatGPT using the ABCE framework. Students showed moderate to high behavioral 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' reported confidence in solving problems. This suggests that ChatGPT may support cognitive learning. Although students were generally aware of accuracy problems and possible misuse, institutional support for AI ethics was limited. This reflects a major gap in formal AI education.

This study adds to the literature by applying the ABCE framework in a Malaysian TVET setting. The findings show that affective and behavioral factors are closely linked to perceived cognitive outcomes. These dimensions do not operate separately. The results therefore support the use of the ABCE framework for studying engagement with AI tools in technical and vocational education. They also help educators understand how students use generative AI.

This study has several limitations. First, all data were collected through self-reported questionnaires at one point in time. This may have caused common method bias (CMB). Second, the cross-sectional design does not allow firm conclusions about whether ChatGPT use causes improvements in problem-solving. Third, convenience sampling was used, and the data came from only one institution. These factors limit the generalizability of the findings. Therefore, the results may not represent all Malaysian TVET students.

Future studies should include more institutions and a wider range of students. This would improve the generalizability of the findings. Longitudinal or experimental designs should also be used to examine whether AI tool use 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 also recommended to further confirm the findings.

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The authors declare no conflicts of interest.

CRediT Author Contribution Statement

Mariadass, M: Conceptualization; Methodology; Validation; Writing - original draft; review and editing; Infographic.
Lim, Y.C; Formal analysis; Visualization.
Raja Gobal, N; Literature synthesis - Related Works; Methodology refinement; Results interpretation; Discussion; Writing – review & editing.

Availability of Data and Materials

Data sharing is not applicable to this article as no new datasets were generated or analyzed in this study.

Ethics Statement

This study did not involve human participants or animal subjects. Ethical approval was therefore not required for this research.

Generative Artificial Intelligence Disclosure

No generative artificial intelligence tools were used in the preparation of this manuscript. All intellectual content is original and solely attributable to the authors.

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