
Empowered by AI: Investigating the Role of AI Tools in Fostering Self-Directed Learning and Motivation among TVET Students

Azrul Nizah binti Yussof, Nor Analiza binti Che Khalid, and Saadiah binti Mohamad

Department of Information and Communication Technology,
Politeknik Sultan Abdul Halim Muadzam Shah (POLIMAS), Kedah

Abstract: The rapid integration of artificial intelligence (AI) tools in higher education has extended beyond task assistance to influencing students' learning behaviours and motivation. In Technical and Vocational Education and Training (TVET), where independent problem-solving and technical competence are essential, understanding the developmental role of AI tools is increasingly important. This study investigates how AI tools contribute to self-directed learning and learning motivation among TVET students. A qualitative case study design was employed involving ten Semester 5 Information Technology students in a Malaysian polytechnic. Data were collected through semi-structured interviews, reflective journals, and document analysis. Thematic analysis revealed two overarching themes. First, AI tools strengthened self-directed learning processes, particularly in planning, monitoring, and autonomous task execution. Second, AI usage enhanced students' motivational states, including increased confidence, greater persistence, and reduced anxiety during technical challenges. While minor risks of over-reliance exist, students demonstrated controlled AI usage. Findings suggest AI functions as a developmental enabler in TVET learning environments.

Keywords: Artificial intelligence; Self-directed learning; Motivation; TVET; Qualitative research

1. INTRODUCTION

The rapid development of artificial intelligence (AI) tools has significantly influenced teaching and learning practices in higher education. Applications such as ChatGPT and Copilot are widely used to generate explanations, support writing tasks, and assist with programming activities (Kasneji et al., 2023). In technical disciplines, these tools demonstrate strong capabilities in code generation, debugging assistance, and conceptual clarification, providing immediate support during complex problem-solving tasks (Prather et al., 2023; Becker et al., 2023). As AI tools become more accessible, their role is expanding beyond task completion towards shaping how students learn, think, and engage with academic work.

Within Technical and Vocational Education and Training (TVET), learning is strongly competency-based and project-oriented, requiring students to independently manage assignments, solve practical problems, and complete technical projects (Tuenpusa et al., 2022). Such learning environments place strong emphasis on self-directed learning, which involves learners taking initiative in planning, monitoring, and evaluating their own learning processes (Knowles, 1975). At the same time, sustained motivation is essential, particularly when students face complex programming challenges and iterative debugging tasks. From the perspective of Self-Determination Theory, motivation is closely linked to the fulfilment of autonomy and competence, which influence students' persistence and engagement in learning activities (Ryan & Deci, 2000; Chang et al., 2024).

Recent studies indicate that AI tools can support learning by providing immediate feedback, structured explanations, and step-by-step guidance (Chang et al., 2024). These features may

reduce uncertainty and help students navigate challenging technical tasks more effectively. As a result, AI tools are not only associated with improved task efficiency but also with enhanced confidence and sustained engagement (Zhang & Xu, 2025). However, despite the growing body of research on AI in higher education, much of the existing literature has primarily focused on students' perceptions, technology acceptance, or performance outcomes (Zawacki-Richter et al., 2019).

Less attention has been given to how AI tools influence deeper learning processes, particularly the development of self-directed learning behaviours and motivation within applied and competency-based contexts such as TVET. Existing studies rarely examine how AI supports learners in managing their own learning processes or sustaining motivation when facing technical challenges. This represents a critical gap, as understanding these developmental dimensions is essential to ensure that AI functions as a supportive learning tool that strengthens autonomy and competence rather than fostering dependency.

Addressing this gap, the present study investigates the role of AI tools in fostering self-directed learning and motivation among TVET students. By focusing on these developmental aspects, this study contributes to a more nuanced understanding of AI-assisted learning in technical education and provides context-specific insights into how AI can support independent and motivated learning in competency-based environments.

Research Objectives

1. To explore how AI tools influence self-directed learning among TVET students.
2. To examine how AI tool usage affects students' learning motivation within a technical and project-based learning environment.

Research Questions

1. How does the use of AI tools influence self-directed learning among TVET students?
2. How does AI tool usage affect students' learning motivation?

2. LITERATURE REVIEW

2.1 AI in Technical Education

The integration of artificial intelligence (AI) in higher education has expanded rapidly, particularly with the emergence of generative AI tools capable of producing text, code, and interactive feedback (Zawacki-Richter et al., 2019; Kasneci et al., 2023). In computer science and Information Technology programmes, these systems demonstrate strong capabilities in code generation, automated feedback, and debugging support (Prather et al., 2023; Becker et al., 2023). While existing studies consistently highlight the efficiency and performance benefits of AI-assisted learning, much of the discussion remains centred on functional outcomes rather than developmental learning processes.

Within Technical and Vocational Education and Training (TVET), learning is inherently applied and competency-based, requiring students to engage in problem-solving, project development, and independent task management (Tuenpusa et al., 2022). In such contexts, the role of AI extends beyond productivity enhancement. AI tools may influence how students approach learning tasks, regulate their progress, and sustain engagement during complex technical activities. However, current literature provides limited insight into how these tools shape students' learning behaviours within authentic, practice-based environments, highlighting the need for more context-specific investigation.

2.2 AI and Self-Directed Learning

Self-directed learning (SDL) refers to the process in which learners take initiative in planning, monitoring, and evaluating their own learning (Knowles, 1975). These processes are particularly critical in technical education, where students must iteratively solve problems, debug errors, and refine solutions independently. From this perspective, SDL represents not only a learning strategy but also a key competency in preparing students for real-world technical tasks.

AI tools can be conceptualised as cognitive supports that potentially facilitate SDL processes. Empirical studies suggest that AI-generated explanations and step-by-step guidance may assist learners in structuring tasks and clarifying misunderstandings (Chang et al., 2024). In programming contexts, AI-assisted systems have been shown to support problem decomposition and conceptual understanding (Prather et al., 2023). These affordances indicate that AI may enhance planning and monitoring processes, which are central components of SDL.

However, the relationship between AI usage and SDL remains complex. While AI may scaffold learning processes, concerns have been raised regarding potential over-reliance, where excessive dependence on automated responses may reduce opportunities for independent thinking (Cotton et al., 2024). This suggests a need to critically examine whether AI strengthens or inadvertently constrains self-directed learning behaviours. Despite growing interest in AI-supported learning, there is still limited empirical evidence, particularly from qualitative perspectives, on how learners actively regulate their learning when using AI tools in real academic contexts.

2.3 AI and Learning Motivation

Motivation is a central factor in sustaining engagement, particularly in technical learning environments characterised by complexity and iterative problem-solving. Self-Determination Theory (SDT) posits that motivation is enhanced when individuals experience autonomy, competence, and relatedness (Ryan & Deci, 2000). In programming education, autonomy and perceived competence are especially important in influencing persistence when students encounter challenging tasks.

Recent empirical studies suggest that AI tools may positively influence motivational states

by providing immediate feedback, accessible explanations, and continuous support (Chang et al., 2024; Zhang & Xu, 2025). These features can reduce uncertainty, enhance perceived competence, and encourage students to persist in completing tasks. In this sense, AI tools may contribute to the fulfilment of key SDT needs, particularly competence and autonomy.

Nevertheless, existing research tends to emphasise surface-level outcomes such as engagement and satisfaction, with less attention given to how AI interacts with deeper motivational processes. Furthermore, the majority of studies rely on quantitative approaches, which may not fully capture the nuanced ways in which students experience motivation during AI-assisted learning. This highlights the need for qualitative inquiry to better understand how AI influences both emotional and behavioural dimensions of motivation in applied learning contexts.

2.4 Research Gap in TVET Context

Although research on AI in higher education continues to expand, much of the existing literature focuses on technology adoption, usability, or general perceptions (Zawacki-Richter et al., 2019). Comparatively fewer studies examine how AI tools influence deeper learning processes, particularly self-directed learning and motivation, within competency-based environments such as TVET.

Moreover, there is a lack of qualitative evidence that explores how students integrate AI tools into their actual learning practices, especially in managing technical coursework and project-based tasks. Given that TVET education emphasises hands-on skills, independent problem-solving, and industry readiness, understanding how AI supports the development of autonomy, competence, and sustained engagement is crucial.

Addressing these gaps, the present study investigates how AI tools foster self-directed learning and motivation among TVET students. By integrating perspectives from Self-Directed Learning and Self-Determination Theory, this study provides a more comprehensive understanding of the developmental role of AI in technical education and directly addresses the research questions concerning learning processes and motivational outcomes.

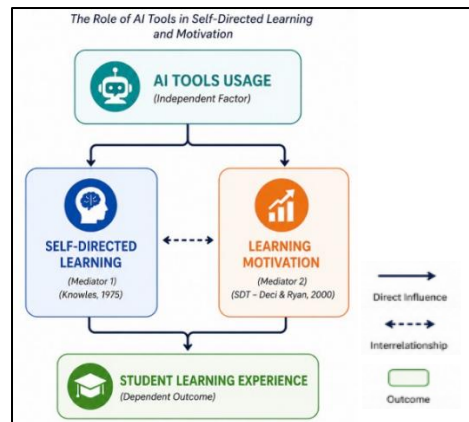


Figure 1: Conceptual Framework of AI-Supported Self-Directed Learning and Motivation

The conceptual framework illustrates in Figure 1 shows that AI tools usage as a key influencing factor in shaping students' learning processes within a TVET context. Grounded in existing literature, AI tools are proposed to support two interrelated dimensions, namely self-directed learning and learning motivation. Self-directed learning, based on Knowles (1975), reflects learners' ability to plan, monitor, and regulate their learning, particularly in managing complex and iterative technical tasks. At the same time, learning motivation, informed by Self-Determination Theory (Deci & Ryan, 2000), represents students' engagement, persistence, and perceived competence when interacting with AI-supported learning environments. These two dimensions are conceptually linked, as effective self-regulation may reinforce motivation, while sustained motivation supports continued engagement in self-directed processes. Collectively, these dimensions contribute to the overall student learning experience, highlighting the developmental role of AI tools beyond mere task completion in technical education contexts.

3. METHODOLOGY

3.1 Research Design

This study employed a qualitative case study design to explore how AI tools influence self-directed learning and motivation among TVET students. A case study approach was selected to enable an in-depth investigation of students' experiences within a bounded educational context, focusing on a specific group of learners engaged in a shared academic environment. The study emphasised understanding behavioural and motivational dimensions of AI usage rather than measuring performance outcomes.

The research was conducted in a Malaysian polytechnic involving Semester 5 Information Technology students enrolled in a project-based semester. At this stage, students were actively engaged in technical coursework, including programming, system development, and Final Year Project (FYP) preparation. This context provided a relevant setting for examining AI usage, as students were required to independently manage complex tasks, solve technical problems, and

complete project deliverables. The qualitative design enabled a rich exploration of students' learning processes, decision-making, and reflections on AI-assisted learning.

3.2 Participants and Sampling

The study involved ten Semester 5 Information Technology students selected through purposive sampling. This sampling approach was used to ensure that participants possessed relevant experience with AI tools and could provide rich, information-rich insights aligned with the research objectives. Participants were selected based on the following criteria:

- (i) active use of AI tools such as ChatGPT, Gemini, or Copilot in academic tasks,
- (ii) enrolment in programming or project-based courses during the semester, and
- (iii) willingness to participate in interviews and complete reflective journals.

The selected participants represented a relatively homogeneous group in terms of academic background (IT programme and semester level), while still allowing variation in individual AI usage practices. This ensured both relevance and depth in the data collected. To maintain confidentiality and ethical standards, all participants were anonymised and identified using codes (P1 to P10) throughout the study as shown in the Table 1 below.

Table 1
Participant's Profile

Participant ID	Gender	Age	Programme	Semester
P1	Female	21	Diploma in IT	Semester 5
P2	Female	21	Diploma in IT	Semester 5
P3	Male	21	Diploma in IT	Semester 5
P4	Male	21	Diploma in IT	Semester 5
P5	Male	22	Diploma in IT	Semester 5
P6	Male	21	Diploma in IT	Semester 5
P7	Male	21	Diploma in IT	Semester 5
P8	Male	21	Diploma in IT	Semester 5
P9	Male	22	Diploma in IT	Semester 5
P10	Male	21	Diploma in IT	Semester 5

3.3 Data Collection

Data were collected using three qualitative methods to enable triangulation and provide a comprehensive understanding of students' experiences. Semi-structured interviews were conducted individually to explore students' perceptions, experiences, and reflections regarding AI tool usage in their learning processes. The interviews allowed flexibility for participants to elaborate on their experiences while ensuring alignment with the research focus.

Reflective journals were collected at three stages of the semester (early, mid, and final). These structured reflections captured the evolution of students' experiences, including how their use of AI tools developed over time, as well as changes in their learning strategies and motivation. Document analysis was conducted on academic artefacts such as AI-assisted coding outputs, logbooks, and assignment drafts.

These documents provided direct evidence of how AI tools were applied in real task execution, allowing the study to move beyond self-reported data. The use of multiple data sources enabled triangulation, strengthening the credibility of the findings through cross-verification across interviews, reflections, and documented practices.

3.4 Data Analysis

Data were analysed using thematic analysis following the six-phase framework proposed by Braun and Clarke (2006). This approach was chosen for its flexibility in identifying patterns across qualitative data.

First, all interview transcripts, reflective journals, and documents were read repeatedly to achieve data familiarisation. Second, initial codes were generated inductively from the data, focusing on patterns related to self-directed learning and motivation. Third, these codes were systematically organised into potential themes. Fourth, themes were reviewed and refined to ensure coherence and alignment with the dataset. Fifth, themes were defined and clearly named to represent key patterns observed across participants. Finally, the findings were reported with supporting evidence from multiple data sources.

Through this iterative process, two overarching themes emerged:

- (1) AI tools and self-directed learning, and
- (2) AI tools and learning motivation,

each comprising several subthemes that reflect behavioural and motivational dimensions of AI usage.

3.5 Trustworthiness and Credibility

Several strategies were employed to ensure the trustworthiness and credibility of the study.

First, data triangulation was achieved through the use of multiple data sources, including interviews, reflective journals, and document analysis, allowing cross-validation of findings. Second, prolonged engagement with the data, through repeated reading and iterative coding, enhanced the depth and accuracy of interpretation. Third, peer debriefing was conducted by reviewing coding and theme development to ensure consistency and reduce researcher bias. Fourth, thick descriptions were provided in the findings through the inclusion of direct participant quotations, enabling readers to understand the context and meaning of the data.

Finally, an audit trail was maintained throughout the research process, documenting decisions related to data collection, coding, and theme development. These measures collectively enhanced the credibility, dependability, and transparency of the qualitative findings. A summary of the research methodology is presented in Table 2 below.

Table 2
Summary of Methodology

Aspect	Description
Research Design	Qualitative case study design focusing on behavioural and motivational dimensions of AI usage
Research Setting	Malaysian polytechnic (TVET), Semester 5 Information Technology students in project-based learning environment
Participants	10 students selected via purposive sampling (active AI users, enrolled in technical courses)
Data Collection	Semi-structured interviews, reflective journals (3 stages), and document analysis
Data Analysis	Thematic analysis using Braun & Clarke (2006) six-phase approach
Trustworthiness	Triangulation, peer debriefing, audit trail, and use of rich participant quotations

4. ANALYSIS AND FINDINGS

Data were analysed using thematic analysis following Braun and Clarke (2006). Interview transcripts, reflective journals, and document artefacts were repeatedly reviewed to achieve data familiarisation. Initial codes were generated inductively and subsequently organised into broader themes aligned with the research questions. Through this process, two overarching themes were identified: (1) AI tools and self-directed learning, and (2) AI tools and learning motivation. Subthemes were developed to capture recurring behavioural and motivational patterns across participants. Findings are supported by triangulated data from semi-structured interviews, reflective journals, and document analysis involving ten TVET students (P1–P10).

4.1 AI Tools and Self-directed Learning

Analysis addressing RQ1 generated one overarching theme, *AI Tools and Self-Directed Learning*, comprising four interrelated subthemes: (i) planning and structuring learning, (ii) monitoring and understanding, (iii) autonomy and responsibility, and (iv) emerging risk of over-reliance. Collectively, these subthemes illustrate how AI tools function as cognitive supports that shape how students organise tasks, regulate understanding, and balance independence with technological assistance.

4.1.1 Planning and Structuring Learning

Students consistently described AI as a tool for organising ideas, outlining assignments, and structuring learning tasks before execution.

P7 stated, *“To assist and give me an outline of how to complete my assignment.”* (Reflective Journal, P7). Similarly, P3 noted, *“AI helps me organize my ideas and understand the steps that need to be taken before starting the assignment.”* (Reflective Journal, P3).

Document artefacts further support this pattern, showing AI being used to structure system configuration proposals (P2) and organise user testing results into formal reports (P7). Across participants, AI was not merely used to complete tasks, but to clarify task requirements and sequence actions more systematically. This suggests that AI plays a facilitative role in the *planning dimension* of self-directed learning by helping students externalise and structure their thinking before task execution.

4.1.2 Monitoring and Understanding

The second subtheme highlights AI’s role in facilitating ongoing monitoring of comprehension and immediate clarification of difficulties.

P1 explained, *“Previously, if we did not understand something, we would keep the question and wait until the following week to ask the lecturer. Now that we have AI, we can ask immediately and receive instant clarification.”* (Interview, P1). P2 described a strategic approach, *“Before using AI, I will read the notes first. If I am still stuck, then I will use AI.”* (Interview, P2).

Reflective journal data reinforce this evaluative process. P2 stated, *“AI enhances my learning by providing accurate explanations that I can compare with my own understanding.”* (Reflective Journal, P2). Document artefacts also demonstrate AI assisting in troubleshooting Laravel database issues and servlet coding structures (Document Analysis, P6; P9).

These patterns indicate that AI supports *metacognitive monitoring*, enabling students to verify understanding, identify gaps, and refine knowledge in real time without interrupting task progression. Importantly, students demonstrated selective and purposeful use of AI rather than passive dependence.

4.1.3 Autonomy and Responsibility

Despite extensive AI usage, students emphasised that AI functions as guidance rather than a substitute for independent thinking.

P1 stated, “*I feel more independent than dependent because AI is a supporting tool, not a replacement for my own thinking.*” (Interview, P1). Similarly, P8 reflected, “*When using artificial intelligence, it only guides me. I still need to think and modify the answer myself.*” (Reflective Journal, P8). P7 acknowledged adjusting AI responses: “*AI guided me, but I had to adjust the answer based on my own project requirements.*” (Reflective Journal, P7).

Document analysis supports this claim, showing students independently implementing and testing solutions after receiving AI guidance (P9). Across participants, AI was positioned as a *supporting mechanism rather than a decision-maker*, indicating that autonomy was not diminished but instead operationalised through guided independence. This reflects a balanced interaction where students retain responsibility for final outputs.

4.1.4 Emerging Risk of Over-Reliance

Although AI was generally perceived as supportive, limited indications of dependency emerged. P1 admitted that “*Without AI, my work will not be completed on time.*” (Reflective Journal, P1). P4 similarly reflected that “*Sometimes I rely too much on AI to complete my assignments quickly.*” (Reflective Journal, P4).

These statements suggest that although AI enhances efficiency, there is a potential risk of over-reliance, particularly under time pressure. However, this tendency was not dominant across participants. Most students demonstrated awareness of the need to balance AI usage with independent effort. This indicates that dependency is *situational rather than habitual*, highlighting the importance of guided and reflective AI use in learning environments.

4.2 AI Tools and Learning Motivation

Analysis addressing RQ2 generated one overarching theme, *AI Tools and Learning Motivation*, consisting of four subthemes: (i) increased confidence and competence, (ii) reduced anxiety and frustration, (iii) task persistence and completion, and (iv) sustained engagement

and professional growth. These findings illustrate how AI tools influence both emotional and behavioural aspects of students' motivation.

4.2.1 Increase Confidence and Competence

Students reported enhanced confidence after using AI to clarify technical concepts and refine academic work.

P1 shared, *"I feel more confident and curious when I understand a topic better."* (Interview, P1). Reflective journal data further highlight this shift. P6 noted, *"Yes, my perception of AI has changed because it helps me feel more confident in my answers."* (Reflective Journal, P6).

Document evidence shows AI assisting in clarifying servlet coding and backend logic (P9), reinforcing skill development. Across participants, improved understanding was closely linked to increased confidence, suggesting that AI contributes to perceived competence, which is a key driver of motivation.

4.2.2 Reduced Anxiety and Frustration

AI tools were frequently described as reducing stress during complex technical tasks. P4 reflected, *"AI helps me when I am unsure about an answer, so I feel less stressed."* (Reflective Journal, P4). P2 stated, *"Now that we have AI, I feel less demotivated because we have guidance."* (Interview, P2).

Document evidence demonstrates AI providing step-by-step debugging support (P4; P6). Immediate clarification appears to reduce frustration and prevent cognitive overload. This suggests that AI functions as an emotional support mechanism that stabilises students' learning experiences during challenging tasks.

4.2.3 Task Persistence and Completion

AI usage was associated with sustained effort and improved task completion. P7 explained, *"It greatly guided me in answering questions during difficult assignments."* (Reflective Journal, P7). P3 observed, *"The use of AI tools has had a positive impact on my motivation to learn."* (Reflective Journal, P3). Interview data further illustrate emotional reinforcement. P9 stated, *"When I get the answer, I feel relieved and happy because it makes the work easier."* (Interview, P9).

These responses indicate that AI reduces cognitive barriers and supports continuous engagement. Rather than abandoning tasks, students are more likely to persist when supported

by immediate guidance, suggesting that AI enhances behavioural motivation through sustained effort.

4.2.4 Sustained Engagement and Professional Growth

Beyond immediate task completion, AI contributed to broader academic and professional development.

Document artefacts reveal AI being used to refine FYP logbooks (Document Analysis, P3), structure proposals (Document Analysis, P2), and resolve backend development issues (Document Analysis, P6; P9).

These patterns suggest that AI tools support sustained engagement within the applied and project-based TVET learning environment.

4.3 Summary of Findings

Across the triangulated data, AI tools are systematically embedded in students' academic practices. Within this TVET context, AI tools:

- (i) Support planning and task organisation
- (ii) Enable real-time monitoring and understanding
- (iii) Promote autonomy and responsibility
- (iv) Enhance confidence and perceived competence
- (v) Reduce anxiety during technical challenges
- (vi) Sustain engagement and persistence

While minor concerns regarding over-reliance exist, students generally demonstrate reflective and controlled use of AI tools. Overall, the findings indicate that AI tools play a significant role in supporting both self-directed learning processes and learning motivation among TVET students.

Table 3
 Summary of Themes, Subthemes and Supporting Evidence

Theme	Subtheme	Description	Evidence (Participants)
AI Tools and Self-Directed Learning	Planning and Structuring Learning	AI supports task organisation, idea structuring, and outlining assignments.	P2, P3, P7

AI Tools and Self-Directed Learning	Monitoring and understanding	AI enables real-time clarification and supports verification of understanding.	P1, P2, P6, P9
AI Tools and Self-Directed Learning	Autonomy and Responsibility	Students use AI as guidance while maintaining independent thinking.	P1, P7, P8, P9
AI Tools and Self-Directed Learning	Emerging Risk of Over-Reliance	Some dependency observed, particularly under time pressure.	P1, P4
AI Tools and Learning Motivation	Increased Confidence and Competence	AI enhances confidence through better understanding of concepts.	P1, P6, P9
AI Tools and Learning Motivation	Reduced Anxiety and Frustration	AI reduces stress by providing immediate guidance and clarification.	P2, P4, P6
AI Tools and Learning Motivation	Task Persistence and Completion	AI supports sustained effort and task completion.	P3, P7, P9
AI Tools and Learning Motivation	Sustained Engagement and Professional Growth	AI contributes to continuous engagement and development in projects.	P2, P3, P6, P9

As summarized in Table 3, these findings are organized into two overarching themes: self-directed learning and learning motivation, each comprising several subthemes supported by evidence from multiple participants. The table provides a structured overview that links the identified themes, their descriptions, and corresponding participant evidence, reinforcing the consistency of patterns observed across the dataset.

5. CONCLUSION & RECOMMENDATIONS

This study examined the role of AI tools in fostering self-directed learning and motivation among TVET students within a competency-based technical environment. The findings indicate that AI tools function not merely as task-support technologies but as developmental enablers that influence how students plan, monitor, and regulate their learning. Students demonstrated the ability to organise assignments, clarify complex programming concepts, and independently refine their work with AI assistance. These patterns align with key principles of self-directed learning, particularly in terms of planning, monitoring, and learner autonomy. Within applied TVET contexts, where independent problem-solving is essential (Tuenpusa et al., 2022), AI tools appear to support rather than replace students' active engagement when used reflectively.

In addition to behavioural development, AI usage was associated with enhanced motivation.

Participants reported increased confidence, reduced anxiety during technical challenges, and sustained persistence in completing assignments. These findings reflect elements consistent with Self-Determination Theory, particularly perceived competence and autonomy (Ryan & Deci, 2000). Emerging research similarly suggests that AI tools may enhance engagement and confidence through timely feedback and structured guidance (Chang et al., 2024; Zhang & Xu, 2025). While minor indications of over-reliance were observed, most students demonstrated awareness of the need to balance AI assistance with independent effort.

Based on these findings, several practical recommendations can be proposed. First, educators in TVET settings should integrate AI literacy into coursework, guiding students on responsible and reflective AI usage. Rather than restricting AI tools entirely, structured integration strategies can help ensure that AI supports cognitive development and autonomy. Second, instructional design should emphasise critical thinking and task modification, encouraging students to evaluate and adapt AI-generated outputs rather than accept them passively. Finally, institutional policies should frame AI as a learning support mechanism that enhances competence and sustained engagement, consistent with broader discussions on AI integration in higher education (Zawacki- Richter et al., 2019).

Overall, this study contributes qualitative insight into the developmental implications of AI adoption in TVET education. By focusing on self-directed learning and motivation, the findings highlight the potential of AI tools to strengthen autonomy, competence, and persistence within project-based technical learning environments when integrated thoughtfully and responsibly.

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