
From Prompt to Practice: A Case Study of Generative AI Tool Integration among TVET Students at POLIMAS

Nurbaya binti Ghazali, Salehah binti Omar and Noorheeza binti Mohd Zaidin

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

Abstract: The rapid advancement of generative artificial intelligence (GenAI) tools such as ChatGPT and GitHub Copilot has reshaped learning practices in higher education. While much existing research focuses on students' perceptions and technology acceptance through quantitative approaches, limited qualitative evidence examines how GenAI tools are embedded within students' actual academic workflows, particularly in Technical and Vocational Education and Training (TVET) contexts. Addressing this gap, this qualitative case study investigates how Semester 5 Information Technology students at Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS) integrate GenAI tools into their academic routines. Data were collected through semi-structured interviews, reflective journals, and document analysis. The data were analysed using thematic analysis. Findings indicate that GenAI tool functions as an embedded learning companion within iterative academic workflows, supporting both writing-based and technical programming tasks. Importantly, students demonstrate regulatory awareness by verifying outputs, manually testing solutions, and adapting AI-generated responses to meet task requirements. This study provides context-specific insight into GenAI tool integration within Malaysian polytechnic education and highlights the importance of structured AI literacy in competency-based TVET environments.

Keywords: Artificial Intelligence, Generative AI, Technology-Enhanced Learning, TVET, AI Literacy

1. INTRODUCTION

The emergence of generative artificial intelligence (GenAI) has significantly transformed higher education, reshaping teaching practices and student learning experiences (Ogunleye et al., 2024; Zawacki-Richter et al., 2019). GenAI tools such as ChatGPT, Gemini, and GitHub Copilot demonstrate advanced capabilities in generating text, producing code, and providing interactive feedback, thereby influencing academic productivity and engagement (Baidoo-Anu & Owusu Ansah, 2023; Dwivedi et al., 2023; Kasneci et al., 2023). While students widely adopt these tools, their integration raises pedagogical and ethical concerns, including academic integrity, misinformation, technological dependence, and the need for assessment redesign (Cotton et al., 2024; Grassini, 2023).

Within computer science and IT education, GenAI supports code generation, debugging, and conceptual clarification, shifting learning beyond syntax memorisation toward problem-solving and analytical reasoning (Becker et al., 2023; Chang et al., 2024; Prather et al., 2023). However, excessive reliance on large language models may undermine independent skill development, highlighting the importance of balanced integration (Jošt et al., 2024). GenAI has also been conceptualised as a cognitive scaffold that supports self-regulated learning by providing accessible and low-risk help-seeking environments (Penney et al., 2025).

Nevertheless, increased usage may simultaneously enhance academic confidence while intensifying technological dependence if not accompanied by regulatory awareness (Zhang & Xu, 2025).

Despite the expanding literature on AI in higher education and STEM disciplines (Ilić et al., 2024), limited research examines how GenAI is embedded within real academic workflows in Technical and Vocational Education and Training (TVET) contexts. Much existing research relies on quantitative surveys focusing on perception and acceptance, with fewer qualitative investigations into workflow-level integration in applied, competency-based environments. Addressing this gap, this study explores how IT students at Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS) integrate GenAI tools into daily academic routines. Through a qualitative case study approach, the research examines workflow integration and regulatory practices within a Malaysian polytechnic context.

Research Objectives

- To investigate the patterns of GenAI tool integration within TVET students' academic workflows.
- To analyse the range of academic tasks for which GenAI tools are utilised in applied technical education.
- To examine how students regulate their use of AI tools during learning activities.

Research Questions

1. How do TVET students at POLIMAS integrate GenAI tools into their academic workflows?
2. What types of academic tasks are supported by GenAI tools?
3. How do students regulate their use of GenAI tools within their learning processes?

2. LITERATURE REVIEW

2.1 Generative AI in Higher Education

AI applications in education have evolved significantly over the past decade, initially focusing on profiling, assessment systems, and intelligent tutoring applications (Zawacki-Richter et al., 2019). The public release of GenAI, particularly large language models (LLMs) such as ChatGPT, accelerated academic interest and institutional adoption across higher education (Ogunleye et al., 2024). These tools demonstrate advanced capabilities in generating text, summarizing materials, producing instructional content, and facilitating interactive learning (Baidoo-Anu & Owusu Ansah, 2023).

GenAI offers opportunities to create flexible and student-centered learning environments. However, its rapid integration has also raised concerns regarding academic integrity, misinformation, biased outputs and the need to redesign traditional assessment practices (Dwivedi et al., 2023; Kasneci et al., 2023; Cotton et al., 2024; Grassini, 2023). Although the

literature on AI in higher education is expanding rapidly, much of it remains perception-oriented and relies on quantitative survey methods. Many studies examine students' acceptance, attitudes, and perceived usefulness of AI tools. While such research provides valuable insights, it offers limited understanding of how AI tools are embedded within students' actual academic workflows during task execution.

2.2 AI in Computer Science and Programming Education

In computer science and IT education, GenAI tools such as ChatGPT, GitHub Copilot and Codex are influencing teaching and learning practices (Becker et al., 2023). LLMs demonstrate strong capabilities in generating syntactically correct code from natural language prompts and assisting with debugging processes (Prather et al., 2023; Chang et al., 2024).

Students frequently use AI tools to clarify programming concepts, generate sample code, and troubleshoot technical errors (Yilmaz & Karaoglan Yilmaz, 2023). Consequently, programming education is increasingly emphasizing higher-order skills such as code comprehension, evaluation, and critical analysis of AI-generated solutions rather than mere syntax memorization (Becker et al., 2023).

Despite these benefits, concerns have emerged regarding overreliance. Excessive dependence on AI-generated code may weaken independent problem-solving skills and negatively influence learning outcomes (Jošt et al., 2024). While existing research examines AI performance and learning outcomes, fewer studies explore how students integrate AI tools sequentially across different stages of academic tasks, including planning, debugging, revision, and refinement, particularly in competency-based educational contexts.

2.3 AI as Cognitive Scaffold and Self-Regulated Learning Support

Beyond technical assistance, GenAI is increasingly conceptualized as a cognitive scaffold that supports learners' metacognitive processes. AI chatbots provide accessible, low social-risk environments that encourage help-seeking without fear of embarrassment (Penney et al., 2025). Students often prefer AI systems that provide detailed explanations and step-by-step guidance rather than direct answers that bypass cognitive engagement (Kamberovic & Krivic, 2025).

This aligns with principles of self-regulated learning, which emphasize learners' ability to monitor and control their strategies (Zimmerman, 2002). However, a paradox exists: while AI usage may enhance academic confidence and efficiency, it may also increase technological dependence when students rely excessively on automated solutions (Zhang & Xu, 2025). Overdependence can potentially reduce independent problem-solving capacity, particularly in applied technical disciplines (Jošt et al., 2024).

Most studies examining these relationships employ quantitative designs that measure correlations between AI usage frequency and motivational constructs. Limited qualitative research investigates how students regulate AI use during real academic tasks, especially in environments that emphasize applied competence.

2.4 AI Integration in TVET and Polytechnic Contexts

Although AI's impact on higher education and STEM disciplines is well documented (Ilić et al., 2024), research focusing on TVET remains limited. TVET institutions prioritize hands-on learning, competency mastery and industry-relevant skill development. Students frequently engage in practical implementation, system development and iterative debugging.

Preliminary findings suggest that AI interventions may enhance vocational self-efficacy and streamline learning processes (Zawacki-Richter et al., 2019; Chang et al., 2024). In regional higher education contexts, including Malaysia, students' adoption of AI tools is influenced by perceived performance benefits and facilitating conditions (Dahri et al., 2024; Venkatesh et al., 2003). However, most research remains concentrated in traditional university environments and relies heavily on quantitative acceptance models. Few studies examine how AI tools are embedded within Malaysian polytechnic settings or explore workflow-level integration in competency-based coursework.

2.5 Research Gap and Positioning of the Present Study

The literature reveals three key gaps. First, a methodological gap persists, as most studies rely on quantitative survey designs and focus primarily on perceptions and acceptance rather than lived academic practices. Second, a practical gap exists in understanding how AI tools are integrated across multiple stages of academic task execution, including coding, debugging, report preparation, and project development. Third, a contextual gap remains in TVET and Malaysian polytechnic education, where applied learning environments may shape AI integration differently than in traditional university settings. Addressing these gaps, the present study adopts a qualitative case study approach to investigate how IT students at POLIMAS integrate GenAI tools into competency-based coursework. By focusing on workflow integration, task-specific support, and regulatory practices, this study provides context-specific insights into GenAI use in Malaysian polytechnic education.

3. METHODOLOGY

3.1 Research Design

This study employed a qualitative case study design to examine how TVET students integrate GenAI tools into their academic workflows. A case study approach was selected to enable an in-depth exploration of GenAI usage within a bounded institutional context, namely the IT diploma programme at POLIMAS. This design allowed the researcher to capture students' lived experiences and real academic practices in a competency-based learning environment.

3.2 Participants and Sampling

Participants were selected using purposive sampling. The study involved ten Semester 5 IT diploma students at POLIMAS, representing a bounded and relatively homogeneous cohort. Data saturation was achieved within this focused sample, consistent with qualitative research suggesting that thematic saturation may occur within 6–12 participants in homogeneous studies (Guest et al., 2006). Semester 5 students were specifically chosen because they were actively

engaged in Final Year Project (FYP) development and advanced technical coursework, contexts in which GenAI tool usage was frequently observed and embedded within applied learning tasks.

The inclusion criteria required participants to:

1. Be enrolled in the IT diploma programme.
2. Actively use GenAI tools (e.g., ChatGPT, Gemini, GitHub Copilot).
3. Engage in both technical-based and writing-based academic tasks involving GenAI support.

This sampling strategy ensured that participants possessed relevant and direct experience with AI-assisted learning practices.

3.3 Data Collection

To enhance data richness and credibility, three data collection methods were employed, namely semi-structured interviews, reflective journals, and document analysis. Individual semi-structured interviews were conducted via Google Meet. Each interview lasted approximately 45 minutes and was audio-recorded with participant consent. Interviews explored patterns of GenAI usage, types of tasks supported, and strategies used to manage AI engagement. The interviews were conducted in both Malay and English to ensure clarity and participant comfort. Audio recordings were transcribed verbatim using digital transcription tools and subsequently reviewed by the researcher to ensure accuracy. Selected excerpts were translated into English for reporting purposes.

Next, each participant submitted three reflective journal entries at the beginning, mid-semester, and end of the semester. The reflections were open-ended and encouraged students to describe their experiences using GenAI tools throughout different stages of their coursework. This approach enabled the researcher to capture developmental changes in GenAI usage over time.

Document analysis involved reviewing academic artefacts related to AI usage. These included GenAI prompt interactions (e.g., ChatGPT queries), coding scripts influenced by GenAI suggestions, and assignment drafts or project documents incorporating GenAI assistance. Participants submitted selected artefacts using a structured template provided by the researcher. The analysis focused on identifying evidence of GenAI integration in both technical-based and writing-based tasks.

4. ANALYSIS AND FINDINGS

Data were analysed using Braun and Clarke's (2006) thematic analysis framework. The analysis followed six phases: familiarisation, coding, theme development, review, definition, and reporting. Coding was conducted manually, and cross-case comparison was used to identify recurring patterns across participants. Themes were refined through triangulation of interviews, reflective journals, and document artefacts to strengthen interpretive depth.

To enhance trustworthiness, methodological triangulation and cross-case comparison were employed to support credibility. Dependability was ensured through systematic documentation of coding decisions, while confirmability was established by grounding interpretations in

participant quotations and documentary evidence. Informed consent was obtained from all participants, and confidentiality was maintained through the use of pseudonyms (P1–P10). All data were securely stored and used solely for research purposes.

This section presents findings from a qualitative case study of ten Semester 5 IT participants at POLIMAS. Situated within a Malaysian TVET polytechnic context, the study examines how GenAI tools are integrated into academic routines. Thematic analysis of the bounded case revealed three interrelated themes aligned with the research questions.

4.1 GenAI Integration within the POLIMAS TVET Context

Research Question 1: How do TVET students at POLIMAS integrate GenAI tools into their academic workflows?

Within this bounded TVET environment, GenAI integration emerged as embedded and iterative rather than occasional. Across all ten participants, GenAI functioned as a first-line cognitive resource during daily learning activities, particularly within applied and project-based coursework.

Students consistently described GenAI as part of their routine study process. For example, P3 reflected:

“I use AI almost every day: to understand difficult questions, get starter ideas, explain new topics in simple language, and check my coding or writing for mistakes and improvements” (Reflective Journal, P3).

Similarly, P2 noted:

“I use AI to understand difficult topics faster. If I don’t understand notes or questions, I ask AI to explain in a simpler way” (Reflective Journal, P2).

Interview data reinforce this pattern. One participant described GenAI as the “first reference” before consulting other materials (Interview, P6). This suggests that within this case, GenAI occupies an initial problem-solving position in students’ academic workflow.

Document analysis further illustrates this embedded integration. Artefacts show GenAI being used to refine FYP logbooks (Document Analysis, P1), structure system configuration proposals (Document Analysis, P2), troubleshoot Arduino compilation errors (Document Analysis, P6), and resolve Laravel database issues (Document Analysis, P7). These documents demonstrate GenAI use across multiple workflow stages namely understanding, implementation, debugging, and refinement.

Within this bounded TVET case, GenAI integration reflects the applied and project-based nature of polytechnic learning. Triangulated evidence indicates that GenAI is not used as an occasional supplementary tool but is systematically embedded within students’ academic workflows. Participants integrate GenAI across multiple stages of task execution from conceptual clarification to technical implementation and final refinement. This demonstrates its role as an

integrated learning companion rather than a peripheral aid.

4.2 Types of Academic Tasks Supported

Research Question 2: What types of academic tasks are supported by GenAI tools?

Analysis across the case reveals two dominant domains of GenAI supported tasks namely writing-based academic tasks and technical programming tasks. These domains are closely intertwined within the project-based TVET curriculum.

4.2.1 Writing-Based Tasks

Students frequently used GenAI to organise, structure, and refine academic writing. P4 explained:

“I use AI to summarise notes and structure assignment answers. It saves time and makes daily learning more efficient” (Reflective Journal, P4).

Similarly, P5 described using GenAI for *“report writing and system documentation”* (Reflective Journal, P5).

Document evidence confirms this pattern. Students used GenAI to transform proposal paragraphs into structured point form (Document Analysis, P9), summarise user testing feedback into formal reports (Document Analysis, P5), and improve project logbook entries (Document Analysis, P8). GenAI therefore functioned as an academic writing scaffold within this case.

4.2.2 Technical and Programming Tasks

GenAI support was equally visible in technical contexts. P6 reflected:

“AI gives guidance when I don’t understand, but I still have to read, think, and do the work myself” (Reflective Journal, P6).

Participants reported using GenAI for debugging code, explaining syntax, preparing for exams, and troubleshooting system errors (Interview, P9; Interview, P1).

Document artefacts provide concrete technical evidence. Students used GenAI to fix missing Arduino libraries (Document Analysis, P6), configure Raspberry Pi environments (Document Analysis, P1), develop servlet logic (Document Analysis, P9) and troubleshoot MySQL authentication errors in Laravel (Document Analysis, P7).

Within this case, GenAI supports both cognitive-heavy programming tasks and structured academic writing, reflecting the dual technical documentation demands characteristic of TVET education.

4.3 Regulation and Learner Agency in AI Use

Research Question 3: How do students regulate their use of GenAI tools within their learning processes?

A defining characteristic of this case is the presence of regulatory awareness across participants. Rather than portraying GenAI as a replacement for independent learning, students consistently framed it as a support mechanism.

For example, P2 stated:

“AI supports my learning, not replacing my effort” (Reflective Journal, P2).

P3 similarly noted:

“AI explains concepts I don’t understand, but I still need to read, think, and practice” (Reflective Journal, P3).

Interview responses echoed this sentiment. One participant remarked that copying answers directly would result in poor understanding (Interview, P7). Another described modifying AI-generated responses to align with assignment requirements (Interview, P5).

Document analysis provides behavioural confirmation of this regulatory stance. Although GenAI supplied troubleshooting steps for Arduino setup (Document Analysis, P6), students executed commands manually and verified compilation results independently. In servlet development tasks (Document Analysis, P9), AI-generated structures were adjusted to meet marking criteria. These sequences reflect a pattern of suggestion → execution → verification → modification.

Within this bounded TVET case, GenAI use appears regulated through active monitoring, adaptation, and manual testing. Students maintain responsibility for execution and comprehension, positioning GenAI as a cognitive scaffold rather than an autonomous solution provider.

4.4 Cross-Case Pattern within the POLIMAS Cohort

Across all ten participants, three consistent patterns define this bounded case. First, GenAI is embedded within iterative academic workflows rather than used occasionally or superficially. Second, GenAI supports both technical implementation and academic writing tasks within the applied, project-based curriculum. Third, students demonstrate regulatory awareness and learner agency when engaging with AI-generated outputs, indicating active monitoring and adaptation rather than passive acceptance.

Taken together, these findings suggest that within this TVET polytechnic context, GenAI integration is structured, task-oriented, and accompanied by metacognitive engagement. Rather than reflecting technological dependence, the case reveals a negotiated form of use where GenAI enhances efficiency and problem-solving while students retain ownership of their learning processes and applied competencies.

5. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This qualitative case study examined how ten Semester 5 IT students at POLIMAS integrate GenAI tools into their academic routines within a Malaysian TVET context. Drawing on triangulated evidence from interviews, reflective journals, and document analysis, the findings extend existing research on AI in higher education by providing workflow-level insight rather than perception-based data.

Consistent with broader research highlighting the rapid transformation of higher education through GenAI (Ogunleye et al., 2024; Zawacki-Richter et al., 2019), this case demonstrates that GenAI tools are embedded within iterative academic workflows in a competency-based environment. Students integrated GenAI across multiple stages of task execution, including conceptual clarification, coding implementation, debugging, and documentation. This reflects patterns observed in computer science education, where AI increasingly functions as a coding assistant and problem-solving aid (Becker et al., 2023; Chang et al., 2024).

Importantly, the findings reveal regulatory awareness among participants. Students framed GenAI as a support mechanism rather than a substitute for independent effort. This aligns with research suggesting that while AI can enhance efficiency and self-efficacy, excessive reliance may weaken independent skill development (Jošt et al., 2024; Zhang & Xu, 2025). Within this case, students demonstrated verification behaviour, manual testing, and adaptation of AI-generated outputs, suggesting metacognitive engagement rather than passive dependence.

Moreover, the integration of GenAI in writing tasks and technical implementation reflects the dual demands of TVET education, where applied competence and structured documentation coexist. While much existing research focuses on acceptance models and perception studies (Dahri et al., 2024; Venkatesh et al., 2003), this study contributes by illuminating how GenAI tools are operationalised within real academic workflows in a polytechnic setting.

As a bounded case study, the findings are context-specific and do not claim statistical generalisation. However, they provide in-depth insight into how GenAI tools move “from prompt to practice” within applied technical education. Rather than reinforcing narratives of either technological threat or unquestioned benefit, this case highlights a negotiated balance between efficiency and learner agency.

5.2 Recommendations

Based on the findings of this case and existing scholarship, several recommendations are proposed for TVET institutions. As artificial intelligence becomes increasingly embedded in academic environments (Kasneji et al., 2023; Dwivedi et al., 2023), institutions should move beyond reactive restrictions and develop structured AI literacy within the curriculum. Although participants demonstrated strategic use of GenAI tools, formal guidance on prompt design, verification strategies, ethical use, and critical evaluation would strengthen responsible integration.

Assessment practices should also prioritise process transparency rather than focusing solely on final outputs. Given ongoing concerns regarding academic integrity and AI-generated content

(Cotton et al., 2024; Grassini, 2023), TVET assessments should incorporate process documentation, explanation of logic, iterative refinement, and reflective justification. Such approaches acknowledge AI's presence while reinforcing conceptual understanding.

GenAI should be framed as a cognitive scaffold within competency-based learning. When positioned as a support tool for reasoning, debugging, and exploration, AI can enhance learning without replacing critical thinking (Kamberovic & Krivic, 2025; Penney et al., 2025; Jošt et al., 2024). Encouraging structured reflection can further strengthen students' metacognitive awareness and self-regulated learning in AI-augmented environments (Zhang & Xu, 2025). Finally, further research across diverse TVET institutions and disciplines is needed, as much of the current literature remains concentrated in traditional university contexts (Ilić et al., 2024).

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