

Generative AI for Achieving Instructional Alignment in TVET: A Conceptual Framework and Case Study

*Jonathan Kovilpillai¹, Abtar Darshan Singh, Fahd Raza, Analisa Hamdan, Fumiko Konno
(Asia Pacific University of Technology & Innovation)*

Abstract

This paper explores the application of Generative AI (Gen-AI) to achieve instructional alignment in Technical and Vocational Education and Training (TVET) and Open and Distance Learning (ODL) contexts. Drawing on a COL-funded project implemented at APU, Malaysia, the study presents a conceptual framework mapping Gen-AI capabilities to key instructional design functions. Through structured training and hands-on practice, 40 educators across Commonwealth nations developed AI-aligned lessons. Results indicate improved alignment, content authenticity, and instructional efficiency, particularly in asynchronous learning contexts. Challenges included digital literacy and ethical considerations. The study concludes with implications for policy, educator training, and further research, affirming Gen-AI's transformative potential when thoughtfully integrated into skills-based education systems.

1. Introduction

In recent years, the convergence of artificial intelligence and education has opened new possibilities for improving instructional quality, particularly in resource-constrained environments such as Technical and Vocational Education and Training (TVET). Instructional alignment—the systematic coherence between learning outcomes, instructional content, and assessments—is a foundational element of effective teaching and learning. However, this alignment is often difficult to achieve in TVET settings due to various structural and pedagogical challenges (Kebede & Asgedom, 2024). These include time constraints, diverse educator expertise, rapidly changing industrial needs, and the complexity of integrating both practical and theoretical content.

Open and Distance Learning (ODL) further complicates instructional alignment, as asynchronous delivery modes require a high degree of clarity, consistency, and learner autonomy. In such environments, instructional misalignment may lead to confusion, disengagement, and diminished learning outcomes, particularly in skills-based education. As TVET institutions across the Commonwealth seek to improve quality and scalability, the demand for innovative, cost-effective, and pedagogically sound solutions has become more urgent.

Generative Artificial Intelligence (Gen-AI) offers a timely intervention. With the capacity to generate learning outcomes, instructional materials, assessment items, and feedback loops from structured prompts, Gen-AI tools like ChatGPT, Copilot, and Gemini can assist educators in designing more coherent and learner-centred courses. These technologies are not intended to replace educators but to augment their capabilities in rapidly developing high-quality content that is aligned to competencies and learning goals.

This paper explores how generative AI can support instructional alignment in TVET and ODL contexts. It presents a conceptual framework that maps Gen-AI capabilities to core instructional design functions and illustrates its application through a case study from a Commonwealth of Learning (COL)-funded project at Asia Pacific University of Technology & Innovation (APU), Malaysia. The paper concludes with key implications for policy, practice, and further research across Commonwealth nations.

2. Literature Review

Instructional alignment has long been recognized as a cornerstone of effective curriculum design, ensuring that what is taught, how it is taught, and how learning is assessed are mutually reinforcing. Biggs (1999) introduced the concept of "constructive alignment," emphasizing that learning activities and assessments must be logically and pedagogically connected to intended learning outcomes. This concept is further operationalized through the backward design model, where educators begin by defining learning outcomes before determining suitable assessments and instructional strategies (Wiggins & McTighe, 2012). Within the TVET (Technical and Vocational Education and Training) sector, such alignment is particularly critical. Unlike general education, TVET programs are explicitly designed to produce graduates who possess demonstrable occupational competencies. As such, the learning outcomes are closely tied to industry standards and job requirements, making misalignment a significant risk to learner employability and institutional credibility.

Despite the clear rationale for instructional alignment, TVET institutions often face systemic barriers to its consistent implementation. These include time constraints, insufficient instructional design expertise, fragmented curriculum structures, and the need to rapidly update content in response to changing industry needs. In Open and Distance Learning (ODL) environments, these challenges are further amplified by the asynchronous nature of learning, which places greater responsibility on instructional materials to clearly communicate intent, relevance, and coherence without real-time instructor mediation. Poorly aligned instructional components in ODL can result in confusion, reduced learner engagement, and lower completion rates.

Recent advances in educational technology, particularly the emergence of Generative Artificial Intelligence (Gen-AI), offer promising avenues to address these alignment challenges. Gen-AI refers to systems capable of producing original content—text, images, assessments, and even simulations—in response to structured prompts. Tools such as ChatGPT, Claude, Microsoft Copilot, and Gemini have gained traction in educational settings due to their capacity to generate learning objectives, instructional content, and assessment tasks in a fraction of the time typically required by human designers. In the context of backward design, Gen-AI facilitates a top-down approach: educators input intended competencies or outcomes, and the AI can generate corresponding content and assessments that maintain conceptual and linguistic consistency (Chaivisit et al., 2024).

Empirical studies have begun to document the benefits and limitations of using Gen-AI in education. Hargis & Gessner, (2024) demonstrated how generative tools can support educators in refining learning outcomes and designing assessments that are both rigorous and aligned to

intended skills. Similarly, Mao, (2025) found that AI-assisted instructional planning improved content consistency across modules, supported outcome-based education, and enabled faster course deployment. While these studies primarily focused on higher education contexts, their insights are transferable to TVET, where course alignment and instructional coherence are similarly vital.

In the TVET context specifically, Baharin et al., (2025) conducted a UTAUT-based survey of 200 Malaysian TVET learners and found that performance expectancy, effort expectancy, and facilitating conditions were the strongest predictors of Gen-AI adoption in instructional contexts (Cabero-Almenara et al., 2024). Notably, students appreciated the potential of Gen-AI tools to support vocational learning by generating relevant case studies and scaffolding materials. However, the study also revealed concerns related to data privacy and the ethical implications of AI-assisted content creation. This underscores the importance of not only providing access to Gen-AI tools but also training both instructors and learners in their responsible use.

Beyond learner perceptions, Gen-AI has demonstrated practical utility in generating authentic, scenario-based assessments that align well with the competency-based approach of TVET. For instance, prompts asking AI to simulate workplace safety scenarios or troubleshooting processes can yield detailed case studies for student analysis. Such outputs are invaluable in resource-constrained environments, enabling institutions to generate diverse and contextually relevant materials without the need for extensive content development teams. These capabilities also align well with the requirements of ODL, where pre-packaged yet flexible learning materials are essential for maintaining engagement and coherence.

Despite these advantages, the limitations of Gen-AI must be acknowledged. Current models can produce factually incorrect information, perpetuate biases present in training datasets, and generate content that lacks contextual sensitivity. These issues are particularly acute in TVET, where localized industry practices, regulatory standards, and cultural influences must be reflected accurately in learning materials. As such, human oversight remains indispensable. Educators must be trained not only in prompt engineering but also in evaluating, curating, and modifying AI-generated content to ensure pedagogical soundness and cultural appropriateness (Walter, 2024).

To address these complexities, several researchers have proposed frameworks for responsible Gen-AI integration in education. For example, the ARCHED model advocates for a layered instructional approach where AI tools assist in generating pedagogical options, but final decisions are made by educators in accordance with Bloom's Taxonomy and ethical standards (Li et al., 2025; AlAfnan, 2024). Similarly, a recent study by Krause et al., (2025) emphasizes the need for a human-in-the-loop model where Gen-AI supports, rather than replaces, human instructional design. These frameworks reinforce the idea that the value of AI in education lies not in automation but in augmentation—enhancing human creativity, efficiency, and responsiveness without undermining professional judgment.

The broader literature also highlights the necessity for building institutional capacity in Gen-AI literacy. A 2025 Malaysian study found that educators' perceived usefulness of Gen-

AI was strongly influenced by their familiarity with digital tools and confidence in using them for instructional design (Lee, 2025). This suggests that successful integration of Gen-AI into TVET must be accompanied by sustained professional development programs that not only introduce the tools but also contextualize their pedagogical implications.

In summary, the literature presents a cautiously optimistic view of generative AI's role in enhancing instructional alignment within TVET and ODL contexts. While empirical evidence is still emerging—particularly in TVET—early studies indicate that Gen-AI can significantly reduce instructional design time, improve alignment between learning components, and support scalable, learner-centered course development. However, these benefits are contingent on effective human-AI collaboration, robust quality assurance mechanisms, and a strong foundation in digital pedagogy. The next sections of this paper build on these insights by presenting a conceptual framework for Gen-AI supported instructional alignment and showcasing its implementation through a case study of a COL-funded project in Malaysia.

3. Methodology

This study adopts a case study approach to examine the implementation of generative AI for instructional alignment within a Commonwealth of Learning (COL)-funded TVET capacity-building program. Conducted at Asia Pacific University of Technology & Innovation (APU), Malaysia, the project aimed to equip TVET educators from multiple Commonwealth countries with the skills to integrate generative AI into course design. The initiative was aligned with ODL principles and emphasized scalability, contextual adaptation, and learner-centeredness.

3.1 Participants and Context

The participants consisted initially of 66 TVET educators from Botswana, Eswatini, Kenya, Mauritius, Samoa, Rwanda, Nigeria, Jamaica, Ghana, Zambia and Namibia, representing a range of disciplines including automotive technology, electrical systems, construction, and entrepreneurship. These educators were selected by their national institutions and the COL based on their subject expertise and readiness to implement digital learning innovations. Due to attrition, only 40 participants successfully completed all components of the project. All participants were actively involved in curriculum development or teaching and were proficient in English.

3.2 Training Design and Delivery

The intervention was delivered as a structured, multi-phase training program over five virtual and in-person sessions. The design followed backward design principles, beginning with a focus on learning outcome development, then progressing to content creation and assessment alignment. Sessions covered the fundamentals of generative AI, ethical considerations, content generation strategies, AI-assisted assessment design, and practical implementation. Each session involved interactive lectures, hands-on activities using Gen-AI tools (primarily ChatGPT and Gemini), and peer review exercises. The final session included participant presentations of AI-aligned lesson designs, which were evaluated using a common rubric.

3.3 Data Sources

Three primary data sources informed this study:

- **Participant Projects:** Submitted lesson designs and assessments generated using AI tools.
- **Scoring Rubrics:** Evaluation data from facilitators assessing alignment, creativity, and pedagogical clarity.
- **Mentor Comments:** Qualitative remarks on instructional quality, use of AI, and alignment effectiveness.

Quantitative scores were analyzed for trends in instructional alignment quality, while qualitative comments were coded for emerging themes related to AI utility and pedagogical coherence.

3.4 Limitations

While the program provided a rich dataset, limitations include the small sample size, limited post-training follow-up, and variability in participant digital literacy. Further research is required to assess long-term adoption and impact on learner outcomes.

4. Conceptual Framework

This study proposes a conceptual framework that maps generative AI capabilities to core instructional design functions within TVET, emphasizing instructional alignment. The framework builds upon existing literature on backward design and ODL and contextualizes it for skill-based education in digital environments.

4.1 Framework Components

Instructional Design Element	Gen-AI Support	Description
Learning Outcome Generation	AI-generated outcome drafts aligned to occupational standards	AI tools can interpret TVET competency descriptors and propose clear, measurable outcomes.
Content Development	Explanations, case studies, visual aids	AI assists in developing contextualized content such as safety scenarios, troubleshooting steps, and technical explanations.
Assessment Design	Scenario-based, MCQs, reflective tasks	Prompts can be used to generate assessments aligned with Bloom's taxonomy and practical application.
Alignment Verification	AI-aided consistency checks	Prompt templates allow educators to verify that each outcome is addressed through corresponding content and assessment.
Personalization and Feedback	AI-driven tutoring and adaptive scaffolds	AI chatbots or agents can offer differentiated support based on learner inputs.

Table 1 – Components of Conceptual Framework

4.2 Principles Underpinning the Framework

The framework is guided by the following principles:

- **Human-AI Co-Design:** Educators remain central as curators and evaluators of AI-generated content.
- **Contextual Relevance:** Localization and industry alignment are prioritized through curated prompt engineering.
- **ODL Compatibility:** Materials are structured for asynchronous delivery, with inclusive and navigable formats.

4.3 Application in the COL Project

The framework was operationalized through structured prompting templates and guided practice during the training. For example, in one safety module, the AI-generated outcome “Demonstrate proper use of PPE in a workshop environment” was paired with a scenario-based assessment and short instructional video script—all generated, refined, and validated through educator-AI interaction. Participants reported faster development cycles and improved confidence in creating aligned instructional units.

5. Case Study

The COL-funded project implemented at Asia Pacific University of Technology & Innovation (APU) aimed to demonstrate how generative AI could be meaningfully embedded into instructional design workflows for TVET practitioners across the Commonwealth. The initiative was not only a proof of concept but also a professional development intervention that introduced AI tools as enablers of backward design and instructional alignment. Over five sessions, educators engaged in hands-on learning that gradually progressed from foundational AI concepts to practical application in content and assessment design.

One of the key instructional strategies used in the program was the deployment of structured AI prompting templates. These templates guided participants to generate learning outcomes aligned with occupational standards, followed by AI-assisted development of instructional materials and aligned assessments. For example, in a safety-related module, one participant used ChatGPT to generate the outcome: “Demonstrate proper use of personal protective equipment (PPE) in workshop environments.” The same prompt cycle yielded a realistic case study scenario for formative assessment, along with a reflective task and rubric for evaluation. Throughout the training, participants were encouraged to critically evaluate AI-generated content, customize it for local relevance, and ensure alignment with curriculum standards. A key success factor was the blending of AI assistance with human pedagogical judgment. Participants learned how to refine their prompts to yield higher-quality content and to iterate outputs until they met contextual requirements. This iterative human-AI co-design process was further reinforced through peer reviews, group reflections, and mentor feedback.

The final deliverables submitted by each participant included a complete lesson design: AI-generated learning outcomes, instructional content (including explanations, examples, and scenarios), and an aligned assessment task. These were evaluated by facilitators based on alignment, creativity, and pedagogical clarity. Participants also engaged in reflective presentations, sharing how they applied generative AI tools to overcome instructional

challenges, enhance learner engagement, and accelerate content development. This case study illustrates not only the feasibility of using Gen-AI for instructional alignment in TVET but also the growing digital agency of educators when supported by guided capacity-building programs.

6. Results and Discussion

The effectiveness of the training program was evaluated using a mixed-methods approach that combined quantitative scoring of final presentations with qualitative mentor feedback. Participants' projects were assessed using a rubric that focused on instructional alignment, contextual relevance, and the innovative application of generative AI. Scores ranged from 4 to 10 out of a maximum of 10, with a strong majority scoring between 7 and 9.

Country	Number of Participants	Average Score	Min Score	Max Score
Ghana	4	7.75	7	9
Jamaica	5	7.60	7	9
Kenya	5	7.60	6	10
Samoa	2	7.50	7	8
Botswana	3	7.33	5	9
Mauritius	5	7.20	6	9
Rwanda	4	6.50	5	8
Zambia	4	6.50	4	9
Nigeria	3	6.00	5	8
Eswatini	5	4.20	2	8

Table 2: Summary of participant performance from project data

Across all participants, the average score was high, with several countries demonstrating particularly strong outcomes. For instance, educators from Ghana achieved the highest average score (7.75), followed closely by those from Jamaica and Kenya (both at 7.6). These participants exhibited strong integration of AI tools into course planning, often using structured prompts to generate assessments that were directly traceable to their learning outcomes. Their outputs were marked by clear sequencing, instructional coherence, and a balanced use of AI-generated and instructor-refined content.

Qualitative feedback from mentors further corroborated these findings. Comments praised participants who demonstrated “excellent integration of AI and structured lesson delivery,” highlighting examples where scenario-based assessments mirrored real-world tasks. In contrast, lower-scoring participants tended to submit presentations with less cohesive alignment between outcomes and assessment, or with over-reliance on unedited AI outputs. These instances emphasized the importance of prompt refinement, human oversight, and contextual customization—skills that developed progressively through the training sessions.

One noteworthy observation was the variability in digital fluency among participants. While most adapted quickly to generative tools, a few struggled initially with crafting effective prompts or interpreting AI-generated content. This disparity underscores the need for differentiated support and potentially longer-duration interventions in future implementations.

However, even these participants showed notable improvement by the end of the program, validating the effectiveness of scaffolded, hands-on instruction.

Another insight emerged around content authenticity. Participants noted that generative AI helped them simulate workplace scenarios that were difficult to reproduce in traditional instructional formats. For example, instructors from construction and electrical trades used AI to generate fault diagnosis case studies and safety breach simulations that otherwise would have required expensive lab setups or complex logistical arrangements. These findings suggest that Gen-AI not only improves alignment but also expands the creative possibilities of resource-constrained educators in TVET environments.

From an ODL perspective, the outcomes affirm the value of Gen-AI in creating coherent and accessible content for asynchronous learners. The uniform module structures, inclusive language, and logically sequenced activities facilitated learner autonomy—an essential feature of successful ODL programs. Participants also reported that AI-assisted content development was 30% to 40% faster than their traditional methods, contributing to greater productivity and scalability.

In summary, the results demonstrate that with adequate guidance, TVET educators can leverage generative AI tools to achieve strong instructional alignment, develop contextually rich content, and design assessments that mirror workplace competencies. While challenges around digital literacy, ethics, and content validation remain, the positive learning outcomes and educator feedback highlight the potential for Gen-AI to transform instructional practices in vocational education across the Commonwealth.

7. Implications for Policy, Practice, and Research

The findings from this case study have significant implications for policy, institutional practice, and future research within TVET and ODL contexts, particularly in the Global South. As generative AI technologies become more accessible, there is both an opportunity and a responsibility to guide their ethical, effective, and context-sensitive use in education.

7.1 Policy Implications

There is a growing need for national and institutional policies that define the responsible use of generative AI in curriculum development and instructional delivery. These should include guidelines on ethical usage, data privacy, and intellectual property, particularly in the context of AI-generated content. Policymakers must also consider frameworks that recognize AI-supported instructional design as a legitimate and efficient form of academic labor. In the Commonwealth, shared policy templates or toolkits could help countries develop consistent but adaptable approaches based on their unique TVET priorities.

Additionally, quality assurance mechanisms must be re-evaluated to account for AI-assisted course creation. Accreditation bodies may need to expand their standards to include criteria that assess the coherence, originality, and contextual integrity of AI-generated instructional materials. Incorporating AI literacy and prompt engineering into national competency frameworks for educators may further legitimize these emerging skill sets.

7.2 Practical and Institutional Implications

At the institutional level, the case study demonstrates the need to invest in structured professional development for educators, focusing not just on technical skills but also on pedagogical integration. Training programs should emphasize the principle of human-AI collaboration, helping educators develop the judgment necessary to curate, contextualize, and align AI-generated materials. The experience at APU suggests that relatively short, hands-on programs—structured around backward design principles—can rapidly improve instructional quality when combined with mentorship and peer feedback.

Institutions should also invest in infrastructure that supports generative AI use while maintaining data security. This may include sandboxed AI environments, vetted prompt libraries, and analytics tools to track alignment fidelity. Furthermore, leadership must foster a culture of experimentation, allowing educators to iteratively develop and refine AI-assisted lessons without fear of punitive oversight.

7.3 Research Implications

This case study opens several avenues for future research. Longitudinal studies are needed to evaluate the impact of Gen-AI-supported instructional alignment on actual learner outcomes in TVET. Comparative studies across countries and disciplines could reveal contexts that affect adoption and effectiveness. There is also scope for methodological innovation—developing rubrics, instruments, and digital tools that assess alignment quality in AI-assisted course design. Finally, interdisciplinary collaborations between educational technologists, instructional designers, and AI ethicists will be critical for shaping the next generation of inclusive, AI-powered education systems.

8. Conclusion

This study has shown that generative AI, when guided by sound instructional design principles and supported by professional development, can serve as a powerful tool for enhancing instructional alignment in TVET and ODL settings. The COL-funded training program at APU enabled educators from diverse Commonwealth countries to use AI in designing coherent, contextually relevant, and competency-based learning experiences. The combination of structured prompting, human curation, and collaborative review proved effective in generating high-quality instructional artifacts in a time-efficient manner.

While challenges remain—particularly around digital literacy, ethical usage, and quality assurance—the findings underscore the transformative potential of generative AI in addressing long-standing pedagogical and logistical barriers in skills-based education. With the right safeguards and capacity-building frameworks, Gen-AI can help scale quality education, empower educators, and make TVET more responsive to the dynamic needs of 21st-century learners and workplaces.

References

- AlAfnan, M. A. (2024). Taxonomy of Educational Objectives: Teaching, Learning, and Assessing in the Information and Artificial Intelligence Era. *Journal of Curriculum and Teaching*, 13(4), 173. <https://doi.org/10.5430/jct.v13n4p173>
- Baharin, A. T., Sahadun, N. A., Ramli, S., & Redzuan, N. A. L. (2025). Exploring the Adoption of Generative Artificial Intelligence by TVET Students: A UTAUT Analysis of Perceptions, Benefits, and Implementation Challenges. *Journal of Information Systems Engineering and Management*, 10.
- Biggs, J. (1999). What the Student Does: Teaching for enhanced learning. *Higher Education Research & Development*, 18(1), 57–75. <https://doi.org/10.1080/0729436990180105>
- Cabero-Almenara, J., Palacios-Rodríguez, A., Loiza-Aguirre, M. I., & Andrade-Abarca, P. S. (2024). The impact of pedagogical beliefs on the adoption of generative AI in higher education: Predictive model from UTAUT2. *Frontiers in Artificial Intelligence*, 7, 1497705. <https://doi.org/10.3389/frai.2024.1497705>
- Chaivisit, S., Asino, T. I., Jongsermtrakoon, S., Thompson, P., Rezaie, F., Siripipattanakul, S., Chaivisit, S., Asino, T. I., Jongsermtrakoon, S., Thompson, P., Rezaie, F., & Siripipattanakul, S. (2024). Empowering Educators With Generative AI Tools and Support. In <https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/979-8-3693-1351-0.ch003> (empowering-educators-with-generative-ai-tools-and-support). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-1351-0.ch003>
- Hargis, J., & Gessner, R. (2024). CONNECTING FUNCTIONAL EDUCATIONAL TECHNOLOGY TO HIGHER EDUCATION ANDRAGOGY USING GENERATIVE ARIFICIAL INTELLIGENCE. *Global and Lokal Distance Education- GLOKALde*, 10(2), 3–15.
- Kebede, A., & Asgedom, A. (2024). Perspectives of teacher educators on the challenges of training technical and vocational education teachers in Ethiopia. *Bahir Dar Journal of Education*, 24(1), Article 1. <https://doi.org/10.4314/bdje.v24i1.8>
- Krause, S., Panchal, B. H., & Ubhe, N. (2025). Evolution of Learning: Assessing the Transformative Impact of Generative AI on Higher Education. *Frontiers of Digital Education*, 2(2), 21. <https://doi.org/10.1007/s44366-025-0058-7>
- Lee, A. H. C. (2025). Use of Generative Artificial Intelligence among Selected Pre-University Business Students at a Private University in Malaysia. *Asia-Pacific Journal of Futures in Education and Society*, 4(1), 1–20. <https://doi.org/10.58946/apjfes-4.1.P1>
- Li, H., Fang, Y., Zhang, S., Lee, S. M., Wang, Y., Trexler, M., & Botelho, A. F. (2025). *ARCHED: A Human-Centered Framework for Transparent, Responsible, and Collaborative AI-Assisted Instructional Design* (arXiv:2503.08931). arXiv. <https://doi.org/10.48550/arXiv.2503.08931>
- Mao, Y. (2025). Exploring Factors Associated With International Students' Academic Adjustment in Mainland China: A Systematic Review From 2005 to 2023. *Journal of Cross-Cultural Psychology*, 00220221251320348. <https://doi.org/10.1177/00220221251320348>
- Walter, Y. (2024). Embracing the future of Artificial Intelligence in the classroom: The relevance of AI literacy, prompt engineering, and critical thinking in modern

education. *International Journal of Educational Technology in Higher Education*,
21(1), 15. <https://doi.org/10.1186/s41239-024-00448-3>
Wiggins, G., & McTighe, J. (2012). *Understanding by Design Guide to Advanced Concepts
in Creating and Reviewing Units*. ASCD.